Windham School District

K-12 Science Curriculum

Approved by the Windham School Board on 6/18/19

Philosophy of Science Education

"Science is built up of facts as a house is of stones, but a collection of facts is no more a science than a pile of stones is a house."

Henri Poincare, La Science et l'Hypothese (1908)

Science is both a body of knowledge that represents current understanding of natural systems and the process whereby that body of knowledge has been established and is being continually extended, refined, and revised. Both elements are essential: one cannot make progress in science without an understanding of both. Likewise, in learning science one must come to understand both the body of knowledge and the process by which this knowledge is established, extended, refined, and revised.

Page 27

"2 Goals for Science Education." National Research Council. 2007. Taking Science to School: Learning and Teaching Science in Grades K-8. Washington, DC: The National Academies Press. doi: 10.17226/11625.

The science curriculum for Windham Schools teaches the facts of science, but also the process of science in grades K-12. Following the guidelines of the Next Generation Science Standards, students in K-12 gain knowledge of scientific facts by doing science in the classroom, learning and practicing engineering skills and, connecting science skills to what they are learning in ELA and Math.

K-5 Science

Children are naturally curious. They explore, observe, question and investigate their world from their very beginning. This natural curiosity is the basis for science instruction and an introduction to the formal skills of science. When a child attends Windham Schools, a carefully designed curriculum in K-5 provides opportunities for students to ask questions and develop their science process skills. Children will learn by doing science, posing questions, making predictions, experimenting, observing and collecting information and finally analyzing their data. This process will build both their skills, scientific knowledge and capacity to learn over time.

The K-5 units of study focus on core concepts in all disciplines: Earth/Space, Life, Physical Science, and Technology/Engineering. Children are at first guided closely by their teacher and over time, more responsibility is given over to the student to guide their learning until they are able to perform the inquiry process by themselves (form the questions, collect data and analyze it by themselves for a given phenomena). The science skills being learned integrate with the literacy and numeracy skills students are also learning. As students practice science, they will also practice writing/communicating scientifically and using measurements to describe nature. Informational texts are provided to support each unit as students explore the different discipline areas. The Windham Schools curriculum provide rich, interactive experiences that will develop problem-solving skills students need in our increasingly technological world.

6-12 Science

The Windham 6-12 Science faculty is committed to developing curious graduates willing to take on the challenge of solving problems. Each course is in alignment with the expectations of the Next Generation Science Standards (NGSS) and is designed to offer students a hands-on experience of content-rich investigations that will ensure students are able to grow in their ability to think creatively, ponder problems, and propose solutions based on evidence and reason. Science investigations allow students to develop their inquiry skills so that they may learn to confidently initiate and investigate their own questions. We are committed to helping students grow their scientific perspective so they will thrive in their future academic studies and careers, have the ability to solve the problems they encounter and a greater appreciation of the physical universe throughout their lives.

Courses in grades 6-8 cover a different discipline area each year beginning with Earth Science in grade 6, Life Science, grade 7 and finally, Physical Science in grade 8. Once students move on to Windham High School, courses are separated by topic. Students need to take three years of science to meet Windham High School graduation requirements and all students take Integrated Science in grade 9 and Biology in grade 10 to meet the State of New Hampshire graduation requirements. Most students choose a year of Chemistry and a year of Physics following Biology. However, Engineering, Computer Science, Environmental Science and many other options, including AP and early college credit courses, are available to students in grades 11 and 12. Whether required or elective, all of these courses embed the skills necessary to become a lifelong learner.

We strongly encourage all students to supplement the traditional science course offerings with Engineering and Computer Science courses to better prepare them for a technologically rich future. Whether choosing a career or academic path after high school, Windham High School students have gained both content knowledge, but also have the skills needed to gain knowledge in the future as needed.

<u>Title of Curriculum</u>: Kindergarten: Forces and Interactions

Unit Name	What (Standards)	How (SEP)	Why (Cross Cutting)
Title: • **Pushes and Pulls**	• Compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. • Design a solution to change the speed or direction of an object with a push or pull.	• Plan and conduct an investigation • Analyze data	• Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Windham School District Curriculum

Kindergarten - Forces and Interactions/Pushes and Pulls

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

● In the kindergarten performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
● Analyze data to determine if a design solution works as intended to change the speed or direction of an object.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Simple tests can be designed to gather evidence to support or refute student ideas about causes.</td><td>ESSENTIAL QUESTIONS
● What are the effects of different strengths of forces on the motion of an object?
● How does this knowledge impact engineering and designs of tomorrow?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
</table>

Content Standards: K-PS2-1 K-PS2-2	*Students will know…* ● Pushes and pulls can have different strengths and directions. ● Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. ● When objects touch or collide, they push on one another and can change motion. ● A bigger push or pull makes things speed up or slow down more quickly. ● A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.	*Students will be skilled at…* ● With guidance, plan and conduct an investigation in collaboration with peers ● Analyze data from tests of an object or tool to determine if it works as intended

Used in Content Area Standards		***21st Century Skills***
not applicable		*Scientists use different ways to study the world.* ● Critical Thinkers ● Communication ● Information Literacy ● Technology Literacy

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Students will: ● plan and carry out investigations to answer questions or test solutions ● use science journals ● analyze data
	OTHER EVIDENCE: Teacher observation of student participation. Use kindergarten science rubric.

<u>Title of Curriculum</u>: Kindergarten: Interdependent Relationships in Ecosystems

Unit Name	What (Standards)	How (SEP)	Why (Cross Cutting)
Title: • **Animals, Plants, and Their Environment**	• Describe patterns of what plants and animals (including humans)need to survive.	• Use observation	• Patterns in the natural and human designed world can be observed and used as evidence. • Events have causes that generate observable patterns. • Systems in the natural and designed world have parts that work together.

Windham School District

Interdependent Relationships in Ecosystems/Animals, Plants, and Their Environment - Kindergarten

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards?):
In the kindergarten performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Use observations to describe patterns of what plants and animals (including humans) need to survive.
Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs
Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…
Patterns in the natural and human designed world can</td><td>ESSENTIAL QUESTIONS
How do plants and animals (including humans) depend upon each other?</td></tr>
</table>

Content Standards: - K-LS1-1 - K-ESS2-2 - K-ESS3-1 - K-ESS3-3	be observed and used as evidence. - Events have causes that generate observable patterns. - Systems in the natural and designed world have parts that work together.	- What is the relationship between the needs of living things and where they live? - How do the choices of humans impact our Earth?
	Acquisition	

• K-2ETS1-1 • K-2ETS1-2 • K-2ETS1-3	*Students will know…* ● All animals need food to live and grow. ● Animals obtain their food from plants or from other animals. ● All plants need water and light to live and grow. ● Plants and animals can change their environment. ● Living things need water, air, resources from the land, and they live in places that have the things they need. ● Humans use natural resources. ● Humans can make choices that reduce their impact on land, water, air, and other living things. ● Sketches, drawings, or physical models can communicate ideas for problem solving.	Students will be skilled at… ● developing models (diagrams, drawings, dioramas , or storyboards) that represent concrete events or design solutions. ● Students will use observation to describe patterns found in the natural world in order to answer scientific questions. ● Students will construct an argument with evidence to support a claim. ● Students will communicate solutions with others in oral or written forms using models and or drawings that provide details about scientific ideas.
Used in Content Area Standards		***21st Century Skills***

not applicable	Our Earth and life is dependent upon solutions to reduce negative impacts on our environment and natural resources. Critical Thinking ● Collaboration ● Communication ● Information Literacy ● Initiative ● Social Skills

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Students will: ● make observations ● design and build models ● use and share observations ● ask questions ● make models

	OTHER EVIDENCE: Teacher observation of student participation. Use kindergarten science rubric.

<u>Title of Curriculum</u>: Kindergarten: Weather and Climate

Unit Name	What (Standards)	How (SEP)	Why (Cross Cutting)
Title: • **Weather and Climate**	• Determine the effect of sunlight on Earth's surface. • Design and build a structure that will reduce the warming effect of sunlight on an area. • Describe patterns of local weather conditions over time. • Obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.	• Make observations • Use tools and materials • Use and share observations • Ask questions	• Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. • Events have causes that generate observable patterns. • People encounter questions about the natural world every day. • People depend on various technologies in their lives; human life would be very different without technology.

Windham School District

Weather and Climate - Kindergarten

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards?):

● In the kindergarten performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

● Make observations to determine the effect of sunlight on Earth’s surface.
● Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.
● Use and share observations of local weather conditions to describe patterns over time.
● Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…

● Patterns in the natural world can be observed, used to describe</td><td>ESSENTIAL QUESTIONS

● How would the absence of the sun affect life on earth?</td></tr>
</table>

<table>
<tr>
<td rowspan="3">Content Standards:
K-PS3-1
K-PS3-2
K-ESS2-1
K-ESS3-2</td>
<td>phenomena, and used as evidence.
Cause and Effect; events have causes that generate observable patterns.
People encounter questions about the natural world every day.</td>
<td>How do patterns and variations in local weather affect our daily lives?
How does weather forecasting help people prepare for, and respond to severe weather?</td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…
Sunlight warms Earth’s Surface.
Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.
Some kinds of severe weather are more likely than others in a given</td>
<td>Students will be skilled at…
Asking questions based on observation to gain more information.
Making observations to collect data that can be used to make comparisons.
Using observations, students will describe patterns to to answer specific questions.
Building and design a device, that will solve specific problems.
Reading grade appropriate texts or other media to obtain scientific information to describe patterns in our natural world.</td>
</tr>
</table>

	region. Severe weather forecasts can prepare communications to respond to these events. • Asking questions, making observations, and gathering information are helpful in thinking about problems.	

Used in Content Area Standards	***21st Century Skills***
not applicable	People depend on various technologies in their lives; human life would be very different without technology. • Critical Thinking • Communication • Collaboration • Social Skills

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Students will:

	● make observations ● design and build structures ● use and share observations ● ask questions ● make models
	OTHER EVIDENCE: Teacher observation of student participation. Use kindergarten science rubric.

Title of Curriculum: **Grade 1 Science: Waves - Light and Sound**

Unit Name	What	How	Why
Title: • **Light and Sound**	• Provide evidence that vibrating materials can make sound and that sound can make materials vibrate. • Construct an evidence-based account that objects can be seen only when illuminated • Determine the effect of placing objects made with different materials in the path of a beam of light • Design and build a device that uses light or sound to solve the problem of communicating over a distance.	• Plan and Conduct Investigations • Make Observations • Use Tools and Materials	• Students will be able to determine that simple tests can be designed to gather evidence to support or refute student ideas. • People depend on various technologies in their lives; human life would be very different without technology.

Windham School District Curriculum

Waves - Light and Sound - Grade 1

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students will demonstrate grade appropriate proficiency in planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

Content Standards:
• 1-PS4-1
• 1-PS4-2</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
● Make observations to construct an evidence-based account that objects can be seen only when illuminated.
● Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.
● Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…
● there is a relationship between sound and vibrating materials as well as between the</td><td>ESSENTIAL QUESTIONS
● What happens when materials vibrate?
● What happens when there is no light?</td></tr>
</table>

• 1-PS4-3 • 1-PS4-4 • K-2ETS1-1 • K-2ETS1-2 • K-2ETS1-3	availability of light and ability to see objects. • light travels from place to place as determined by placing objects made with different materials in the path of a beam of light.	
	Acquisition	
	Students will know… • sound can make matter vibrate, and vibrating matter can make sound • Objects can be seen if light is available to illuminate them or if they give off their own light. • Some materials allow light to pass through them, others allow only some light through and others block all light and create a dark shadow on any surface beyond them, where the light cannot reach. • People use a variety of devices to communicate (send and receive information) over long distances.	Students will be skilled at… • Planning and conducting investigations collaboratively to produce data to serve as the basis for evidence to answer a question. • Making observations (firsthand or from media) to construct an evidence-based account for natural phenomena • Using tools and materials provided to design a device that solves a specific problem.

Used in Content Area Standards	***21st Century Skills***
not applicable	• *Collaboration and teamwork* • *Creativity and imagination* • *Critical thinking* • *Problem solving*

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Teacher Observations • Classroom Discussion • End of Topic Assessment • Grade 1 Science Rubric
	OTHER EVIDENCE: • Plan and conduct an investigation.

	• Make meaningful observations and/or measurements. • Ask questions. • Define a simple design problem

Title of Curriculum: **Grade 1 Science: Space Systems - Patterns and Cycles**

Unit Name	What	How	Why
Title: • **Sun, Moon, Stars**	• Describe patterns that can be predicted. • Relate the amount of daylight to the time of year.	• Make observations of the sun, moon, and stars	• Students will be able to determine that patterns in the natural world can be observed, used to describe phenomena, and used as evidence. • Science assumes natural events happen today as they happened in the past. • Many events are repeated.

Windham School District Curriculum

Space Systems - Patterns and Cycles - Grade 1

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Students will demonstrate grade appropriate proficiency in planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

Content Standards:

● 1-ESS1-1
● 1-ESS1-2</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Use observations of the sun, moon and stars to describe patterns that can be predicted.
● Make observations at different times of year to relate the amount of daylight to the time of year.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…
● Movement of objects in the sky can be observed, described, and predicted as patterns.</td><td>ESSENTIAL QUESTIONS
● What objects are in the sky and how do they seem to move?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
</table>

• K-2ETS1-1 • K-2ETS1-2 • K-2ETS1-3	• Patterns of the motion of the sun, moon and stars in the sky can be observed, described, and predicted. • Seasonal patterns of sunrise and sunset can be observed, described, and predicted.	• Making observations (firsthand or from media) to collect data that can be used to make comparisons. • Using observations (firsthand or from media) to describe patterns in the natural world in order to answer specific questions.
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration and teamwork • Creativity and imagination • Critical thinking • Problem solving

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT:

	● Teacher Observations ● Classroom Discussion ● End of Topic Assessment ● Grade 1 Science Rubric
	OTHER EVIDENCE: ● Plan and conduct an investigation. ● Make meaningful observations and/or measurements. ● Ask questions. ● Define a simple design problem

<u>Title of Curriculum</u>: Grade 1 Science: Structure, Function, and Information Processing

Unit Name	What	How	Why
Title: ● **Adaptation**	● Design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. ● Determine patterns in behavior of parents and offspring that help offspring survive. ● Construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.	● Use materials to design a solution. ● Read texts and use media. ● Make observations.	● Students will be able to determine that patterns in the natural world can be observed, used to describe phenomena, and used as evidence. ● Students will be able to determine that the shape and stability of structures of natural and designed objects are related to their function(s). ● Every human-made product is designed by applying some knowledge of the natural world and is built by using materials derived from the natural world.

Windham School District Curriculum

Structure, Function and Information Processing - Grade 1

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students will demonstrate grade appropriate proficiency in planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

Content Standards:</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
● Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.
● Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● plants and animals use their external parts to help them survive, grow and meet their needs.</td><td>ESSENTIAL QUESTIONS
● What are some ways plants and animals meet their needs so that they can survive and grow?</td></tr>
</table>

• 1-LS1-1 • 1-LS1-2 • 1-LS3-1 • K-2ETS1-1 • K-2ETS1-2 • K-2ETS1-3	• behaviors of parents and offspring help the offspring survive. • young plants and animals are like, but not exactly the same as, their parents.	
	Acquisition	
	Students will know… • All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. • Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring survive. • Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.	Students will be skilled at… • Making observations (firsthand or from media) to construct an evidence-based account for natural phenomena • Using materials to design a device that solves a specific problem or a solution to a specific problem. • Reading grade-appropriate texts and using media to obtain scientific information to determine patterns in the natural world.

	• Young animals are very much, but not exactly, like their parents. Plants also are very much, but not exactly, like their parents. • Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration and teamwork • Creativity and imagination • Critical thinking • Problem solving

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Teacher Observations • Classroom Discussion • End of Topic Assessment

	• Grade 1 Science Rubric
	OTHER EVIDENCE: • Plan and conduct an investigation. • Make meaningful observations and/or measurements. • Ask questions. • Define a simple design problem

<u>Title of Curriculum</u>: **Grade 1 Science: Engineering Design**

Unit Name	What	How	Why
Title: • **Engineering Design**	• Define a simple problem that can be solved through the development of a new or improved object or tool. • Illustrate how the shape of an object helps it function as needed to solve a given problem. • Compare the strengths and weaknesses of two objects designed to solve the same problem.	• Ask questions, make observations, and gather information about a situation people want to change. • Develop a simple sketch, drawing, or physical model. • Analyze data from tests of two objects designed to solve the same problem.	• Students will be able to determine that the shape and stability of structures of natural and designed objects are related to their functions.

Windham School District Curriculum

Engineering Design - Grade 1

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:

Students will demonstrate grade appropriate proficiency in planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
Analyze data from test of two objects designed to solved the same problem to compare the strengths and weaknesses of how each performs.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
</table>

Content Standards: • K-2-ETS1-1 • K-2-ETS1-2 • K-2-ETS1-3	• A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations and gathering information are helpful in thinking about problems. • Before beginning to design a solution, it is important to clearly understand the problem. • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solution to other people. • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	• Asking questions based on observations to find more information about the natural and/or designed world. • Defining a simple problem that can be solved through the development of a new or improved object or tool. • Developing a simple model based on evidence to represent a proposed object or tool. • Analyzing data from tests of an object or tool to determine if it works as intended.
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration and teamwork • Creativity and imagination • Critical thinking • Problem solving

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Teacher Observations ● Classroom Discussion ● End of Topic Assessment ● Grade 1 Science Rubric
	OTHER EVIDENCE: ● Plan and conduct an investigation. ● Make meaningful observations and/or measurements. ● Ask questions. ● Define a simple design problem

Title of Curriculum: **Grade 2 Science: Earth's Systems-Processes that Shape the Earth**

Unit Name	What	How	Why
Title: • **Erosion**	• Provide evidence that Earth events can occur quickly or slowly • Determine how to slow or prevent wind or water from changing the shape of the land • Represent the shapes and kinds of land and bodies of water in an area • Identify where water is found on Earth and that it can be solid or liquid	• Use information from several sources • Compare multiple solutions • Develop a model • Obtain information	• Students will be able to develop and use technologies to show impact on the natural world

Windham School District Curriculum

Earth's Systems: Processes that Shape the Earth - Grade 2

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards?):

Students will demonstrate grade appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions. Students will be engaging in argument from evidence, as well as obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to apply their understanding of the idea that wind and water can change the shape of the land and compare design solutions to slow or prevent such change. Students are able to use information and models to identify and represent the shapes and kinds of land and bodies of water in an area.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…

● Scientists study the natural and material world. They develop and use technologies to show impact on the natural world.</td><td>ESSENTIAL QUESTIONS

● How does land change and what are some things that cause it to change?
● What are the different kinds of land and bodies of water?
● How do the properties of earth materials differ?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
</table>

<table>
<tr><td>Content Standards:

2-ESS1-1

2-ESS2-1

2-ESS2-2

2-ESS2-3</td><td>Students will know how to…

● List that some events happen very quickly and others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)

● Demonstrate that wind and water can change the shape of the land. (2- ESS2-1)

● Illustrate that maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2- 2)

● Reference that water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)

● Conclude that because there is always more than one possible solution to a problem, it is useful to compare and test designs.</td><td>Students will be skilled at…

● Developing a model to represent patterns in the natural world. (2-ESS2-2)

● Making observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1)

● Comparing multiple solutions to a problem. (2-ESS2-1)

● Obtaining information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">This content may offer opportunities to cross reference the following Common Core Standards:

ELA/Literacy –</td><td>Students will use:

● Collaboration and teamwork, creativity and imagination, critical thinking, as well as problem solving to become better</td></tr>
</table>

RI.2.1 Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (2-ESS1-1) RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS1-1),(2-ESS2-1) RI.2.9 Compare and contrast the most important points presented by two texts on the same topic. (2-ESS2-1) W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (2-ESS1-1),(2-ESS2-3) W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-ESS1-1) W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-ESS1-1),(2-ESS2-3) SL.2.2 Recount or describe key ideas or details from a text read aloud or information presented orally or through other media. (2-ESS1-1) SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-ESS2-2) Mathematics – MP.2 Reason abstractly and quantitatively. (2-ESS2-1),(2-ESS2-1),(2-ESS2-2) MP.4 Model with mathematics. (2-ESS1-1),(2-ESS2-1),(2-ESS2-2) MP.5 Use appropriate tools strategically. (2-ESS2-1) 2.NBT.A Understand place value. (2-ESS1-1)	decision makers about scientific and technical issues and apply science to their daily lives.

2.NBT.A.3 Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. (2-ESS2-2) 2.MD.B.5 Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. (2-ESS2-1)	

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Grade 2 Science Rubric ● Launch Log/Science Notebook ● End of Unit Assessments
	OTHER EVIDENCE: Students who understand the concepts can: ● Observe and classify patterns of different kinds of materials ● Plan and conduct investigations collaboratively ● Collect, analyze and interpret data ● Construct explanations and engage in discussion with evidence to support a claim ● Integrate technology

<u>Title of Curriculum</u>: Grade 2 Science: Structures and Properties of Matter

Unit Name	What	How	Why
Title: • **Matter**	• Describe and classify different kinds of materials by their observable properties • Determine which materials have the properties that are best suited for an intended purpose • Construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object • Use evidence to identify that some changes caused by heating or cooling can be reversed and some cannot	• Plan and conduct an investigation • Analyze data obtained from testing different materials • Make observations • Construct an argument	• Students will be able to determine that human made products are designed by applying knowledge of the natural world and is built using material derived from the natural world

Windham School District Curriculum

Structures and Properties of Matter - Grade 2

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:

Competencies (Standards?):

Students will demonstrate grade appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions. Students will be engaging in argument from evidence, as well as obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to show an understanding of observable properties of materials, through analysis and classification of different materials.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…

● Human made products are designed by applying knowledge of the natural world and are built using material derived from the natural world</td><td>ESSENTIAL QUESTIONS

● How are materials similar and different from one another?
● How do the properties of materials relate to their use?
● How are solids and liquids represented in our daily lives?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know how to…</td><td>Students will be skilled at…</td></tr>
</table>

Content Standards: **2-PS1-1** **2-PS1-2** **2-PS1-3** **2-PS1-4**	● *I*dentify that different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1) ● Demonstrate that different properties are suited to different purposes. (2- PS1-2),(2-PS1-3) ● Construct a plan to show a great variety of objects can be built up from a small set of pieces. (2-PS1-3) ● Describe that heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)	● Planning and conducting an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-PS1-1) ● Analyzing data from tests of an object or tool to determine if it works as intended. (2-PS1-2) ● Making observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3) ● Constructing an argument with evidence to support a claim. (2- PS1-4)
Used in Content Area Standards		***21st Century Skills***
This content may offer opportunities to cross reference the following Common Core Standards: ELA/Literacy –		*Students will use:* ● Collaboration and teamwork, creativity and imagination, critical thinking, as well

RI.2.1 Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (2-PS1-4) RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-PS1-4) RI.2.8 Describe how reasons support specific points the author makes in a text. (2-PS1-2),(2-PS1-4) W.2.1 Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., because, and, also) to connect opinion and reasons, and provide a concluding statement or section. (2-PS1-4) W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-PS1-1),(2-PS1- 2),(2-PS1-3) W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-PS1-1),(2-PS1-2),(2-PS1-3) Mathematics – MP.2 Reason abstractly and quantitatively. (2-PS1-2) MP.4 Model with mathematics. (2-PS1-1),(2-PS1-2) MP.5 Use appropriate tools strategically. (2-PS1-2) 2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (2-PS1-1),(2-PS1-2)	as problem solving to become better decision makers about scientific and technical issues and apply science to their daily lives.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Grade 2 Science Rubric ● Launch Log/Science Notebook ● End of Unit Assessments
	OTHER EVIDENCE: Students who understand the concepts can: ● Observe and classify patterns of different kinds of materials ● Plan and conduct investigations collaboratively ● Collect, analyze and interpret data ● Construct explanations and engage in discussion with evidence to support a claim ● Integrate technology

<u>Title of Curriculum</u>: Grade 2 Science: Interdependent Relationships in Ecosystems

Unit Name	What	How	Why
Title: • **Plants**	• Determine if plants need sunlight and water to grow • Mimic the function of an animal in dispersing seeds or pollinating plants • Compare the diversity of life in different habitats	• Plan and conduct an investigation • Develop a simple model • Make observations of plants and animals	• Students will be able to identify that events have causes that generate observable patterns • Students will be able to determine that the shape of a natural structure is related to its function

Windham School District Curriculum

Interdependent Relationships in Ecosystems - Grade 2

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards?):

Students will demonstrate grade appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions. Students will be engaging in argument from evidence, as well as obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to develop an understanding of what plants need to grow and how plants depend on animals for seed dispersal and pollination. Students are also expected to compare the diversity of life in different habitats.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…

● Events have causes that generate observable patterns
● The shape of a natural structure is related to its function</td><td>ESSENTIAL QUESTIONS

● What do plants need to grow?
● How many types of living things live in a place?
● How can you describe the effects of light and water on seed germination and plant growth?
● How are plants connected with other living things?</td></tr>
</table>

<table>
<tr><td rowspan="3">Content Standards:

2-LS2-1

2-LS2-2

2-LS4-1</td><td></td><td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know how to…

● State that plants depend on water and light to grow. (2-LS2-1)

● Explain that plants depend on animals for pollination or to move their seeds around. (2-LS2-2)

● Recognize that there are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)

● Create designs that can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem’s solutions to other people.</td><td>Students will be skilled at…

● Developing a simple model based on evidence to represent a proposed object or tool. (2-LS2-2)

● Planning and conducting an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-LS2-1) Making observations (firsthand or from media) to collect data which can be used to make comparisons. (2-LS4-1)</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">This content may offer opportunities to cross reference the following Common Core Standards:

ELA/Literacy –</td><td>Students will use:

● Collaboration and teamwork, creativity and imagination, critical thinking, as well as problem solving to become better decision</td></tr>
</table>

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-LS2-1),(2-LS4-1) W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-LS2-1),(2-LS4-1) SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-LS2-2) Mathematics – MP.2 Reason abstractly and quantitatively. (2-LS2-1),(2-LS4-1) MP.4 Model with mathematics. (2-LS2-1),(2-LS2-2),(2-LS4-1) MP.5 Use appropriate tools strategically. (2-LS2-1) 2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems. (2-LS2-2),(2-LS4-1)	makers about scientific and technical issues and apply science to their daily lives.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Grade 2 Science Rubric ● Launch Log/Science Notebook ● End of Unit Assessments

	OTHER EVIDENCE: Students who understand the concepts can: ● Observe and classify patterns of different kinds of materials ● Plan and conduct investigations collaboratively ● Collect, analyze and interpret data ● Construct explanations and engage in discussion with evidence to support a claim ● Integrate technology

<u>Title of Curriculum</u>: Grade 2 Science: Engineering Design

Unit Name	What	How	Why
Title: • **Engineering**	• Define a simple problem that can be solved through the development of a new or improved object or tool • Illustrate how the shape of an object helps it function as needed to solve a given problem. • Solve the same problem to compare the strengths and weaknesses of how each performs.	• Ask questions, make observations, and gather information about a situation people want to change • Develop a simple sketch, drawing, or physical model • Analyze data from tests of two objects designed	• Students will be able to demonstrate the engineering design process to show that shape and stability of natural structures and designed objects are related to their functions

Windham School District Curriculum

Engineering Design - Grade 2

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:

Competencies (Standards?):

Students will demonstrate grade appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions. Students will be engaging in argument from evidence, as well as obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to observe the crosscutting concepts of patterns; cause and effect; energy and matter; structure and function; and stability and change. Students will be able to understand the influence of engineering, technology, and science on society and the natural world.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…

● the engineering design process shows that shape and stability of natural structures and designed objects are related to their functions</td><td>ESSENTIAL QUESTIONS

● Why do engineers and designers strive to improve products used in our daily life?
● Why do we use the engineering design process to solve design challenges?
● How can the engineering design process benefit us in solving problems in our daily life?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know how to…</td><td>Students will be skilled at…</td></tr>
</table>

Content Standards: **K-2-ETS1-1** **K-2-ETS1-2** **K-2-ETS1-3**	● Define situations that people want to change or create can be approached as a problem to be solved through engineering. (K-2- ETS1-1) ● Ask questions, make observations, and gather information are helpful in thinking about problems. (K-2-ETS1-1) ● State, before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1) ● Construct designs that can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2) ● Conclude that because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)	● Asking questions based on observations to find more information about the natural and/or designed world. (K-2- ETS1-1) ● Defining a simple problem that can be solved through the development of a new or improved object or tool. (K-2- ETS1-1) ● Developing a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2) ● Analyzing data from tests of an object or tool to determine if it works as intended. (K-2-ETS1-3)
Used in Content Area Standards		***21st Century Skills***
This content may offer opportunities to cross reference the following Common Core Standards: ELA/Literacy –		*Students will use:* ● *Collaboration and teamwork, creativity and* imagination, critical thinking, as well as

RI.2.1 Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. (K-2-ETS1-1) W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-1),(K-2-ETS1-3) W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1),(K-2-ETS1-3) SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K-2-ETS1-2) Mathematics – MP.2 Reason abstractly and quantitatively. (K-2-ETS1-1),(K-2-ETS1-3) MP.4 Model with mathematics. (K-2-ETS1-1),(K-2-ETS1-3) MP.5 Use appropriate tools strategically. (K-2-ETS1-1),(K-2-ETS1-3) 2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1),(K-2-ETS1-3)	problem solving to become better decision makers about scientific and technical issues and apply science to their daily lives.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Grade 2 Science Rubric

	● Launch Log/Science Notebook
	OTHER EVIDENCE: Students who understand the concepts can: ● Observe and classify patterns of different kinds of materials ● Plan and conduct investigations collaboratively ● Collect, analyze and interpret data ● Construct explanations and engage in discussion with evidence to support a claim ● Integrate technology

<u>Title of Curriculum</u>: Grade 3 Forces and Interaction

Unit Name	What	How	Why
Title: • **Forces and Interactions**	• The effects of balanced and unbalanced forces on the motion of an object. • A pattern can be used to predict future motion. • Determine if there is a cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. • Scientific ideas about magnets.	• Students will plan and conduct and investigation. • Students will make observations and/or measurements of an object's motion. • Students will ask scientific and non scientific questions. • Students will define a simple design problem that can be solved with magnets.	• Patterns of change can be used to make predictions. • Cause and effect relationships are routinely identified, tested, and used to explain change. • Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.

Windham School District Science Curriculum

Forces and Interactions: Third Grade

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students will use the NGSS Science and Engineering Practices to demonstrate understanding of Forces and Interactions. Students will be expected to ask questions, define problems, and plan and carry out investigations.

Competencies (Standards?):

Content Standards:
3-PS2-1
3-PS2-2
3-PS2-3
3-PS2-4</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
Make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.
Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
Define a simple design problem that can be solved by applying scientific ideas about magnets.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…
Patterns of change can be used to make predictions.</td><td>ESSENTIAL QUESTIONS
How do balanced and unbalanced forces on an object affect the object?
How can magnets be used?</td></tr>
</table>

	• Cause and effect relationships are routinely identified, tested, and used to explain change. • Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.	
	Acquisition	
	Students will know… • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. • The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.	*Students will be skilled at…* • Asking questions that can be investigated based on patterns such as cause and effect relationships. • Defining a simple problem that can be solved through the development of a new or improved object or tool. • Planning and conducting an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Making observations and/or measurements to produce data to serve as the basis for evidence for an

	• Objects in contact exert forces on each other. • Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	explanation of a phenomenon or test a design solution. • Recognizing patterns using a variety of methods, tools, and techniques.

Used in Content Area Standards	***21st Century Skills***
not applicable	• Critical Thinkers • Communication • Information Literacy • Technology Literacy • Productivity

Stage 2 – Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT:

	• Plan and conduct an investigation of forces on the motion of an object. • Make meaningful observations and/or measurements on patterns to predict future motions. • Ask scientific and non scientific questions about the relationship of magnetic interactions. • Define a simple design problem that can be solved by use of magnets.
	OTHER EVIDENCE: • Teacher Observations • Classroom Discussion • Unit Assessment

Title of Curriculum: **Grade 3 Interdependent Relationship in Ecosystems**

Unit Name	What	How	Why
Title: • **Interdependent Relationships in Ecosystems**	• Some animals form groups that help members survive. • Fossils provide evidence of the organisms and the environments in which they lived long ago. • In a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. • When the environment changes and the types of plants and animals that live there may change.	• Students will construct an argument in verbal or written form • Students will analyze and interpret data through inquiries • Students will construct an argument with evidence from inquiries • Students will make a claim in verbal or written form	• Cause and effect relationships are routinely identified and used to explain change. • Observable phenomena exist from very short to very long time periods. • A system can be described in terms of its components and their interactions. • Knowledge of relevant scientific concepts and research findings is important in engineering. • Science assumes consistent patterns in natural systems.

Windham School District Science Curriculum

Interdependent Relationships in Ecosystems: Third Grade

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students will use the NGSS Science and Engineering Practices to demonstrate understanding of Interdependent Relationships in Ecosystems. Students will be expected to analyze and interpret data and engage in argument from evidence

Competencies (Standards?):

Content Standards:
3-LS2-1
3-LS4-1
3-LS4-3
3-LS4-4</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
Construct an argument that some animals form groups that help members survive.
Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…
Cause and effect relationships are routinely identified and used to explain change.</td><td>ESSENTIAL QUESTIONS
How do animals work together to survive in their ecosystem?</td></tr>
</table>

	• Observable phenomena exist from very short to very long time periods. • A system can be described in terms of its components and their interactions. • Knowledge of relevant scientific concepts and research findings is important in engineering. • Science assumes consistent patterns in natural systems.	• How are plants, animals, and environments of the past similar or different from current plants, animals, and environments? • What happens to organisms when their environment changes?
	Acquisition	
	Students will know… • When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. • Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.	Students will be skilled at… • Analyzing and interpreting data to make sense of phenomena using logical reasoning • Constructing an argument with evidence, data, and/or a model. • Making a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

	• Some kinds of plants and animals that once lived on Earth are no longer found anywhere. • Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. • For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. • Populations live in a variety of habitats, and change in those habitats affects the organisms living there.	
Used in Content Area Standards		**21st Century Skills**
not applicable		• Critical Thinking • Collaboration • Communication • Information Literacy • Initiative • Social Skills

Stage 2 – Evidence	
Evaluative Criteria	**Assessment Evidence**
	ASSESSMENT: ● Construct an argument that some animals form groups that help members survive. ● Analyze and interpret data about fossils and the organism's environment long ago. ● Make a claim about environment changes and the types of plants and animals that may change as well.
	OTHER EVIDENCE: ● Unit Assessment ● Teacher Observations ● Classroom Discussion

<u>Title of Curriculum</u>: Grade 3 Inheritance and Variation of Traits: Life Cycles and Traits

Unit Name	What?	How?	Why ?
Title: • **Inheritance and Variation of Traits: Life Cycles and Traits**	• Organisms have unique and diverse life cycles, but all have in common birth, growth, reproduction, and death. • Plants and animals have traits inherited from parents that variation of these traits exists in a group of similar organisms. • Traits can be influenced by the environment. • Variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.	• Students will develop models using different materials. • Students will analyze and interpret data to provide evidence. • Students will use evidence to support an explanation in verbal or written form.	• Similarities and differences in patterns can be used to sort and classify natural phenomena. • Patterns of change can be used to make predictions. • Cause and effect relationships are routinely identified and used to explain change.

Windham School District Science Curriculum

Inheritance and Variation of Traits: Life Cycles and Traits: Third Grade

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students will use the NGSS Science and Engineering Practices to demonstrate understanding of Inheritance and Variation of Traits: Life Cycles and Traits. Students will be expected to develop and use models, analyze and interpret data, construct explanations and design solutions.

Competencies (Standards?):

Content Standards:

• 3-LS1-1
• 3-LS3-1
• 3-LS3-2
• 3-LS4-2</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

● Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
● Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.
● Use evidence to support the explanation that traits can be influenced by the environment.
● Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

● Similarities and differences in patterns can be used to sort and classify natural phenomena.</td><td>ESSENTIAL QUESTIONS

● How do organisms vary in their traits?
● How are life cycles of plants and animals similar? How are they different?</td></tr>
</table>

	• Patterns of change can be used to make predictions. • Cause and effect relationships are routinely identified and used to explain change.	• How can the environment affect the traits of organisms? • How do animals adapt to survive changes in their ecosystem?
	Acquisition	
	Students will know… • Reproduction is essential to the continued existence of every kind of organism. • Plants and animals have unique and diverse life cycles. • Many characteristics of organisms are inherited from their parents. • Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. • Many characteristics involve both inheritance and environment. • Different organisms vary in how they look and function because they have different inherited information.	Students will be skilled at… • Developing models to describe phenomena. • Analyzing and interpreting data to make sense of phenomena using logical reasoning. • Using evidence (e.g., observations, patterns) to support an explanation. • Using evidence (e.g., observations, patterns) to construct an explanation. • Recognizing patterns.

	• The environment also affects the traits that an organism develops. • Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.	

Used in Content Area Standards	**21st Century Skills**
not applicable	• Creativity • Critical Thinking • Collaboration • Communication • Media Literacy • Productivity • Technology Literacy

Stage 2 – Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Develop models to describe life cycles.

	- Analyze and interpret data about inherited traits. - Use evidence to support the explanation that traits can be influenced by the environment. - Use evidence to construct an explanation on variation among individuals of the same species.
	OTHER EVIDENCE: - Unit Assessment - Teacher Observations - Classroom Discussion

<u>Title of Curriculum</u>: Grade 3 Weather and Climate

Unit Name	What?	How?	Why ?
Title: ● **Weather and Climate**	● Typical weather conditions expected during a particular season ● Climates in different regions of the world ● Reducing the impacts of a weather-related hazards	● Students will represent data in tables and graphical displays. ● Students will obtain and combine information to describe the given topic. ● Students will make a claim about the merit of a design solution in verbal or written form.	● Patterns of change can be used to make predictions. ● Cause and effect relationships are routinely identified, tested, and used to explain ● Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. ● Science affects everyday life.

Windham School District Science Curriculum

Weather and Climate: Third Grade

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students will use the NGSS Science and Engineering Practices to demonstrate understanding of Weather and Climate. Students will be expected to analyze and interpret data, engage in an argument from evidence, and obtain, evaluate, and communicate information.

Competencies (Standards?):</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
Obtain and combine information to describe climates in different regions of the world.
Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Patterns of change can be used to make predictions.
Cause and effect relationships are routinely identified, tested, and used to explain
Engineers improve existing technologies or develop new ones to increase their</td><td>ESSENTIAL QUESTIONS
What is typical weather in different parts of the world and during different times of the year?
How can the impact of weather-related hazards be reduced?</td></tr>
</table>

<table>
<tr><td rowspan="4">Content Standards:
3-ESS2-1
3-ESS2-2
3-ESS3-1
3-5ETS1-1
3-5ETS1-2
3-5ETS1-3</td><td>benefits, decrease known risks, and meet societal demands.
Science affects everyday life.</td><td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
<tr><td>Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.
A variety of natural hazards result from natural processes.
Humans cannot eliminate natural hazards but can take steps to reduce their impacts.</td><td>Representing data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.
Making a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.
Obtaining and combining information from books and other reliable media to explain phenomena.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">not applicable</td><td>Critical Thinking
Communication</td></tr>
</table>

	• Collaboration • Information Literacy • Productivity • Social Skills

Stage 2 – Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Represent data in tables and graphical displays to describe typical weather conditions. • Obtain and combine information to describe climates of the world. • Make a claim to reduce the impact of hazardous weather.
	OTHER EVIDENCE: • Unit Assessments • Teacher Observations • Classroom Discussion

<u>Title of Curriculum</u>: Grade 4 Science: Energy

Unit Name	What	Why	How
Title: ● **Energy**	● The faster a given object is moving, the more energy it possesses. ● Energy can be moved from place to place by moving objects or through sound, light, or electric currents. ● Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. ● Light also transfers energy from place to place. ● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The	● Cause and effect relationships are routinely identified and used to explain change. ● Energy can be transferred in various ways and between objects. ● Knowledge of relevant scientific concepts and research findings is important in engineering ● Over time, people's needs and wants change, as do their demands for new and improved technologies. ● Engineers improve existing technologies or develop new ones. ● Most scientists and engineers work in teams. ● Science affects everyday life. ● The faster a given object is moving, the more energy it possesses. ● Energy can be moved from place to place by moving objects or through sound, light, or electric currents	● Students will ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. ● Students will make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. ● Students will use evidence (e.g., measurements, observations, patterns) to construct an explanation. ● Students will apply scientific ideas to solve design problems. ● Students will obtain and combine information from books and other reliable media to explain phenomena.

	currents may have been produced to begin with by transforming the energy of motion into electrical energy. ● When objects collide, the contact forces transfer energy so as to change the objects' motions. ● The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. ● Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. ● Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared		

	on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.		

Windham School District Science Curriculum

Energy - Grade 4

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students will use the NGSS Science and Engineering Practices to demonstrate understanding of Energy. Students will be expected to ask questions and define problems, plan and carry out investigations, construct explanations and design solutions, and obtain, evaluate and communicate information.

Competencies (Standards?):
● Physical Science</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Use evidence to construct an explanation relating the speed of an object to the energy of that object.
● Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
● Ask questions and predict outcomes about the changes in energy that occur when objects collide.
● Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
● Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
</table>

Content Standards	Students will understand that…	
• 4-PS3-1 • 4-PS3-2 • 4-PS3-3 • 4-PS3-4 • 4-ESS3-1	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1) **Energy and Matter** • Energy can be transferred in various ways and between objects. (4-PS3-1), (4- PS3-2),(4-PS3-3),(4-PS3-4) **Interdependence of Science, Engineering, and Technology** • Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1) I**nfluence of Engineering, Technology, and Science on Society and the Natural World** • Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1)	• What is energy and how is it related to motion? • How is energy transferred? • How can energy be used to solve a problem?

	● Engineers improve existing technologies or develop new ones. (4-PS3-4) **Science is a Human Endeavor** ● Most scientists and engineers work in teams. (4-PS3-4) ● Science affects everyday life. (4-PS3-4)	
	Acquisition	
	Students will know… **PS3.A: Definitions of Energy** ● The faster a given object is moving, the more energy it possesses. (4- PS3-1) ● Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3) **PS3.B: Conservation of Energy and Energy Transfer** ● Energy is present whenever there are moving objects, sound, light, or heat.	*Students will be skilled at…* ● Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3) ● Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2) ● Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)

	When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2),(4-PS3-3) ● Light also transfers energy from place to place. (4-PS3-2) ● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4) **PS3.C: Relationship Between Energy and Forces** ● When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3) PS3.D:	● Apply scientific ideas to solve design problems. (4- PS3-4) ● Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)

	Energy in Chemical Processes and Everyday Life ● The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4) ESS3.A: Natural Resources ● Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1) **ETS1.A: Defining Engineering Problems** ● Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how	

	well each takes the constraints into account. (secondary to 4-PS3-4)	
Used in Content Area Standards		***21st Century Skills***
Common Core State Standards Connections: ELA/Literacy – RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1) RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1) RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1) W.4.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1) W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),(4-PS3-3),(4-PS3-4),(4-ESS3-1) W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4),(4-ESS3-1) W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1),(4-ESS3-1)		

Mathematics – MP.2 Reason abstractly and quantitatively. (4-ESS3-1) MP.4 Model with mathematics. (4-ESS3-1) 4.OA.A.1 Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-1) 4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4-PS3-4)	

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use evidence to construct an explanation relating the speed of an object to its energy. ● Make observations to provide evidence that energy can be transferred by sound, light, heat, and electric currents. ● Ask questions and predict outcomes about the changes in energy when objects collide. ● Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. ● Obtain and combine information to describe that energy and fuels are derived from natural resources and affect the environment.

	OTHER EVIDENCE: ● Inquiry ● Teacher Observations ● Classroom Discussions

<u>Title of Curriculum</u>: Grade 4 Science: Waves and Information

Unit Name	What	Why	How
Title: • **Waves and Information**	• Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. • Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). • Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. • Different solutions need to be tested in order to determine	• Similarities and differences in patterns can be used to sort and classify natural phenomena. • Similarities and differences in patterns can be used to sort and classify designed products. • Knowledge of relevant scientific concepts and research findings is important in engineering.	• Students will develop a model using an analogy, example, or abstract representation to describe a scientific principle. • Students will generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. • Students will understand that science findings are based on recognizing patterns.

	which of them best solves the problem, given the criteria and the constraints.		

Windham School District Science Curriculum

Waves and Information - Grade 4

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Students will use the NGSS Science and Engineering Practices to demonstrate understanding of Waves and Information. Students will be expected to develop and use models, construct explanations and design solutions, and understand that scientific knowledge is based on empirical evidence.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
● Generate and compare multiple solutions that use patterns to transfer information.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…

Patterns
● Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)</td><td>ESSENTIAL QUESTIONS

● What are waves and what are some things they can do?</td></tr>
</table>

<table>
<tr><td rowspan="4">Content Standards:
4-PS4-1.
4-PS4-3.
3-5ETS1-1
3-5ETS1-2
3-5ETS1-3</td>
<td>Similarities and differences in patterns can be used to sort and classify designed products. (4- PS4-3)
Interdependence of Science, Engineering, and Technology
Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)</td>
<td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

PS4.A: Wave Properties
Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (Note: This</td>
<td>Students will be skilled at…
Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)
Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)</td></tr>
</table>

	grade band endpoint was moved from K–2). (4-PS4-1) ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: Information Technologies and Instrumentation** ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3) **ETS1.C: Optimizing The Design Solution** ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary to 4-PS4-3)	● Science findings are based on recognizing patterns. (4- PS4-1)

Used in Content Area Standards	*21st Century Skills*
Common Core State Standards Connections: ELA/Literacy – RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS4-3) RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3) SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-1) Mathematics – MP.4 Model with mathematics. (4-PS4-1) 4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-1)	

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop a model of waves to describe patterns in amplitude and wavelength and that waves can cause objects to move

	• Generate and compare multiple solutions that use patterns to transfer information (such as Morse Code)
	OTHER EVIDENCE: • Inquiry • Teacher Observations • Classroom Discussions

<u>Title of Curriculum</u>: Grade 4 Science: Structure, Function, and Information Processing

Unit Name	What	Why	How
Title: • **Structure, Function, and Information Processing**	• An object can be seen when light reflected from its surface enters the eyes. • Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. • Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.	• Cause and effect relationships are routinely identified. • A system can be described in terms of its components and their interactions.	• Develop a model to describe phenomena. • Use a model to test interactions concerning the functioning of a natural system. • Construct an argument with evidence, data, and/or a model.

Windham School District Science Curriculum

Structure, Function, and Information Processing - Grade 4

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students will use the NGSS Science and Engineering Practices to demonstrate understanding of Structure, Function, and Information Processing. Students will be expected to develop and use models and engage in argument from evidence.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…

Cause and Effect</td><td>ESSENTIAL QUESTIONS
How do internal and external structures support the survival,</td></tr>
</table>

Content Standards: ● 4-PS4-2 ● 4-LS1-1 ● 4-LS1-2	● Cause and effect relationships are routinely identified. (4-PS4-2) **Systems and System Models** ● A system can be described in terms of its components and their interactions. (4- LS1-1), (LS1-2)	growth, behavior, and reproduction of plants and animals?
	Acquisition	
	Students will know… **PS4.B: Electromagnetic Radiation** ● An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2) **LS1.A: Structure and Function** ● Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1) LS1.D: **Information Processing** ● Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's	*Students will be skilled at…* ● Develop a model to describe phenomena. (4-PS4-2) ● Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2) ● Construct an argument with evidence, data, and/or a model. (4-LS1-1)

	brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)	
Used in Content Area Standards		***21st Century Skills***
Common Core State Standards Connections: ELA/Literacy – W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1) SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-2),(4-LS1-2) Mathematics – MP.4 Model with mathematics. (4-PS4-2) 4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-2) 4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line symmetric figures and draw lines of symmetry. (4-LS1-1)		•

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop a model to describe that light reflecting from objects, enters the eye and can be seen. ● Construct an argument that plants and animals have internal and external structures that support survival, growth, behavior, and reproduction. ● Use a model to describe that animals process information through their senses, process, and respond.
	OTHER EVIDENCE: ● Inquiry ● Teacher Observations ● Classroom Discussions

Title of Curriculum: Grade 4 Science: Earth's Systems: Processes that Shape the Earth

Unit Name	What	Why	How
Title: • **Earth's Systems: Processes that Shape the Earth**	• Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. • Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. • The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and	• Patterns can be used as evidence to support an explanation. • Cause and effect relationships are routinely identified, tested, and used to explain change. • Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. • Science assumes consistent patterns in natural systems.	• Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. • Analyze and interpret data to make sense of phenomena using logical reasoning. • Identify the evidence that supports particular points in an explanation. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

	volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. ● Living things affect the physical characteristics of their regions. ● A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. ● Testing a solution involves investigating how well it performs under a range of likely conditions.		

Windham School District Science Curriculum

Earth's Systems: Processes that Shape the Earth - Grade 4

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students will use the NGSS Science and

Engineering Practices to demonstrate understanding of Earth's Systems: Processes that Shape the Earth. Students will be expected to plan and carry out investigations, analyze and interpret data, and construct explanations and design solutions.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
Analyze and interpret data from maps to describe patterns of Earth's features.
Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…

Patterns</td><td>ESSENTIAL QUESTIONS</td></tr>
</table>

Content Standards: ● 4-ESS1-1 ● 4-ESS2-1 ● 4-ESS2-2 ● 4-ESS3-2 ● 3-5ETS1-1 ● 3-5ETS1-2 ● 3-5ETS1-3	● Patterns can be used as evidence to support an explanation. (4-ESS1-1),(4-ESS2-2) **Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1),(4-ESS3-2) **Influence of Engineering, Technology, and Science on Society and the Natural World** ● Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2) **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Science assumes consistent patterns in natural systems. (4-ESS1-1)	● What patterns of Earth's features can be determined with the use of maps?

	Acquisition	
	Students will know… **ESS1.C: The History of Planet Earth** ● Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1) **ESS2.A: Earth Materials and Systems** ● Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** ● The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and	*Students will be skilled at…* ● Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1) ● Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2) ● Identify the evidence that supports particular points in an explanation. (4-ESS1-1) ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)

	volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2) **ESS2.E: Biogeology** ● Living things affect the physical characteristics of their regions. (4-ESS2-1) **ESS3.B: Natural Hazards** ● A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.)	

<table>
<tr><td></td><td>ETS1.B: Designing Solutions to Engineering Problems

● Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)</td><td></td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">Common Core State Standards Connections:

ELA/Literacy –

RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)

RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, timelines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)

RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2) W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1),(4-ESS2-1) W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS1-1),(4-ESS2-1) W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1)</td><td></td></tr>
</table>

Mathematics – MP.2 Reason abstractly and quantitatively. (4-ESS1-1),(4-ESS2-1),(4-ESS3-2) MP.4 Model with mathematics. (4-ESS1-1),(4-ESS2-1),(4-ESS3-2) MP.5 Use appropriate tools strategically. (4-ESS2-1) 4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS1-1),(4-ESS2-1) 4.MD.A.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. (4-ESS2-1),(4-ESS2-2) 4.OA.A.1 Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-2)	

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Identify evidence from patterns in rock formations to explain changes in landscapes over time.

	● Make observations and/or measurements to provide evidence of weathering and erosion. ● Analyze and interpret data from maps to describe patterns in Earth's features. ● Generate and compare multiple solutions to reduce impacts of earthquakes, floods, tsunamis, and/or volcanic eruptions.
	OTHER EVIDENCE: ● Inquiry ● Teacher Observations ● Classroom Discussions

<u>Title of Curriculum</u>: Grade 5 Science: Structure and Properties of Matter

Unit Name	What	Why	How
Title: • **Matter**	• Matter of any type can be subdivided into particles that are too small to see. • The weight of matter is conserved when it changes form. • Identify materials based on their properties. • When substances are mixed, a new substance with different properties may be formed.	• To identify that objects exist from very small to immensely large. • To distinguish that standard units are used to measure and describe physical properties. • To recognize there are consistent patterns in natural systems. • To identify, test, and explain cause and effect relationships	• Students will develop a model • Students will measure and graph quantities • Students will make observations and measurements • Students will conduct an investigation

Windham School District Curriculum Template

Structure and Properties of Matter - Grade 5

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students will use the NGSS science and engineering practices to develop and use models, plan and carry out investigations, and use mathematics and computational thinking to demonstrate understanding of the structure and properties of matter.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Develop a model to describe that matter is made of particles too small to be seen.
● Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
● Make observations and measurements to identify materials based on their properties.
● Conduct an investigation to determine whether the mixing of two or more substances results in new substances.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…

Cause and Effect</td><td>ESSENTIAL QUESTIONS
● What is the structure of matter?
● When matter changes, does its weight change?
● What are the properties of matter?
● Does mixing two or more substances result in a new substance?</td></tr>
</table>

Content Standards:		
• PS1-1 • -PS1-2 • -PS1-3 • -PS1-4 • -5ETS1-1 • -5ETS1-2 • -5ETS1-3	• Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS1-4) • **Scale, Proportion, and Quantity** • Natural objects exist from the very small to the immensely large. (5-PS1-1) • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2), (5-PS1-3) • **Scientific Knowledge Assumes Order and Consistency in Natural Systems** • Science assumes consistent patterns in natural systems.(5-PS1-2)	
	Acquisition	
	Students will know…	*Students will be skilled at…*

	PS1.A: Structure and Properties of Matter • Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. • Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale	Developing and Using Models • Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use models to describe phenomena. (5-PS1-1) Planning and Carrying Out Investigations • Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in • one to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity.which variables are controlled and the number of trials considered. (5-PS1-4) • Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3) Using Mathematics and Computational Thinking • Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)

	mechanism of evaporation and condensation.) **PS1.B: Chemical Reactions:** • No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) • When two or more different substances are mixed, a new substance with different properties may be formed.	

Used in Content Area Standards	***21st Century Skills***
ELA/Literacy **RI.5.7** **W.5.7** **W.5.8** **W.5.9** Mathematics- **MP.2**	*Students will use:* • One to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity.

MP.4 **MP.5** **5.NBT.A.1** **5.NF.B.7** **5.MD.A.1** **5.MD.C.3** **5.MD.C.4**	

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop a model to explain matter is made of particles ● Measure and graph quantities to show matter is conserved ● Make observations and measurements to identify materials ● Conduct an investigation to observe the mixing of substances
	OTHER EVIDENCE: ● SAS ● Unit Assessment(s) ● Inquiry Activities ● Teacher observations ● Classroom discussions ● Small group work/projects

<u>Title of Curriculum</u>: Grade 5: Matter and Energy in Organisms and Ecosystems

Unit Name	What	Why	How
Title: • **Ecosystems**	• Energy in animals' food was once energy from the sun. • Plants get the materials they need for growth chiefly from air and water. • Matter moves between plants, animals, decomposers, and the environment.	• To understand that energy can be transferred in various ways and between objects • To argue that matter is transported into, out of, and within systems. • To describe a system in terms of its components and their interactions.	• Students will use models • Students will support arguments • Students will develop models

Windham School District Curriculum Template

Matter and Energy in Organisms and Ecosystems - Grade 5

Stage 1 Desired Results		
ESTABLISHED GOALS:	***Transfer***	
	Students will be able to: ● **Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.** ● **Support an argument that plants get the materials they need for growth chiefly from air and water.** ● **Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.**	
	Meaning	
Content Standards:	ENDURING UNDERSTANDINGS *Students will understand that…* **Systems and System Models** ● A system can be described in terms of its components and their interactions. (5-LS2-1)	ESSENTIAL QUESTIONS ● *How does matter cycle through ecosystems?* ● *Where does energy and food come from and what is it used for?*

• **-PS3-1** • **-LS1-1** • **-LS2-1**	**Energy and Matter** • Matter is transported into, out of, and within systems. (5-LS1-1) • Energy can be transferred in various ways and between objects. (5-PS3-1)	
	Acquisition	
	Students will know… • **PS3.D: Energy in Chemical Processes and Everyday Life** • The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1) **LS1.C: Organization for Matter and Energy Flow in Organisms** • Food provides animals with the materials they need for body repair and growth and the	*Students will be skilled at…* **Developing and Using Models** • Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use models to describe phenomena. (5-PS3-1) • Develop a model to describe phenomena. (5-LS2-1) **Engaging in Argument from Evidence** • Engaging in argument from evidence in 3–5 builds on K– 2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

	energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1) (5-LS1-1) **Plants acquire their material for growth chiefly from air and water.** **LS2.A: Interdependent Relationships in Ecosystems** ● The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to	● Support an argument with evidence, data, or a model. (5-LS1-1)

	meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1) ◦ **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** ● Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)	

Used in Content Area Standards	***21st Century Skills***
ELA/Literacy- **RI.5.1** **RI.5.7** **RI.5.9** **W.5.1** **SL.5.5**	*Students will use:* ● One to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity.

Mathematics- **MP.2** **MP.4** **MP.5** **5.MD.A.1**	

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use models to represent the flow of energy ● Support an argument on plant needs ● Develop a model to describe the movement of matter
	OTHER EVIDENCE: ● Teacher observations ● Classroom discussions ● Small group work/projects ● SAS ● Unit Assessment(s) ● Inquiry Activities

Title of Curriculum: **Grade 5: Earth's Systems**

Unit Name	What	Why	How
Title: • **Earth's Systems**	• Describe ways the geosphere, biosphere, geosphere, and/or atmosphere interact. • Provide evidence about the distribution of water on Earth. • Human impacts on Earth systems.	• To describe a system in terms of its components and their interactions. • To measure and describe physical quantities. • To make a connection that science questions can be answered with evidence.	• Students will develop a model • Students will describe and graph water distribution • Students will obtain and combine information

Windham School District Curriculum Template

Earth’s Systems - Grade 5

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Students will use the NGSS science and engineering practices to develop and use models, use mathematics and computational thinking, and obtain, evaluate, and communicate information to demonstrate understanding of earth’s systems.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
● Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
● Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand that…

Scale, Proportion, and Quantity
● Standard units are used to measure and describe physical</td><td>ESSENTIAL QUESTIONS

● How much water can be found in different places on Earth?
● How do the geosphere, biosphere, hydrosphere, and atmosphere interact?</td></tr>
</table>

Content Standards:		
• -ESS2-1 • -ESS2-1 • -ESS3-1 • 3-5ETS1-1 • 3-5ETS1-2 • 3-5ETS1-3	quantities such as weight, and volume. (5-ESS2-2) **Systems and System Models** • A system can be described in terms of its components and their interactions. (5-ESS2-1), (5-ESS3-1) **Science Addresses Questions About the Natural and Material World** • Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)	• How can the Earth's resources and environment be protected?
	Acquisition	
	• *Students will know…* **ESS2.A: Earth Materials and Systems** • Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple	*Students will be skilled at…* **Developing and Using Models** • Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model using an example to describe a scientific principle. (5-ESS2-1) **Using Mathematics and Computational Thinking**

	ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1) **ESS2.C: The Roles of Water in Earth's Surface Processes** • Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5- ESS2-2) **ESS3.C: Human Impacts on Earth Systems** • Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect	• Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2) **Obtaining, Evaluating, and Communicating Information** • Obtaining, evaluating, and communicating information in 3– 5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)

	Earth's resources and environments. (5-ESS3-1)	

Used in Content Area Standards	***21st Century Skills***
ELA/Literacy- **RI.5.1** **RI.5.7** **RI.5.9** **W.5.8** **W.5.9** **SL.5.5** *Mathematics-* **MP.2** **MP.4** **5.G.2**	*Students will use:* • One to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity.

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT:

	• Develop a model to explain interactions of hydrosphere, atmosphere, geosphere and biosphere. • Measure and graph quantities to show amounts of water on Earth • Research how communities use scientific information to conserve Earth's resources
	OTHER EVIDENCE: • SAS • Unit Assessment(s) • Inquiry Activities • Teacher observations • Classroom discussions • Small group work/projects

<u>Title of Curriculum</u>: Grade 5: Space Systems: Stars and the Solar System

Unit Name	What	Why	How
Title: ● **Space Systems: Stars and the Solar System**	● Gravitational force exerted by Earth on objects is directed down. ● Apparent brightness of the sun compared to other stars is due to their relative distances from Earth. ● Reveal patterns of daily changes in length and direction of shadows. ● Reveal patterns of day and night ● Reveal patterns of the seasonal appearance of some stars in the sky.	● To identify and explain change using cause and effect relationships. ● To recognize that natural objects exist from the very small to the immensely large. ● To sort, classify, communicate and analyze simple rates of change for natural phenomena using similarities and differences in patterns.	● Students will support an argument ● Students will represent data in graphical displays

Windham School District Curriculum Template

Space Systems: Stars and the Solar System - Grade 5

Stage 1 Desired Results

<table>
<tr>
<td rowspan="4">
ESTABLISHED GOALS:

Students will use the NGSS science and engineering practices to analyze and interpret data and engage in argument from evidence to demonstrate understanding of stars and the solar system.

Content Standards:

PS2-1
5-ESS1-1
5-ESS1-2

</td>
<td colspan="2">Transfer</td>
</tr>
<tr>
<td colspan="2">
Students will be able to:

Support an argument that the gravitational force exerted by Earth on objects is directed down.
Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.
Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

</td>
</tr>
<tr>
<td colspan="2">Meaning</td>
</tr>
<tr>
<td>
ENDURING UNDERSTANDINGS

Students will understand that…

Patterns

Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change

</td>
<td>
ESSENTIAL QUESTIONS

How do lengths and directions of shadows change from day to day?
How do relative lengths of day and night change throughout the year?
How does the appearance of some stars change in different seasons?

</td>
</tr>
</table>

	for natural phenomena. (5-ESS1-2) **Cause and Effect** ● Cause and effect relationships are routinely identified and used to explain change. (5-PS2-1) **Scale, Proportion, and Quantity** ● Natural objects exist from the very small to the immensely large. (5-ESS1-1)	
	Acquisition	
	Students will know… **PS2.B: Types of Interactions** ● The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5-PS2-1) **ESS1.A: The Universe and its Stars** ● The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in	*Students will be skilled at…* **Developing and Using Models** ● Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ● Use models to describe phenomena. (5-PS3-1) ● Develop a model to describe phenomena. (5-LS2-1) **Engaging in Argument from Evidence** ● Engaging in argument from evidence in 3–5 builds on K– 2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

	their distance from Earth. (5-ESS1-1) **ESS1.B: Earth and the Solar System** ● The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)	● Support an argument with evidence, data, or a model. (5-LS1-1)

Used in Content Area Standards	***21st Century Skills***
ELA/Literacy **RI.5.1** **RI.5.7** **RI.5.8** **R.I.5.9**	*Students will use:* ● One to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity.

W.5.1 **S.L.5.5.** *Mathematics* **MP.2** **MP.4** **5.NBT.A.2** **5.G.A.2**	

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Support an argument on gravitational force ● Support an argument comparing sun brightness to other stars ● Represent data on the changes of shadow length and seasonal appearance of stars
	OTHER EVIDENCE: ● Teacher observations ● Classroom discussions ● Small group work/projects ● Individual work/projects ● SAS ● Unit Assessment (s) ● Inquiry Activities

Title of Curriculum: **Grade 6: Earth/Space Science Earth's Place in the Universe**

Unit Name	What (DCI)	Why (CC)	How (perf exp.)
Title: ● **Earth's Place in the Universe**	**The Universe and Its Stars** ● Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. ● Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. **Earth and the Solar System** ● The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. ● This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.	● **Developing and Using Models** to develop, use, and revise models to describe, test, and predict more abstract phenomena and design systems. ● **Analyzing and Interpreting Data** to extend quantitative analysis to investigations, distinguish between correlation and causation, and basic statistical techniques of data and error analysis. ● **Constructing Explanations and Designing Solutions** to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific	● Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. ● Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. ● Analyze and interpret data to determine scale properties of objects in the solar system. ● Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

	• The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. **The History of Planet Earth** • The geologic time scale interpreted from rock strata provides a way to organize Earth's history . Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.	ideas, principles, and theories.	

Windham School District Science Curriculum

Content Topic: Earth's Place in the Universe - Grade 6

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students examine the Earth's place in relation to the solar system, Milky Way galaxy, and universe. There is a strong emphasis on a systems approach, and a strong connection to engineering through the instruments and technologies that have allowed us to explore the objects in our solar system and obtain the data that support the theories that explain the formation and evolution of the universe.

Content Standards:

Earth's Place in the Universe
MS-ESS1-1
MS-ESS1-2
MS-ESS1-3
MS-ESS1-4
MS-ETS1-1</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
Analyze and interpret data to determine scale properties of objects in the solar system.
Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand…
Patterns

Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1)</td><td>ESSENTIAL QUESTIONS

"What is Earth's place in the Universe?"
"What makes up our solar system and how can the motion of Earth explain seasons and eclipses?"</td></tr>
</table>

• MS-ETS1-2 • MS-ETS1-3 • MS-ETS1-4	• **Scale, Proportion, and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3),(MS-ESS1-4) • **Systems and System Models** Models can be used to represent systems and their interactions. (MS-ESS1-2)	• "How do people figure out that the Earth and life on Earth have changed through time?"
	Acquisition	
	Students will know… **ESS1.A: The Universe and Its Stars** • Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) • Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) **ESS1.B: Earth and the Solar System** • The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held	*Students will be skilled at…* • **Developing and Using Models** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2) **Analyzing and Interpreting Data** • Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations,

	in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3) ● This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.(MS-ESS1-1) ● The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2) ESS1.C: The History of Planet Earth The geologic time scale interpreted from rock strata provides a way to organize Earth's history . Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1- 4)	distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ● Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3) **Constructing Explanations and Designing Solutions** ● Constructing explanations and designing solutions in 6– 8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ● Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4)
Used in Content Area Standards		***21st Century Skills***

not applicable	● One to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity. ● Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-ESS1-3)

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop a model to explain the Earth-Moon-Sun system ● Use a model to describe the role of gravity in the motion of objects in the Universe ● Construct a scientific explanation based on evidence of the Earth's History ● Analyze and interpret data to determine scale properties of the Solar System
	OTHER EVIDENCE MAY INCLUDE: ● Labs ● Interactive online tools

Title of Curriculum: **Grade 6: Earth/Space Science Earth's Systems**

Unit Name	What (DCI)	Why (CC)	How (perf exp.)
Title: ● **Earth's Systems**	**The History of Planet Earth** ● Tectonic processes continually generate new ocean seafloor at ridges and destroy old seafloor at trenches. **Earth's Materials and Systems** ● All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. ● The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of	● **Developing and Using Models** to develop, use, and revise models to describe, test, and predict more abstract phenomena and design systems. ● **Planning and Carrying Out Investigations** to include investigations that use multiple variables and provide evidence to support explanations or solutions. ● **Analyzing and Interpreting Data** to extend quantitative analysis to investigations, distinguish between correlation and causation, and basic statistical techniques of data and error analysis. ● **Constructing Explanations and Designing Solutions** to include constructing explanations and designing solutions supported by multiple sources of evidence consistent	● Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. ● Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. ● Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions ● Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity ● Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions ● Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates

	a second to billions of years. These interactions have shaped Earth's history and will determine its future. **Plate Tectonics and Large-Scale System Interactions** ● Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. **The Roles of Water in Earth's Surface Processes** ● Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. ● The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and	with scientific ideas, principles, and theories.	

	ocean temperatures and currents, are major determinants of local weather patterns. ● Global movements of water and its changes in form are propelled by sunlight and gravity. ● Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. ● Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. **Weather and Climate** ● Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of		

	which can affect oceanic and atmospheric flow patterns. • Because these patterns are so complex, weather can only be predicted probabilistically. • The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.		

Windham School District Science Curriculum

Content Topic: Earth's Systems - Grade 6

<table>
<tr><th colspan="2">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">ESTABLISHED GOALS:

Students understand how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems.

Students investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data. Students develop understanding of the factors that control weather.

Content Standards:

Earth's Systems

• MS-ESS2-1</td><td>Transfer</td></tr>
<tr><td>Students will be able to

● Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
● Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
● Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions
● Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity
● Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions
● Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates</td></tr>
<tr><td>Meaning</td></tr>
</table>

• MS-ESS2-2 • MS-ESS2-3 • MS-ESS2-4 • MS-ESS2-5 • MS-ESS2-6 • MS-ETS1-1 • MS-ETS1-2 • MS-ETS1-3 • MS-ETS1-4	ENDURING UNDERSTANDINGS • **Patterns** Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3) • **Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5) • **Scale, Proportion, and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2- 2) **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs— and energy, matter, and information flows within systems. (MS-ESS2-6) **Energy and Matter**	ESSENTIAL QUESTIONS *Students will understand…* • "How do the materials in and on Earth's crust change over time?" • "How does the movement of tectonic plates impact the surface of Earth?" • "How does water influence weather, circulate in the oceans, and shape Earth's surface?" • "What factors interact and influence weather?" • "How have living organisms changed the Earth?" • "How have Earth's changing conditions impacted living organisms?"

	• Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4) **Stability and Change** • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)	
	Acquisition	
	Students will know… **ESS1.C: The History of Planet Earth** Tectonic processes continually generate new ocean seafloor at ridges and destroy old seafloor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3) **ESS2.A: Earth's Materials and Systems** • All Earth processes are the result of energy flowing and matter cycling within and among the planet's	*Students will be skilled at…* **Developing and Using Models** • Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-ESS2-1),(MS-ESS2-6)

	systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1) ● The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** ● Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3) **ESS2.C: The Roles of Water in Earth's Surface Processes**	● Develop a model to describe unobservable mechanisms. (MS-ESS2-4) **Planning and Carrying Out Investigations** Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. ● Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5) **Analyzing and Interpreting Data** ● Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic

	• Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5) • Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) • Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)	statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3) **Constructing Explanations and Designing Solutions** • Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. (MS-ESS2-2)

	ESS2.D: Weather and Climate ● Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) ● Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) ● The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)	

Used in Content Area Standards	***21st Century Skills***
	● One to one technology, employing 21st century skills of collaboration,

not applicable	communication, critical thinking and creativity.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. ● Construct an explanation based on evidence for how geoscience processes have changed Earth's surface. ● Analyze and interpret data to provide evidence of the past plate motions ● Develop a model to describe the cycling of water through Earth's systems ● Collect data to provide evidence for how the complex interactions of air masses results in changes in weather conditions ● Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates
	OTHER EVIDENCE MAY INCLUDE: ● Labs ● Interactive online tools

<u>Title of Curriculum</u>: Grade 6: Earth/Space Science

Unit Name	What (DCI)	Why (CC)	How (perf exp.)
Title: • **Earth and Human Activity**	**Natural Resources** • Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. **Natural Hazards** • Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.	• **Asking Questions and Defining Problems** to specify relationships between variables, and clarifying arguments and models. • **Analyzing and Interpreting Data** in 6–8 builds on K–5 and progresses to extend quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • **Constructing Explanations and Designing Solutions** to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • **Engaging in Argument from Evidence** to construct a convincing argument that supports or refutes claims for	• Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. • Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. • Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. • Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. • Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

	Human Impacts on Earth Systems ● Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. ▪ Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **Global Climate Change** ● Human activities, such as the release of greenhouse gases from burning fossil fuels, are	either explanations or solutions about the natural and designed world(s).	

	major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.		

Windham School District Science Curriculum

Content Topic: Earth/Space Science - Grade 6

<table>
<tr><th colspan="2">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students understand the ways that human activities impacts Earth's other systems. Students use many different practices to understand the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts of their development.</td><td>Transfer</td></tr>
<tr><td>Students will be able to
● Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
● Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
● Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
● Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
● Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.</td></tr>
<tr><td>Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand… | ESSENTIAL QUESTIONS</td></tr>
</table>

<table>
<tr>
<td rowspan="3">Content Standards:

Earth and Human Activity

● MS-ESS3-1
● MS-ESS3-2
● MS-ESS3-3
● MS-ESS3-4
● MS-ESS3-5</td>
<td>Patterns

● Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)

Cause and Effect

● Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)

Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3- 1),(MS-ESS3-4)

Stability and Change

● Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)</td>
<td>● “How is the availability of needed natural resources related to naturally occurring processes?”

● “How can natural hazards be predicted?”

● “How do human activities affect Earth systems”

● “How do we know our global climate is changing?”</td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…

ESS3.A: Natural Resources

● Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water,</td>
<td>Students will be skilled at…

Asking Questions and Defining Problems

● Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying</td>
</tr>
</table>

	and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1) **ESS3.B: Natural Hazards** ● Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2) **ESS3.C: Human Impacts on Earth Systems** ● Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) ● Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4)	relationships between variables, and clarifying arguments and models. ● Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5) **Analyzing and Interpreting Data** ● Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ● Analyze and interpret data to determine similarities and differences in findings. (MS-ESS3-2) **Constructing Explanations and Designing Solutions** ● Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ● Construct a scientific explanation based on valid and reliable evidence obtained

	ESS3.D: Global Climate Change ● Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)	from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1) ● Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3) **Engaging in Argument from Evidence** ● Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). ● Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-ESS3-4)

Used in Content Area Standards	*21st Century Skills*
not applicable	- one to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity. - All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1),(MS-ESS3-4) - The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2),(MS-ESS3-3)

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT:

	● Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. ● Analyze and interpret data on natural hazards to forecast future catastrophic events. ● Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. ● Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. ● Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
	OTHER EVIDENCE MAY INCLUDE: ● Labs ● Interactive online tools

Windham School District Science Curriculum

Content Topic: Earth/Space Science - Grade 6

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students examine the Earth's place in relation to the solar system, Milky Way galaxy, and universe. There is a strong emphasis on a systems approach, and a strong connection to engineering through the instruments and technologies that have allowed us to explore the objects in our solar system and obtain the data that support the theories that explain the formation and evolution of the universe.

Content Standards:

Earth's Place in the Universe
● MS-ESS1-1
● MS-ESS1-2
● MS-ESS1-3
● MS-ESS1-4</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
● Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
● Analyze and interpret data to determine scale properties of objects in the solar system.
● Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand…

Patterns</td><td>ESSENTIAL QUESTIONS
● "What is Earth's place in the Universe?"</td></tr>
</table>

• MS-ETS1-3 • MS-ETS1-4	• Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1) **Scale, Proportion, and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3),(MS-ESS1-4) **Systems and System Models** • Models can be used to represent systems and their interactions. (MS-ESS1-2)	• "What makes up our solar system and how can the motion of Earth explain seasons and eclipses?" • "How do people figure out that the Earth and life on Earth have changed through time?"
	Acquisition	
	Students will know… **ESS1.A: The Universe and Its Stars** • Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) • Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) **ESS1.B: Earth and the Solar System**	*Students will be skilled at…* **Developing and Using Models** • Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2) **Analyzing and Interpreting Data**

	● The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3) ● This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.(MS-ESS1-1) ● The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2) ESS1.C: The History of Planet Earth The geologic time scale interpreted from rock strata provides a way to organize Earth's history . Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1- 4)	● Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ● Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3) **Constructing Explanations and Designing Solutions** ● Constructing explanations and designing solutions in 6– 8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ● Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4)

Used in Content Area Standards	*21st Century Skills*
not applicable	• One to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity. • Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-ESS1-3)

Stage 2 - Evidence

Evaluative Criteria	*Assessment Evidence*
	ASSESSMENT: • Develop a model to explain the Earth-Moon-Sun system • Use a model to describe the role of gravity in the motion of objects in the Universe • Construct a scientific explanation based on evidence of the Earth's History • Analyze and interpret data to determine scale properties of the Solar System
	OTHER EVIDENCE MAY INCLUDE:

	• Labs • Interactive online tools

Windham School District Science Curriculum

Content Topic: Earth/Space Science - Grade 6

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">ESTABLISHED GOALS:

Students understand how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems.

Students investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data. Students develop understanding of the factors that control weather.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

● Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
● Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
● Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions
● Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity
● Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions
● Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>Content Standards:

Earth's Systems

• MS-ESS2-1
• MS-ESS2-2
• MS-ESS2-3</td><td>ENDURING UNDERSTANDINGS

Patterns

● Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3)</td><td>ESSENTIAL QUESTIONS

Students will understand…

● "How do the materials in and on Earth's crust change over time?"
● "How does the movement of tectonic plates impact the surface of Earth?"</td></tr>
</table>

• MS-ESS2-4
• MS-ESS2-5
• MS-ESS2-6
  ● MS-ETS1-3
  ● MS-ETS1-4
	Cause and Effect
	● Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5)
	Scale, Proportion, and Quantity
	● Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2- 2)
	Systems and System Models
	● Models can be used to represent systems and their interactions—such as inputs, processes and outputs— and energy, matter, and information flows within systems. (MS-ESS2-6)
	Energy and Matter
	● Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)
	Stability and Change
	● Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)
		● "How does water influence weather, circulate in the oceans, and shape Earth's surface?"
		● "What factors interact and influence weather?"
		● "How have living organisms changed the Earth?"
		● "How have Earth's changing conditions impacted living organisms?"

	Acquisition	

	Students will know… **ESS1.C: The History of Planet Earth** ● Tectonic processes continually generate new ocean seafloor at ridges and destroy old seafloor at trenches. (HS.ESS1.C GBE) (secondary to MS-ESS2-3) **ESS2.A: Earth's Materials and Systems** ● All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1) ● The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** ● Maps of ancient land and water patterns, based on investigations of	*Students will be skilled at…* **Developing and Using Models** ● Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ● Develop and use a model to describe phenomena. (MS-ESS2-1),(MS-ESS2-6) ● Develop a model to describe unobservable mechanisms. (MS-ESS2-4) **Planning and Carrying Out Investigations** ● Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. ● Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5) **Analyzing and Interpreting Data**

	rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3) **ESS2.C: The Roles of Water in Earth's Surface Processes** ● Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5) ● Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) ● Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) ● Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)	● Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ● Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3) **Constructing Explanations and Designing Solutions** ● Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ● Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. (MS-ESS2-2)

	ESS2.D: Weather and Climate ● Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) ● Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) ● The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)	
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity.

<table>
<tr><th colspan="2">Stage 2 - Evidence</th></tr>
<tr><td>Evaluative Criteria</td><td>Assessment Evidence</td></tr>
<tr><td></td><td>ASSESSMENT:
Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process.
Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface.
Analyze and interpret data to provide evidence of the past plate motions
Develop a model to describe the cycling of water through Earth’s systems
Collect data to provide evidence for how the complex interactions of air masses results in changes in weather conditions
Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates</td></tr>
<tr><td></td><td>OTHER EVIDENCE MAY INCLUDE:
Labs
Interactive online tools</td></tr>
</table>

Windham School District Science Curriculum

Content Topic: Earth/Space Science - Grade 6

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students understand the ways that human activities impacts Earth’s other systems. Students use many different practices to understand the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts of their development.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Construct a scientific explanation based on evidence for how the uneven distributions of Earth’s mineral, energy, and groundwater resources are the result of past and current geoscience processes.
Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems.
Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand…</td><td>ESSENTIAL QUESTIONS</td></tr>
</table>

<table>
<tr>
<td rowspan="3">Content Standards:

Earth and Human Activity
MS-ESS3-1
MS-ESS3-2
MS-ESS3-3
MS-ESS3-4
MS-ESS3-5</td>
<td>Patterns
Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)
Cause and Effect
Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3- 1),(MS-ESS3-4)
Stability and Change
Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)</td>
<td>“How is the availability of needed natural resources related to naturally occurring processes?”
“How can natural hazards be predicted?”
“How do human activities affect Earth systems”
“How do we know our global climate is changing?”</td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…

ESS3.A: Natural Resources
Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water,</td>
<td>Students will be skilled at…

Asking Questions and Defining Problem
Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying</td>
</tr>
</table>

	and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1) **ESS3.B: Natural Hazards** ● Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2) **ESS3.C: Human Impacts on Earth Systems** ● Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) ● Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4)	relationships between variables, and clarifying arguments and models. ● Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5) **Analyzing and Interpreting Data** ● Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ● Analyze and interpret data to determine similarities and differences in findings. (MS-ESS3-2) **Constructing Explanations and Designing Solutions** ● Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ● Construct a scientific explanation based on valid and reliable evidence obtained

	ESS3.D: Global Climate Change ● Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)	from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1) ● Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3) **Engaging in Argument from Evidence** ● Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). ● Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-ESS3-4)
Used in Content Area Standards		***21st Century Skills***
		● one to one technology, employing 21st century skills of collaboration,

not applicable	communication, critical thinking and creativity. ● All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1),(MS-ESS3-4) ● The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2),(MS-ESS3-3)

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. ● Analyze and interpret data on natural hazards to forecast future catastrophic events.

	● Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. ● Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. ● Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
	OTHER EVIDENCE MAY INCLUDE: ● Labs ● Interactive online tools

Title of Curriculum: Grade 7: Life Science

Unit Name	What	Why	How
From Molecules to Organisms: Structures and Processes **Material is covered throughout the following units:** • **Living Things** • **Natural Selection/ Evolution** • **Cell Structure** • **Cell Processes** • **Human Body**	***Structure and Function*** • All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). • Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.	• Cause and effect relationships may be used to predict phenomena in natural systems. • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. • Phenomena that can be observed at one scale may not be observable at another scale. • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. • Matter is conserved because atoms are conserved in physical and chemical processes. • Within a natural system, the transfer of energy drives the motion and/or cycling of matter. • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural	• Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. • Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function. • Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. • Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. • Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. • Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. • Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support

	Growth and Development of Organisms ● Animals engage in characteristic behaviors that increase the odds of reproduction. ● Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. ● Genetic factors as well as local conditions affect the growth of the adult plant. **Organization for Matter and Energy Flow in Organisms** ● Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.	structures/systems can be analyzed to determine how they function.	growth and/or release energy as this matter moves through an organism. ● Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

	• Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. **Information Processing** • Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. **Energy in Chemical Processes and Everyday Life** • The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide		

	and water combine to form carbon-based organic molecules and release oxygen. • Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.		

Windham School District Curriculum Template

Content Topic: Life Science - Grade 7

Stage 1 Desired Results	
ESTABLISHED GOALS: Students can gather information and use this information to support explanations of the structure and function relationship of cells. They can communicate understanding of cell theory. They have a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organism. The understanding of cells provides a context for the plant process of photosynthesis and the movement of matter and energy needed for the cell. Students can construct an explanation for how environmental and genetic factors affect growth of organisms. They can connect this to the role of animal behaviors in reproduction of animals as well as the dependence of some plants on animal behaviors for their reproduction.	***Transfer*** *Students will be able to :* ● *Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.* ● *Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function.* ● *Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.* ● *Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.* ● *Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.* ● *Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.*

<table>
<tr>
<td rowspan="3">

Competencies (Standards?):

Content Standards: (ngss.nsta.org)

From Molecules to Organisms: Structures and Processes

- MS-LS1-1
- MS-LS1-2
- MS-LS1-3
- MS-LS1-4
- MS-LS1-5
- MS-LS1-6
- MS-LS1-7
- MS-LS1-8

</td>
<td colspan="2">

- *Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.*
- *Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.*

</td>
</tr>
<tr>
<td colspan="2">

Meaning

</td>
</tr>
<tr>
<td>

ENDURING UNDERSTANDINGS

Students will understand …

- Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8)
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4), (MS-LS1-5)
- Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1)
- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3)

</td>
<td>

ESSENTIAL QUESTIONS

- How can one explain the ways cells contribute to the function of living organisms.
- How do environmental and genetic factors influence the growth of organisms?
- How do matter and energy cycle into and out of organisms?
- What is the (significance) importance of the characteristics that are common to all living things?

</td>
</tr>
</table>

	• Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7) • Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6) • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-2)	
	Acquisition	
	Students will know… **LS1.A: Structure and Function** • All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)	Students will be skilled at… **Developing and Using Models** • Develop and use a model to describe phenomena.(MS-LS1-2) • Develop a model to describe unobservable mechanisms. (MS-LS1-7)

	• Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2) • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3) **LS1.B: Growth and Development of Organisms** • Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4) • Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4) • Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5) **LS1.C: Organization for Matter and Energy Flow in Organisms**	**Planning and Carrying Out Investigations** • Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1) **Constructing Explanations and Designing Solutions** • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-5),(MS-LS1-6) **Engaging in Argument from Evidence** • Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3) • Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a

	• Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6) • Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7) **LS1.D: Information Processing** • Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8) **PS3.D: Energy in Chemical Processes and Everyday Life** • The chemical reaction by which plants produce complex food molecules (sugars)	phenomenon or a solution to a problem. (MS-LS1-4) **Obtaining, Evaluating, and Communicating information** • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS1-8)

	requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6) ● Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)	
Used in Content Area Standards		***21st Century Skills***
not applicable		● *one to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity.* ● Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1) ● Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3)

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Conduct an investigation to provide evidence that living things are made of cells. ● Develop and use a model to describe the structure and function of a cell as a whole. ● Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. ● Use argument and scientific reasoning to explain how characteristic animal behaviors and specialized plant structures increase the probability of successful reproduction. ● Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. ● Construct a scientific explanation for the role of photosynthesis in the cycling of matter and flow of energy. ● Develop a model to describe how food is rearranged through chemical reactions. ● Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain.
	OTHER EVIDENCE: ***Activities may include:*** ● Labs ● Interactive/online simulations ● Discussion ● Projects

Title of Curriculum: Grade 7: Ecosystems: Interactions, Energy, and Dynamics

Unit Name	What	Why	How
Ecosystems: Interactions, Energy, and Dynamics **Material is covered throughout the following units:** • **Ecosystems** • **Natural Selection**	**Interdependent Relationships in Ecosystems** • Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. • Growth of organisms and population increases are limited by access to resources. • Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in	• Patterns can be used to identify cause and effect relationships. • Cause and effect relationships may be used to predict phenomena in natural or designed systems. • The transfer of energy can be tracked as energy flows through a natural system. • Small changes in one part of a system might cause large changes in another part. • The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. • Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.	• Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. • Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. • Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. • Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. • Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

	contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. **Cycle of Matter and Energy Transfer in Ecosystems** ● Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms	● Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.	

	that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. **Ecosystem Dynamics, Functioning, and Resilience** ● Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. ● Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. **Biodiversity and Humans** ● Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on — for example, water purification and recycling.		

	Developing Possible Solutions ● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.		

Windham School District Curriculum Template

Content Topic: Life Science - Grade 7

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Students can analyze and interpret data, develop models, and construct arguments and demonstrate a deeper understanding of resources and the cycling of matter and the flow of energy in ecosystems. They can also study patterns of the interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on population. They evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Competencies (Standards?):

Content Standards:

Ecosystems: Interactions, Energy, and Dynamics

● MS-LS2-1
● MS-LS2-2
● MS-LS2-3</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

● Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
● Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
● Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
● Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
● Evaluate competing design solutions for maintaining biodiversity and ecosystem services.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand …</td><td>ESSENTIAL QUESTIONS</td></tr>
</table>

• MS-LS2-4 • MS-LS2-5 • MS-ETS1-1 • MS-ETS1-2 • MS-ETS1-3 • MS-ETS1-4	• Patterns can be used to identify cause and effect relationships. (MS-LS2-2) • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1) • The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3) • Small changes in one part of a system might cause large changes in another part. (MS- LS2-4), (MS-LS2-5) • The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-LS2-5) • Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through	• How does a system of living and non-living things operate to meet the needs of the organisms in an ecosystem? • How do organisms interact with each other within and across multiple ecosystems? • How do changes to physical or biological components of an ecosystem affect populations of organisms? • How can humans help maintain the biodiversity of ecosystems?

	measurement and observation. (MS-LS2-3) ● Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)	
	Acquisition	
	Students will know… **LS2.A: Interdependent Relationships in Ecosystems** ● Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) ● In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) ● Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)	*Students will be skilled at…* **Developing and Using Models** ● Develop a model to describe phenomena. (MS-LS2-3) **Analyzing and Interpreting Data** ● Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1) **Constructing Explanations and Designing Solutions** ● Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2) **Engaging in Argument from Evidence**

	• Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2) **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** • Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and	• Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4) • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)

	nonliving parts of the ecosystem. (MS-LS2-3) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** ● Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4) ● Biodiversity describes the variety of species found in Earth’s terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem’s biodiversity is often used as a measure of its health. (MS-LS2-5) **LS4.D: Biodiversity and Humans** ● Changes in biodiversity can influence humans’ resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on — for example, water purification and recycling. (secondary to MS-LS2-5) **ETS1.B: Developing Possible Solutions** ● There are systematic processes for evaluating solutions with respect to how	

	well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)	

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity. ● The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-LS2-5) ● Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3) ● Scientific knowledge can describe the consequences of actions but does not

	necessarily prescribe the decisions that society takes. (MS-LS2-5)

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Analyze and interpret data about the effects of resource availability on organisms and populations of organisms. ● Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. ● Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. ● Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. ● Evaluate competing design solutions for maintaining biodiversity and ecosystem services. ● Research and analyze methods for maintaining biodiversity with an emphasis on scientific, economic, and social considerations
	OTHER EVIDENCE: ***Activities may include:*** ● Labs ● Interactive/online simulations ● Discussion ● Projects ● Field Experience

Title of Curriculum: **Grade 7: Heredity: Inheritance and Variation of Traits Material**

Unit Name	What	Why	How
Heredity: Inheritance and Variation of Traits **Material is covered throughout the following units:** • **Heredity/Genetics** • **Natural Selection** • **Cell Processes**	**Growth and Development of Organisms** • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. **Inheritance of Traits** • Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. • Variations of inherited traits between parent and	• Cause and effect relationships may be used to predict phenomena in natural systems. • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/ systems can be analyzed to determine how they function.	• Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. • Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

	offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. **Variation of Traits** • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. • In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism.		

Windham School District Curriculum Template

Content Topic: Life Science - Grade 7

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students can use models to describe ways gene mutations and sexual reproduction contribute to genetic variation. They will develop a deeper understanding of how gene structure determines differences in the functioning of organisms.

Competencies (Standards?):</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

● Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

● Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand …

● Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

● Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function</td><td>ESSENTIAL QUESTIONS

● How do living organisms pass traits from one generation to the next?

● How does asexual reproduction and sexual reproduction differ in their ability to contribute to the diversity and continuity of life?</td></tr>
</table>

Content Standards: ***Heredity: Inheritance and Variation of Traits*** • MS-LS3-1 • MS-LS3-2 • MS-ETS1-3 • MS-ETS1-4	depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)	
	Acquisition	
	Students will know… **LS1.B: Growth and Development of Organisms** • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MS-LS3-2) **LS3.A: Inheritance of Traits** • Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins,	*Students will be skilled at…* • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)

	which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) ● Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) **LS3.B: Variation of Traits** ● In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) ● In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)	
Used in Content Area Standards		***21st Century Skills***

not applicable	● One to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop and use a model to describe why structural changes to genes (mutations) may affect proteins and may result in harmful, beneficial, or neutral effects to an organism. ● Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
	OTHER EVIDENCE: ***Activities may include:*** ● Labs ● Interactive/online simulations ● Discussion ● Projects

Unit Name	What	Why	How
Biological Evolution: Unity and Diversity **Material is covered throughout the following units:** • **Natural Selection/ Evolution** • **Heredity/Genetics**	**Evidence of Common Ancestry and Diversity** • The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. • Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. • Comparison of the embryological	• Patterns can be used to identify cause and effect relationships. • Graphs, charts, and images can be used to identify patterns in data.	• Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. • Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. • Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. • Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. • Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms.

	development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. **Natural Selection** ● Natural selection leads to the predominance of certain traits in a population, and the suppression of others. ● In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to their offspring. (MS-LS4-5) **Adaptation** ● Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that		● Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

	support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.		

Windham School District Curriculum Template

Content Topic: Life Science - Grade 7

<table>
<tr><th colspan="2">Stage 1 Desired Results</th></tr>
<tr><td rowspan="2">ESTABLISHED GOALS:

Students can construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They can use ideas of genetic variation in a population to make sense of organisms surviving and reproducing, hence passing on the traits of the species. They are able to use fossil records and anatomical similarities of the relationships among organisms and species to support their understanding.

Competencies (Standards?):</td><td>Transfer</td></tr>
<tr><td>Students will be able to
Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.
Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals’ probability of surviving and reproducing in a specific environment.
Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms.</td></tr>
</table>

<table>
<tr><td rowspan="6">Content Standards:

Biological Evolution: Unity and Diversity

MS-LS4-1

MS-LS4-2

MS-LS4-3

MS-LS4-4

MS-LS4-5

MS-LS4-6</td><td colspan="2">Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand …
Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1),(MS-LS4-3)
Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4),(MS-LS4-5),(MS-LS4-6)</td><td>ESSENTIAL QUESTIONS
How do organisms change over time in response to changes in the environment?
What is the value of a classification system in informing our knowledge of evolutionary relationships?
What characteristics do all living things share?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

LS4.A: Evidence of Common Ancestry and Diversity
The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through</td><td>Students will be skilled at…
Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3)
Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1)</td></tr>
</table>

	radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1) ● Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2) ● Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3) **LS4.B: Natural Selection** ● Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4) ● In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes,	● Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6) ● Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) ● Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4) ● Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS4-5)

	which are then passed on to their offspring. (MS-LS4-5) **LS4.C: Adaptation** ● Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology, employing 21st century skills of collaboration, communication, critical thinking and creativity. ● Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire

	industries and engineered systems. (MS-LS4-5)

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth. ● Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and fossil organisms to infer evolutionary relationships. ● Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. ● Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing. ● Research information about technologies that have changed the way humans influence the inheritance of desired traits in organisms. ● Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
	OTHER EVIDENCE: ***Activities may include:*** ● Labs ● Interactive/online simulations ● Discussion ● Projects

Title of Curriculum: **Grade 8 Science: Matter and its Interactions**

Unit Name	What	Why	How
Matter and its Interactions	**Structure and Properties of Matter** • Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely	**Patterns** • Students should be able to identify macroscopic patterns related to the nature of microscopic and atomic-level structure. **Cause and Effect** • Students should be able to identify cause and effect relationships that may be used to predict phenomena in natural or designed systems. **Scale, Proportion, and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. • The transfer of energy can be tracked as energy flows through a designed or natural system.	• Develop models to describe the atomic composition of simple molecules and extended structures. • Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. • Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. • Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. • Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. • Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

	spaced and may vibrate in position but do not change relative locations. ● Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). ● The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. **Chemical Reactions** ● Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. ● The total number of each type of atom is conserved, and thus the mass does not change.	**Structure and Function** ● Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.	

	• Some chemical reactions release energy, others store energy. **Definitions of Energy** • The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MSPS1-4) • The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that		

	relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary to MS-PS1-4) **Developing Possible Solutions** ● A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary to MS-PS1-6) **Optimizing the Design Solution** ● Although one design may not perform the best across all tests, identifying the		

	characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (secondary to MS-PS1-6) ● The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary to MS-PS1-6)		

Windham School District Science Curriculum

Content Topic: Physical Science - Grade 8

<table>
<tr><th colspan="2">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">ESTABLISHED GOALS:

By the end of middle school, students will be able to apply understanding that pure substances have characteristic physical and chemical properties and are made from a single type of atom or molecule. They will be able to provide molecular level accounts to explain states of matters and changes between states, that chemical reactions involve regrouping of atoms to form new substances, and that atoms rearrange during chemical reactions. Students are also able to apply an understanding of the design and the process of optimization in engineering to chemical reaction systems

Competencies (Standards?):</td><td>Transfer</td></tr>
<tr><td>Students will be able to

Develop models to describe the atomic composition of simple molecules and extended structures.
Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
</td></tr>
<tr><td>Meaning</td></tr>
</table>

Content Standards:	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Matter and its Interactions • MS-PS1-1 • MS-PS1-2 • MS-PS1-3 • MS-PS1-4 • MS-PS1-5 • MS-PS1-6 • MS-ETS1-1 • MS-ETS1-2 • MS-ETS1-3 • MS-ETS1-4	*Students will understand…* **Patterns** • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2) **Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4) **Scale, Proportion, and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1) **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5) • The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)	• "How do atomic and molecular interactions explain the properties of matter that we see and feel?

	Structure and Function ● Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3)	
	Acquisition	
	Students will know… **PS1.A: Structure and Properties of Matter** ● Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) ● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2),(MS-PS1-3) ● Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)	*Students will be skilled at…* **Developing and Using Models** ● Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ● Develop a model to predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4) ● Develop a model to describe unobservable mechanisms. (MS-PS1-5) **Analyzing and Interpreting Data** ● Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative

	• In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4) **PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2), (MS-PS1-3), (MS-PS1-5) • The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)	analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2) **Constructing Explanations and Designing Solutions** • Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MSPS1-6) Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.

	• Some chemical reactions release energy, others store energy. (MS-PS1-6) **PS3.A: Definitions of Energy** • The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MS-PS1-4) • The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of	• Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3)

	atoms in the system, and the state of the material. (secondary to MS-PS1-4) **ETS1.B: Developing Possible Solutions** ● A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary to MS-PS1-6) **ETS1.C: Optimizing the Design Solution** ● Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (secondary to MS-PS1-6) ● The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	
Used in Content Area Standards		***21st Century Skills***
not applicable		

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Students will be able to: ● Develop models to describe the atomic composition ● Analyze and interpret data to determine if a chemical reaction has occurred. ● Gather information to describe that synthetic materials come from natural resources and impact society. ● Develop a model that predicts and describes changes when thermal energy is added or removed. ● Develop and use a model to describe how mass is conserved. ● Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
	OTHER EVIDENCE: ● Formatives ● Summatives ● Labs ● Homework

Title of Curriculum: **Grade 8 Science: Motion and Stability: Forces and Interactions**

Unit Name	What	Why	How
Motion and Stability: Forces and Interactions	**Forces and Motion** ● For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). ● The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.	**Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural or designed systems. **Systems and System Models** ● Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. **Stability and Change** ● Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.	● Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. ● Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. ● Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. ● Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. ● Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

	• All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. **Types of Interactions** • Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. • Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have		

	large mass—e.g., Earth and the sun. ● Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).		

Windham School District Science Curriculum

Content Topic: Physical Science - Grade 8

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

By the end of middle school, students will be able to apply Newton’s Third Law of Motion to relate forces to explain the motion of objects. Students also apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while others repel. In particular, students will develop understanding that gravitational interactions are always attractive but that electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Students are also able to apply an engineering practice and concept to solve a problem caused when objects collide.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.
Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.
Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand…</td><td>ESSENTIAL QUESTIONS</td></tr>
</table>

Competencies (Standards?) *Content Standards:* *Forces and Motion:* • *MS-PS2-1* • *MS-PS2-2* • *MS-PS2-3* • *MS-PS2-4* • *MS-PS2-5* • MS-ETS1-1 • MS-ETS1-2 • MS-ETS1-3 • MS-ETS1-4	***Cause and Effect*** • *Cause and effect relationships may be used to predict phenomena in natural or designed systems.* ***Systems and System Models*** • *Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.* ***Stability and Change*** • *Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.*	• "How can one describe physical interactions between objects and within systems of objects?"
	Acquisition	

	Students will know… ***PS2.A: Forces and Motion*** ● For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1) ● The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2) ● All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MSPS2-2) ***PS2.B: Types of Interactions*** ● Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and	*Students will be skilled at…* **Asking Questions and Defining Problems** ● Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. ● Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3) **Planning and Carrying Out Investigations** ● Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. ● Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the

	their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) ● Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4) ● Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)	gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS2-2) ● Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (MS-PS2-5) **Constructing Explanations and Designing Solution** ● Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ● Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1) **Engaging in Argument from Evidence** ● Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.

		• Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)

Used in Content Area Standards	***21st Century Skills***
not applicable	· Influence of Science, Engineering, and Technology on Society and the Natural World • The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1)

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Students will be able to: ● Design a solution involving two colliding objects ● Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. ● Ask questions to determine the factors that affect the strength of electric and magnetic forces. ● Construct and present arguments to support the claim that gravitational interactions are attractive and depend on the masses of the objects. ● Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
	OTHER EVIDENCE: ● Formatives ● Summatives ● Labs ● Homework

Title of Curriculum: **Grade 8 Science: Energy**

Unit Name	What	Why	How
Energy	**Definitions of Energy** ● Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. ● A system of objects may also contain stored (potential) energy, depending on their relative positions. ● Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. **Conservation of Energy and Energy Transfer** ● When the motion energy of an object changes, there is	**Scale, Proportion, and Quantity** ● Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes **Systems and System Models** ● Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. **Energy and Matter** ● Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). ● The transfer of energy can be tracked as energy flows through a designed or natural system.	● Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. ● Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. ● Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. ● Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. ● Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

	inevitably some other change in energy at the same time. ● The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. ● Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **Relationship Between Energy and Forces** ● When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. **Defining and Delimiting and Engineering Problem** ● The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful.		

	Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. **Developing Possible Solutions** ● A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem.		

Windham School District Curriculum Template

Content Topic: Physical Science - Grade 8

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Students develop their understanding of important qualitative ideas about energy including that the interactions of objects can be explained and predicted using the concept of transfer of energy from one object or system of objects to another, and the total change of energy in any system is always equal to the total energy transferred into or out of the system. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students will also come to know the difference between energy and temperature, and begin to develop an understanding of the relationship between force and energy. Students are also able to apply an understanding of design to the process of energy transfer.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
</table>

<table>
<tr>
<td rowspan="3">Competencies (Standards?):

Content Standards:

Energy:

● MS-PS3-1
● MS-PS3-2
● MS-PS3-3
● MS-PS3-4
● MS-PS3-5
● MS-ETS1-3
● MS-ETS1-4</td>
<td>Students will understand…

Scale, Proportion, and Quantity

● Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1),(MS-PS3-4)

Systems and System Models

● Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2)

Energy and Matter

● Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5)

● The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3)</td>
<td>

How can energy be transferred from one object or system to another?</td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…</td>
<td>Students will be skilled at…</td>
</tr>
</table>

	PS3.A: Definitions of Energy ● *Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1)* ● *A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2)* ● *Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4)* ***PS3.B: Conservation of Energy and Energy Transfer*** ● *When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5)* ● *The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4)* ● *Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3)*	***Developing and Using Models*** ● Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ● Develop a model to describe unobservable mechanisms. (MS-PS3-2) **Planning and Carrying Out Investigations** ● Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. ● Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4) **Analyzing and Interpreting Data**

	PS3.C: Relationship Between Energy and Forces ● *When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)* ***ETS1.A: Defining and Delimiting an Engineering Problem*** ▪ *The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to MS-PS3-3)* ***ETS1.B: Developing Possible Solutions*** ● *A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to MS-PS3-3)*	● Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ● Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1) **Constructing Explanations and Designing Solutions** ● Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing expl*anations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.* ● *Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3)* ***Engaging in Argument from Evidence*** ● *Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either*

		explanations or solutions about the natural and designed worlds. ● *Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5)*

Used in Content Area Standards	***21st Century Skills***
not applicable	

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Students will be able to: ● Construct and interpret graphs to describe the relationships of kinetic energy to mass and the speed of an object. ● Develop a model to describe how potential energy is stored in a system.

	- Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. - Plan an investigation to determine the relationships among energy transferred, type of matter, mass, and temperature of the sample. - Construct, use, and present arguments to support the claim that when the kinetic energy changes, energy is transferred.
	OTHER EVIDENCE: - Formatives - Summatives - Labs - Homework

Title of Curriculum: **Grade 8 Science: Waves and Their Applications in Technologies for Information Transfer**

Unit Name	What	Why	How
Waves and Their Applications in Technologies for Information Transfer	**Wave Properties** ● A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. ● A sound wave needs a medium through which it is transmitted. **Electromagnetic Radiation** ● When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. ● The path that light travels can be traced as straight lines, except at surfaces between different transparent materials	**Patterns** ● Graphs and charts can be used to identify patterns in data. **Structure and Function** ● Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. ● Structures can be designed to serve particular functions.	● Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. ● Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. ● Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

	(e.g., air and water, air and glass) where the light path bends. ● A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. ● However, because light can travel through space, it cannot be a matter wave, like sound or water waves. **Information Technologies and Instrumentation** ● Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.		

Windham School District Curriculum Template

Content Topic: Physical Science - Grade 8

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS

Students are able to describe and predict characteristic properties and behaviors of waves when the waves interact with matter. Students can apply an understanding of waves as a means to send digital information.

Competencies (Standards?):</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS

Students will understand…

Patterns</td><td>ESSENTIAL QUESTIONS
“What are the characteristics properties of waves and how can they be used?”</td></tr>
</table>

<table>
<tr>
<td rowspan="3">Content Standards:

Waves and Electromagnetic Radiation

● MS-PS4-1
● MS-PS4-2
● MS-PS4-3</td>
<td>Graphs and charts can be used to identify patterns in data. (MS-PS4- 1)

Structure and Function

● Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS4-2)

● Structures can be designed to serve particular functions. (MS-PS4-3)</td>
<td></td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…

PS4.A: Wave Properties

● A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)

● A sound wave needs a medium through which it is transmitted. (MS-PS4-2)

PS4.B: Electromagnetic Radiation

● When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object’s material and the frequency (color) of the light. (MS-PS4-2)</td>
<td>Students will be skilled at…

Developing and Using Models

● Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

● Develop and use a model to describe phenomena. (MS-PS4-2)

Using Mathematics and Computational Thinking

● Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and</td>
</tr>
</table>

	• *The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2)* • *A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)* • *However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)* ***PS4.C: Information Technologies and Instrumentation*** *Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)*	using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1) **Obtaining, Evaluating, and Communicating Information** • Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods. ▪ Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3)
Used in Content Area Standards		***21st Century Skills***
not applicable		**Influence of Science, Engineering, and Technology on Society and the Natural World** • *Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3)*

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: Students will be able to: ● Use mathematical representations to describe how the amplitude of a wave is related to the energy in a wave. ● Develop and use a model to describe that waves are reflected, absorbed, or transmitted. ● Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information.
	OTHER EVIDENCE: ● Formatives ● Summatives ● Labs ● Homework

<u>Title of Curriculum:</u> **Integrated Science - Chemistry - Grade 9**

<table>
<tr><th>Unit Name</th><th>What</th><th>How</th><th>Why</th></tr>
<tr>
<td>Chemistry

Topics in which this unit appears:

● States of Matter
● Periodic Table
● Chemical Reactions</td>
<td>● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
● The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.
● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
● A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.</td>
<td>● Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms
● Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
● Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
● Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
● Develop models to illustrate the changes in the composition</td>
<td>To answer the question:
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
● The total amount of energy and matter in closed systems is conserved.
● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
● Much of science deals with constructing explanations of how things change and how they remain stable.
● Science assumes the universe is a vast single system in which basic laws are consistent.</td>
</tr>
</table>

	● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. ● Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.	of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	

Windham School District

Integrated Science - Chemistry Unit - Grade 9

<table>
<tr><th colspan="2">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">ESTABLISHED GOALS:
Students will be introduced to the basic principles of chemistry, specifically related to the properties of matter and energy.

Competencies (Standards?):

Content Standards:
● HS-PS1-1
● HS-PS1-2
● HS-PS1-5
● HS-PS1-7
● HS-PS1-8</td>
<td>Transfer: Performance Expectations

Students will be able to:
● Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms
● Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
● Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
● Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
● Develop models to illustrate the changes in the composition of the nucleus of the atom</td></tr>
<tr><td>Meaning: Crosscutting</td></tr>
<tr><td><table><tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
● The total amount of energy and matter in closed systems is conserved.
● Changes of energy and matter in a system</td><td>ESSENTIAL QUESTIONS
● What can the periodic table tell us about the elements?
● How is matter changed and conserved in a chemical reaction?
● How do you show what happens during a chemical reaction?
● How are nuclear and chemical reactions similar and different?</td></tr></table></td></tr>
</table>

	can be described in terms of energy and matter flows into, out of, and within that system. ● Much of science deals with constructing explanations of how things change and how they remain stable. ● Science assumes the universe is a vast single system in which basic laws are consistent.	● How are atoms changed during nuclear reactions? ● How do electrons affect the chemical properties of atoms? ● How do elements combine to form compounds? ● What happens when electrons in atoms absorb or release energy? ● What happens when matter is heated and cooled? ● How is energy conserved? ● How is energy related to chemical reaction? ● How does energy take on different forms?
	Acquisition: DCI/SEP	

	Students will know…	Students will be skilled at…
	Students will know… ● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ● Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. ● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy.	**Students will be skilled at…** ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. ● Use a model to predict the relationships between systems or between components of a system. ● Conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g.,number of trials, cost, risk, time). ● Use mathematical representations of phenomena to support claims. ● Apply scientific principles and evidence to provide an explanation of phenomena ● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

	• The total number of neutrons plus protons does not change in any unclear process.	

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Integrated Science -Earth's Geological History - Grade 9**

Unit Name	What	How	Why
Earth's Geological History **Topics in which this unit appears:** ● Geological history of Earth ● Relative and absolute dating methods ● Geology and rock history	● Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. ● Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. ● Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.	● Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. ● Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.	**To answer the question:** ● Observation to determine patterns in the Earth's structure and processes. ● Science deals with constructing explanations of how things change and how they remain stable. ● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. ● Absolute and Relative dating provide ways for scientists to understand the history of Earth.

Windham School District

Integrated Science - Earth's Geological History Unit - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:
Students will be introduced to Earth's planetary history and how scientists reconstruct events based on relative and absolute dating methods and observed changes in Earth's processes.

Competencies (Standards?):

Content Standards:
HS-ESS1-5
HS-ESS1-6</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Empirical evidence is needed to identify patterns.
Much of science deals with constructing explanations of how things change and how they remain stable.
Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.</td><td>ESSENTIAL QUESTIONS
What forces wear down and build up Earth's surface?
How can conclusions about the Earth be drawn through the identification and classification of rocks and minerals?
How are Earth processes and change evidenced in rock formations?
How can absolute dating (dendrochronology and radioactive dating) provide insight into the history of the Earth and its processes?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
</table>

	Students will know…	Students will be skilled at…
	Students will know… ● Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. ● Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. ● Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.	**Students will be skilled at…** ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. ● Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data supports the explanation or conclusion. ● Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.
Used in Content Area Standards		***21st Century Skills***
not applicable		● one to one technology ● employing 21st century skills of collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Apply scientific reasoning and evidence to construct an account of Earth's formation and early history. ● Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: Integrated Science - Earth's Interior - Grade 9

Unit Name	What	How	Why
Earth's Interior **Topics in which this unit appears:** ●	● Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. ● Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. ● Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from	● Model how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. ● Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. ● Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. ● Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. ● Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.	**To answer the question:** ● Observations and experiential evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. ● Energy drives the cycling of matter within and between systems. ● Much of science deals with constructing explanations of how things change and how they remain stable. ● Change and rates of change can be quantified and modeled over very short or very long periods of time. ● Some system changes are irreversible.

	Earth's interior and gravitational movement of denser materials toward the interior. ● The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. ● Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust.		

Windham School District

Integrated Science - Earth’s Interior Unit - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will gain in understanding in how the major earth systems interact.

Competencies (Standards?):

Content Standards:
● HS-ESS2-1
● HS-ESS2-2
● HS-ESS2-3
● HS-ESS2-4
● HS-ESS2-7</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Model how Earth’s internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
● Analyze geoscience data to make the claim that one change to Earth’s surface can create feedbacks that cause changes to other Earth systems.
● Develop a model based on evidence of Earth’s interior to describe the cycling of matter by thermal convection.
● Use a model to describe how variations in the flow of energy into and out of Earth’s systems result in changes in climate.
● Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
● Energy drives the cycling of matter within and between systems.
● Much of science deals with constructing explanations of how things change and how they remain stable.
● Change and rates of change can be</td><td>ESSENTIAL QUESTIONS

● What forces cause the distribution of Earth’s resources?
● What forces cause energy movement in Earth’s systems?
● How do the major Earth systems interact?</td></tr>
</table>

		quantified and modeled over very short or very long periods of time. Some system changes are irreversible	

	Students will know… ● Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. ● Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. ● Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. ● The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation,	**Students will be skilled at…** ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. ● Use a model to provide mechanistic accounts of phenomena. ● Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution.

	volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. ● Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust.	

Used in Content Area Standards	***21st Century Skills***
not applicable	● one to one technology ● employing 21st century skills of collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Model how Earth's internal and surface processes form continental and ocean-floor features. ● Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. ● Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. ● Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. ● Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Integrated Science - Properties of Waves - Grade 9**

Unit Name	What	How	Why
Properties of Waves **Topics in which this unit appears:**	• The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. • Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) • Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and	• Use mathematical representations to relationships among the frequency, wavelength, and speed of waves traveling in various media. • Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. • Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. • Model the motion and properties of seismic waves. • Design and engineer structures based on the movement of various seismic waves on the Earth's surface. • Evaluate a solution to a real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	**To answer the question:** • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. • Systems can be designed to cause a desired effect. • Systems can be designed for greater or lesser stability. • Science and engineering complement each other in the cycle known as research and development (R&D). • Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

	the particle model explains other features. ● When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. ● Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.		

Windham School District

Integrated Science - Properties of Waves - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will gain an understanding of the properties of waves (physical and electromagnetic).

Competencies (Standards?):

Content Standards:
● HS-PS4-1
● HS-PS4-3
● HS-PS4-4
● HS-PS4-5
● HS-ETS1-3</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
● Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
● Model the motion and properties of seismic waves.
● Design and engineer structures based on the movement of various seismic waves on the Earth's surface.
● Evaluate a solution to a real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.
● Systems can be designed to cause a desired effect.
● Systems can be designed for greater or</td><td>ESSENTIAL QUESTIONS
● What is the relationship between wavelength and frequency?
● If all waves travel at the same speed (the speed of light) how can we explain the difference in energy across the electromagnetic spectrum?
● How do you know that waves carry energy?</td></tr>
</table>

	lesser stability. ● Science and engineering complement each other in the cycle known as research and development (R&D). ● Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.	● Explain how knowledge of waves helps us understand our world better and improve the quality of our lives? ● How do the properties of EM waves determine their use in society and science? ● What determines the colors you see in nature? ● What are the different types of seismic waves?
	Acquisition: DCI/SEP	

	Students will know… ● The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. ● Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. ● When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. ● Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. ● Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet.	**Students will be skilled at…** ● Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. ● Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. ● Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. ● Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, and textually).
Used in Content Area Standards		***21st Century Skills***

not applicable	● one to one technology ● employing 21st century skills of collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. ● Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. ● Communicate how some technological devices use wave behavior and wave interactions to transmit and capture information and energy. ● Model the motion and properties of seismic waves. ● Design and engineer structures based on the movement of various seismic waves on the Earth's surface. ● Evaluate a solution to a real-world problem based on prioritized criteria and trade-offs.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: Integrated Science - Astronomy - Grade 9

Unit Name	What	How	Why
Astronomy **Topics in which this unit appears:**	- The star called the Sun is changing and will burn out over a lifespan of approximately 10 billion years. - The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. - The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. - Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive	- Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. - Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. - Communicate scientific ideas about the way stars, over their life cycle, produce elements. - Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. - Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. - Use mathematical representations to support the claim that the total momentum of	**To answer the question:** - Much of science deals with constructing explanations of how things change and how they remain stable. - In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. - Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems. - Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). - The significance of a phenomenon is dependent on the scale proportion, and quantity at which it occurs. - Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. - Science assumes the universe is a vast single system in which basic laws are consistent.

	stars achieve a supernova stage and explode. ● Kepler’s laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. ● Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. ● Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. ● Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.	a system of objects is conserved when there is no net force on the system.	

Windham School District

Integrated Science - Astronomy - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will gain an understanding of the processes which govern the formation, evolution and workings of the solar system and our universe.

Competencies (Standards?):

Content Standards:
HS-ESS1-1
HS-ESS1-2
HS-ESS1-3
HS-ESS1-4
HS-PS2-1
HS-PS2-2</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun’s core to release energy that eventually reaches Earth in the form of radiation.
Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
Communicate scientific ideas about the way stars, over their life cycle, produce elements.
Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Much of science deals with constructing explanations of how things change and how they remain stable.
In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
Energy cannot be created or destroyed– only moved between one place and another place, between objects and/or</td><td>ESSENTIAL QUESTIONS
How do scientists develop the model for our solar system?
Why do we observe various astronomical cycles?
How do we define a planet?
Why do stars shine?
How do we differentiate the various types of stars in the universe?
How do stars change over time?
How is the universe organized?</td></tr>
</table>

	fields, or between systems. ● Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). ● The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. ● Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. ● Science assumes the universe is a vast single system in which basic laws are consistent.	● How do astronomers study the universe?
	Acquisition: DCI/SEP	

	Students will know…	Students will be skilled at…
	Students will know… ● The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. ● The study of stars' light spectra and brightness is used to identify compositional elements of stars, and their movements. ● The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. ● Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. ● Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. ● Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. ● Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.	**Students will be skilled at…** ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. ● Use mathematical or computational representations of phenomena to describe explanations. ● Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, and textually). ● Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory.

Used in Content Area Standards	***21st Century Skills***
not applicable	● one to one technology ● employing 21st century skills of collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop a model to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy. ● Construct an explanation of the Big Bang theory. ● Communicate scientific ideas about the way stars produce elements. ● Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. ● Analyze data to support Newton's second law of motion, F=MA ● Use mathematical representations to support the claim that the total momentum of a system of objects is conserved.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum:</u> Integrated Science - Weather and Climate - Grade 9

Unit Name	What	How	Why
Weather and Climate **Topics in which this unit appears:**	• The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. • The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. • Scientists and engineers can make major contributions by developing technologies that produce less pollution and	• Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. • Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. • Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. • Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*	**To answer the question:** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Feedback (negative or positive) can stabilize or destabilize a system. • Modern civilization depends on major technological systems. • Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. • New technologies can have deep impacts on society and the environment, including some that were not anticipated.

	waste and that preclude ecosystem degradation. ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ● Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. ● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.		

Windham School District

Integrated Science - Weather and Climate - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">ESTABLISHED GOALS:
Students will gain an understanding of the various systems that govern weather and climate.

Competencies (Standards?):

Content Standards:
HS-ESS2-2
HS-ESS2-4
HS-ESS3-4
HS-PS3-3
HS-ETS-1</td><th colspan="2">Transfer: Performance Expectations</th></tr>
<tr><td colspan="2">Students will be able to:
Use a model to describe how variations in the flow of energy into and out of Earth’s systems result in changes in climate.
Analyze geoscience data to make the claim that one change to Earth’s surface can create feedbacks that cause changes to other Earth systems.
Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting

ENDURING UNDERSTANDINGS
Students will understand that…
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
Feedback (negative or positive) can stabilize or destabilize a system.
Modern civilization depends on major technological systems.
Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks
ESSENTIAL QUESTIONS
What regulates weather and climate?
How are weather and climate different?
How can we harness the power of the wind?
How can we convert energy from one form to another?</td></tr>
</table>

	Students will know…	Students will be skilled at…
	Students will know… ● The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. ● The foundation for Earth's global climate systems is the electromagnetic radiation from the Sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. ● Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ● Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.	**Students will be skilled at…** ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. ● Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.

Used in Content Area Standards	*21st Century Skills*
not applicable	● one to one technology ● employing 21st century skills of collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. ● Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. ● Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. ● Design, build, and refine a device that works to convert one form of energy into another form of energy. ● Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: **Honors Integrated Science: Chemistry - Grade 9**

Unit Name	What	Why	How
Chemistry	● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. ● A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. ● In many situations, a dynamic and condition-dependent balance between a	● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. ● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. ● The total amount of energy and matter in closed systems is conserved. ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. ● Much of science deals with constructing explanations of how things change and how they remain stable. ● Science assumes the universe is a vast single system in which basic laws are consistent.	● Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms ● Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. ● Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. ● Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. ● Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. ● Choose a level of accuracy appropriate to limitations on measurement when reporting quantities

	reaction and the reverse reaction determines the numbers of all types of molecules present. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. ● Nuclear processes, including fusion, fission, and ● radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. ● Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.		

Windham School District Curriculum

Honors Integrated Science: Chemistry - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will be introduced to the basic principles of chemistry, specifically related to the properties of matter and energy.

Content Standards:
• HS-PS1-1
• HS-PS1-2
• HS-PS1-5
• HS-PS1-7
• HS-PS1-8</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms
● Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
● Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
● Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
● Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
● The total amount of energy and matter in</td><td>ESSENTIAL QUESTIONS
● What can the periodic table tell us about the elements?
● How is matter changed and conserved in a chemical reaction?
● How do you show what happens during a chemical reaction?
● How are nuclear and chemical reactions similar and different?</td></tr>
</table>

	closed systems is conserved. ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. ● Much of science deals with constructing explanations of how things change and how they remain stable. ● Science assumes the universe is a vast single system in which basic laws are consistent.	● How are atoms changed during nuclear reactions? ● How do electrons affect the chemical properties of atoms? ● How do elements combine to form compounds? ● What happens when electrons in atoms absorb or release energy? What happens when matter is heated and cooled? How is energy conserved? How is energy related to chemical reaction? How does energy take on different forms?
	Acquisition	

	Students will know… ● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. ● A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. ● Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. ● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present.	**Students will be skilled at…** ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. ● Use a model to predict the relationships between systems or between components of a system. ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g.,number of trials, cost, risk, time), and refine the design accordingly. ● Use mathematical representations of phenomena to support claims. ● Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. ● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

	• The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. • Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. • The total number of neutrons plus protons does not change in any nuclear process. • Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.	• Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.

Used in Content Area Standards	*21st Century Skills*
	● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use the periodic table as a model to predict the relative properties of elements ● Construct and revise an explanation for the outcome of a simple chemical reaction ● Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. ● Apply scientific principles and evidence to provide an explanation for the rate at which a reaction occurs. ● Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Honors Integrated Science - Earth's Geological History: Grade 9**

Unit Name	What	Why	How
Earth's Geological History	● Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. ● Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. ● Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.	● Observation to determine patterns in the Earth's structure and processes. ● Science deals with constructing explanations of how things change and how they remain stable. ● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. ● Absolute and Relative dating provide ways for scientists to understand the history of Earth.	● Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. ● Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. ● Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion and nuclear decay.

Windham School District Curriculum

Honors Integrated Science: Unit - Earth's Geological History - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will be introduced to Earth's planetary history and how scientists reconstruct events based on relative and absolute dating methods and observed changes in Earth's processes.

Content Standards:
HS-ESS1-5
HS-ESS1-6</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Empirical evidence is needed to identify patterns.
Much of science deals with constructing explanations of how things change and how they remain stable.
Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.</td><td>ESSENTIAL QUESTIONS
What forces wear down and build up Earth's surface?
How can conclusions about the Earth be drawn through the identification and classification of rocks and minerals?
How are Earth processes and change evidenced in rock formations?
How can absolute dating (dendrochronology and radioactive dating) provide insight into the history of the Earth and its processes?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Continental rocks, which can be older than 4 billion years, are generally much older</td><td>Students will be skilled at…
Develop a model based on evidence to illustrate the relationships between</td></tr>
</table>

	than the rocks of the ocean floor, which are less than 200 million years old. ● Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. ● Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. ● Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.	systems or between components of a system. ● Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data supports the explanation or conclusion. ● Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.

Used in Content Area Standards	***21st Century Skills***
	● *One to one technology* ● *Employing 21st century skills of collaboration* ● *Communication* ● *Critical thinking* ● *Creativity*

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT:

	• Apply scientific reasoning and evidence to construct an account of Earth's formation and early history. • Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
	OTHER EVIDENCE: • Unit and Summative Assessments • Unit specific research labs, research papers and projects • Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: **Honors Integrated Science - Earth's Interior: Grade 9**

Unit Name	What	Why	How

Earth's Interior	● Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. ● Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. ● Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. ●	● Observations and experiential evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. ● Energy drives the cycling of matter within and between systems. ● Much of science deals with constructing explanations of how things change and how they remain stable. ● Change and rates of change can be quantified and modeled over very short or very long periods of time. ● Some system changes are irreversible.	● Model how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. ● Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. ● Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. ● Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. ● Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

Windham School District Curriculum

Honors Integrated Science: Earth's Interior - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will gain in understanding in how the major earth systems interact.

Content Standards:
HS-ESS2-1
HS-ESS2-2
HS-ESS2-3
HS-ESS2-4
HS-ESS2-7</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Model how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
Energy drives the cycling of matter within and between systems.
Much of science deals with constructing explanations of how things change and how they remain stable.</td><td>ESSENTIAL QUESTIONS
What forces cause the distribution of Earth's resources?
What forces cause energy movement in Earth's systems?
How do the major Earth systems interact?</td></tr>
</table>

	● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. ● Feedback (negative or positive) can stabilize or destabilize a system.	
	Acquisition	

	Students will know… ● Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. ● Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. ● Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. ● The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation,	**Students will be skilled at…** ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. ● Use a model to provide mechanistic accounts of phenomena. ● Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Construct an oral and written argument or counter-arguments based on data and evidence.

	volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. • Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust.	

Used in Content Area Standards	*21st Century Skills*
	• One to one technology • Employing 21st century skills of collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence

Evaluative Criteria	*Assessment Evidence*
	ASSESSMENT: • Model how Earth's internal and surface processes form continental and ocean-floor features. • Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. • Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. • Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. • Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
	OTHER EVIDENCE: • Unit and Summative Assessments • Unit specific research labs, research papers and projects • Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Honors Integrated Science - Properties of Waves: Grade 9

Unit Name	What	Why	How
Properties of Waves	● The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. ● Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) ● Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.	● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. ● Systems can be designed to cause a desired effect. ● Systems can be designed for greater or lesser stability. ● Science and engineering complement each other in the cycle known as research and development (R&D). ● Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.	● Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. ● Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. ● Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. ● Model the motion and properties of seismic waves. ● Design and engineer structures based on the movement of various seismic waves on the Earth's surface. ● Evaluate a solution to a real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

	• When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. • Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.		

Windham School District Curriculum

Honors Integrated Science: Properties of Waves - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will gain an understanding of the properties of waves (physical and electromagnetic).

Content Standards:
● HS-PS4-1
● HS-PS4-3
● HS-PS4-4
● HS-PS4-5
● HS-ETS1-3</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
● Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
● Model the motion and properties of seismic waves.
● Design and engineer structures based on the movement of various seismic waves on the Earth's surface.
● Evaluate a solution to a real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.
● Systems can be designed to cause a</td><td>ESSENTIAL QUESTIONS
● What is the relationship between wavelength and frequency?
● If all waves travel at the same speed (the speed of light) how can we explain the difference in energy across the electromagnetic spectrum?
● How do you know that waves carry energy?</td></tr>
</table>

	desired effect. ● Systems can be designed for greater or lesser stability. ● Science and engineering complement each other in the cycle known as research and development (R&D). ● Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.	● Explain how knowledge of waves helps us understand our world better and improve the quality of our lives? ● How do the properties of EM waves determine their use in society and science? ● What determines the colors you see in nature? ● What are the different types of seismic waves?
	Acquisition	

	Students will know… ● The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. ● Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) ● Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. ● When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. ● Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the	**Students will be skilled at…** ● Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. ● Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. ● Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. ● Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). ● Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. ● Analyze complex real-world problems by specifying criteria and constraints for successful solutions.

	presence of an element, even in microscopic quantities. ● Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet.	

Used in Content Area Standards	*21st Century Skills*
	● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. ● Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. ● Communicate how some technological devices use wave behavior and wave interactions to transmit and capture information and energy. ● Model the motion and properties of seismic waves. ● Design and engineer structures based on the movement of various seismic waves on the Earth's surface. ● Evaluate a solution to a real-world problem based on prioritized criteria and trade-offs.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification ● Build, analyze and collect data on an engineered structure designed to withstand a simulated earthquake.

<u>Title of Curriculum</u>: **Honors Integrated Science - Astronomy: Grade 9**

Unit Name	What	Why	How
Astronomy	● The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. ● The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. ● The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. ● Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.	● Much of science deals with constructing explanations of how things change and how they remain stable. ● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. ● Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems. ● Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). ● The significance of a phenomenon is dependent on the scale proportion, and quantity at which it occurs. ● Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.	● Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. ● Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. ● Communicate scientific ideas about the way stars, over their life cycle, produce elements. ● Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. ● Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. ● Use mathematical representations to support the claim that the total momentum of a system of objects is

	• Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. • Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. • Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. • Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.	• Science assumes the universe is a vast single system in which basic laws are consistent.	conserved when there is no net force on the system. • Using a Spectrophotometer to analyze and differentiate between emission and absorption spectra of stars and non-stellar gases

Windham School District Curriculum

Honors Integrated Science: Astronomy - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will gain an understanding of the processes which govern the formation, evolution and workings of the solar system and our universe.

Content Standards:
● HS-ESS1-1
● HS-ESS1-2
● HS-ESS1-3
● HS-ESS1-4
● HS-PS2-1
● HS-PS2-2</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
● Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
● Communicate scientific ideas about the way stars, over their life cycle, produce elements.
● Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
● Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
● Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the syste</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Much of science deals with constructing explanations of how things change and how they remain stable.
● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
● Energy cannot be created or destroyed–only moved between one place and</td><td>ESSENTIAL QUESTIONS
● How do scientists develop the model for our solar system?
● Why do we observe various astronomical cycles?
● How do we define a planet?
● Why do stars shine?
● How do we differentiate the various types of stars in the universe?
● How do stars change over time?</td></tr>
</table>

	another place, between objects and/or fields, or between systems. ● Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). ● The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. ● Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. ● Science assumes the universe is a vast single system in which basic laws are consistent.	● How is the universe organized? ● How do astronomers study the universe?
	Acquisition	
	Students will know… ● The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. ● The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. ● The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.	**Students will be skilled at…** ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. ● Use mathematical or computational representations of phenomena to describe explanations. ● Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

	• Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. • Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. • Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. • Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. • Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. • In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.	• Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). • Using a Spectrophotometer to analyze and differentiate between emission and absorption spectra of stars and non-stellar gases. • Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory.

Used in Content Area Standards	***21st Century Skills***
	● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop a model to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy. ● Construct an explanation of the Big Bang theory. ● Communicate scientific ideas about the way stars produce elements. ● Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. ● Analyze data to support Newton's second law of motion, F=MA ● Use mathematical representations to support the claim that the total momentum of a system of objects is conserved.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Honors Integrated Science - Weather and Climate: Grade 9**

Unit Name	What	Why	How
Weather and Climate	• The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. • The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. • Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.	• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Feedback (negative or positive) can stabilize or destabilize a system. • Modern civilization depends on major technological systems. • Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. • New technologies can have deep impacts on society and the environment, including some that were not anticipated.	• Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. • Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. • Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. • Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*

	- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. - Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.		

Windham School District Curriculum

Honors Integrated Science: Weather and Climate - Grade 9

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will gain an understanding of the various systems that govern weather and climate.

Content Standards:
● HS-ESS2-2
● HS-ESS2-4
● HS-ESS3-4
● HS-PS3-3
● HS-ETS-1</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
● Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
● Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
● Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*
● Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
● Feedback (negative or positive) can stabilize or destabilize a system.
● Modern civilization depends on major technological systems.
● Engineers continuously modify these</td><td>ESSENTIAL QUESTIONS
● What regulates weather and climate?
● How are weather and climate different?
● How can we harness the power of the wind?
● How can we convert energy from one form to another?</td></tr>
</table>

	technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. ● New technologies can have deep impacts on society and the environment, including some that were not anticipated.	
	Acquisition	
	Students will know… ● The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. ● Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. ● The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. ● Scientists and engineers can make major contributions by developing technologies	**Students will be skilled at…** ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. ● Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. ● Science arguments are strengthened by multiple lines of evidence supporting a single explanation.

	that produce less pollution and waste and that preclude ecosystem degradation. ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ● Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. ● “Electrical energy” may mean energy stored in a battery or energy transmitted by electric currents. *(secondary)* ● Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. ● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. ● The availability of energy limits what can occur in any system. ● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.	

	● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.	
Used in Content Area Standards		***21st Century Skills***
		● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. ● Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. ● Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. ● Design, build, and refine a device that works to convert one form of energy into another form of energy. ● Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification.

Title of Curriculum: **Life Science - Cells and Cell Processes - Grade 10**

Unit Name	What	How	Why
Cells and Cell Processes **Topics in which this unit appears:** ● Cells ● Cell Processes ● Anatomy	● Students are able to investigate cells and the explanations for cell processes as the basic units of life, the hierarchical systems of organisms, and the role of specialized cells for maintenance and growth. ● Students demonstrate understanding of how systems of cells function together to support the life processes. ● Students demonstrate their understanding through critical reading, using models, and conducting investigations.	● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. ● Construct an explanation based on valid and reliable evidence obtained from a variety of sources and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**To answer the question:** ● "How do the structures of organisms enable life's functions?"

Windham School District Curriculum

Life Science - Cells and Cell Processes - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will be introduced to the basic cell processes and functions, to include division, characteristics, homeostasis, and similarities and differences among organisms.

Competencies (Standards):

Content Standards:
• HS-LS1-2
• HS-LS1-3</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— such as energy , matter, and information flows—within and between systems at different scales.
● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</td><td>ESSENTIAL QUESTIONS
● What characteristics do all living things share and how does variation upon these characteristics create the diversity of life on the planet?
● How does the process of science help biologists investigate how nature works at all levels?
● What is the relationship between structure and function in molecules, organs, and living systems?
● What characteristics do all cells share in common and what makes each type of cell unique?
● How do cellular processes provide the energy and basic structure organisms need to survive?
● What happens when communication, on a cellular level, breaks down or is incorrect?</td></tr>
</table>

<table>
<tr><td rowspan="3"></td><td></td><td>How does homeostasis coordinate the diverse and complex functions of the human body?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…
Systems of specialized cells within organisms help them perform the essential functions of life.
All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.
Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.</td><td>Students will be skilled at…
Developing and using models based on evidence to illustrate the relationships between systems or between components of a system.
Planning and carrying out investigations individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data, and refine the design accordingly.
Constructing explanations and designing solutions based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">not applicable</td><td>Collaboration
Communication
Critical thinking
Creativity</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. ● Plan and conduct an investigation to provide evidence on how organisms maintain homeostasis.
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum:</u> Life Science - Cellular Respiration & Photosynthesis - Grade 10

Unit Name	What	How	Why
Cellular Respiration & Photosynthesis **Topics in which this unit appears:** ● Cellular Respiration ● Photosynthesis	● Students can construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. ● They can relate the nature of science to how explanations may change in light of new evidence and the implications for our understanding of the tentative nature of science.	● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. ● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**To answer the question:** ● "How do organisms obtain and use energy they need to live and grow? How do matter and energy move through ecosystems?"

Windham School District Curriculum

Life Science: Cellular Respiration & Photosynthesis - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will be introduced to the processes of cellular respiration and photosynthesis, how they work, and transfer energy in the environment.

Competencies (Standards):

Content Standards:
• HS-LS1-5
• HS-LS1-6
• HS-LS1-7
• HS-LS2-4
• HS-LS2-5</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
● Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
● Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a transfer of energy.
● Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
● Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon in the ecosystem.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows— within and between systems at different scales.
● Changes of energy and matter in a system can be described in terms of energy and</td><td>ESSENTIAL QUESTIONS
● How does the process of science help biologists investigate how nature works at all levels, from the molecules in cells to the biosphere and follows a logical sequence of events?
● How and why does energy flow but matter recycles through an ecosystem?
● How do humans shape the planet on a global scale to better meet their needs?</td></tr>
</table>

	matter flows into, out of, and within that system. ● Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. ● Energy drives the cycling of matter within and between systems.	● How do the relationships between components of an ecosystem shape it? ● What roles do each of the components in an ecosystem play? ● How do environmental and cellular changes affect humans?
	Acquisition	

	Students will know…	Students will be skilled at…
	● The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. ● The students will know the reactants and products in the major processes of photosynthesis and cellular respiration. ● As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. ● As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. ● Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. ● Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical,	● Developing and using a model based on evidence to illustrate the relationships between systems or components of a system. ● Constructing and revising an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

	physical, geological, and biological processes. ● The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. ● Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.	

Used in Content Area Standards	*21st Century Skills*
not applicable	● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. ● Construct an explanation for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. ● Use a model to illustrate that cellular respiration is a chemical process resulting in a net transfer of energy. ● Construct an explanation for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon in the environment.
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Life Science - Ecology - Grade 10**

Unit Name	What	How	Why
Ecology **Topics in which this unit appears:** ● Ecology	● Students demonstrate an ability to investigate the role of biodiversity in ecosystems and the role of animal behavior on survival of individuals and species. ● Students have increased understanding of interactions among organisms and how those interactions influence the dynamics of ecosystems. ● Students understand organisms' interactions with each other and their physical environment, how organisms obtain resources, change the environment, and how these changes affect both organisms and ecosystems.	● Use mathematics and computational thinking to create and use mathematical and/or computational representations of phenomena or design solutions to support explanations. (In the form of graphing) ● Create or revise a simulation of a phenomenon, designed device, process, or system. ● Construct explanations and design solutions to complex real-world problems, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. ● Engage in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	**To answer the question:** ● "How do organisms interact with the living and non-living environment to obtain matter and energy?"

Windham School District Curriculum

Life Science: Ecology - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Students will be introduced to ecological processes such as food webs with energy transfer, carrying capacity, and environmental factors.

Competencies (Standards):

Content Standards:
• HS-LS2-1
• HS-LS2-6
• HS-LS2-7
• HS-LS2-8</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
● Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
● Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
● Evaluate the evidence for the role of group behavior on individual and species’ chances to survive and reproduce.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
● Much of science deals with constructing explanations of how things change and how they remain stable.</td><td>ESSENTIAL QUESTIONS
● How do humans shape the planet on a global scale to better meet their needs?
● How do the relationships between components of an ecosystem shape it?
● What roles do each of the components in an ecosystem play?
● How and why does energy flow but matter recycles through an ecosystem?
● How do environmental and cellular changes affect humans?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
</table>

	• Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. • Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.	• Using mathematics and computational thinking to create and use mathematical and/or computational representations of phenomena or design solutions to support explanations. • Constructing explanations and designing solutions to complex real-world problems, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. • Engaging in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

	- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. - Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. - Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. - Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). - Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity	

	through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. ● When evaluating solutions, it is important to take into account a range of constraints, such as cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ● Both physical models and computers can be used in various ways to aid in the engineering design process.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. ● Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

	● Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. ● Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Life Science - Genetics - Grade 10**

Unit Name	What	How	Why
Genetics **Topics in which this unit appears:** • Mendelian Genetics • Molecular Genetics	• Students demonstrate understanding of the relationship of DNA and chromosomes in the processes of cellular division that pass traits from one generation to the next. • Students can determine why individuals of the same species vary in how they look, function, and behave. Students can develop conceptual models for the role of DNA in the unity of life on Earth and use probability models to explain the importance of variation within populations for the survival and evolution of species. • Ethical issues related to genetic modification of organisms and the nature of science can be described. • Students can explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation.	• Ask questions and define problems that arise from examining models or a theory to clarify relationships. • Develop and use models based on evidence to illustrate the relationships between systems or between components of a system. • Analyze and interpret data while applying concepts of probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. • Engage in arguments from evidence and evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	**To answer the question:** • "How are the characteristics from one generation related to the previous generation?"

Windham School District Curriculum

Life Science: Genetics - Grade 10

Stage 1 Desired Results

ESTABLISHED GOALS:
Students will be introduced to basic genetic components such as DNA, inheritance, and trait expression.

Competencies (Standards):

Content Standards:
- HS-LS1-4
- HS-LS3-1
- HS-LS3-3

Transfer

Students will be able to:

- Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- Apply concepts of probability to explain the variation and distribution of expressed traits in a population.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…
- Cause and Effect: Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- Systems and System Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy , matter, and information flows— within and between systems.

ESSENTIAL QUESTIONS
- How does DNA control heredity?
- How does an organism's DNA, along with the environment, determine an organism's characteristics?
- How does the study of Mendelian Genetics allow us to determine and predict patterns of inheritance?
- How does the manipulation of genetics, reproduction, development and evolution affect the quality of human life?

Acquisition

Students will know…
- All cells contain genetic information in the form of DNA molecules. Genes are regions

Students will be skilled at…

	in the DNA that contain the instructions that code for the formation of proteins. ● In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. ● Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA . The instructions for forming species' characteristics are carried in DNA . All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. ● In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental	● Asking questions and defining problems that arise from examining models or a theory to clarify relationships. ● Developing and using models, including mathematical models, based on evidence to illustrate the relationships between systems or between components of a system. ● Engaging in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

	factors can also cause mutations in genes, and viable mutations are inherited. ● Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.	
Used in Content Area Standards		**21st Century Skills**
not applicable		● Collaboration ● Communication ● Critical thinking ● Creativity

<u>Title of Curriculum:</u> Life Science - Natural Selection & Evolution - Grade 10

Unit Name	What	How	Why
Natural Selection and Evolution **Topics in which this unit appears:** ● Evolution ● Natural Selection	● Students can investigate patterns to find the relationship between the environment and natural selection. ● Students demonstrate understanding of the factors causing natural selection and the process of evolution of species over time. ● They demonstrate understanding of how multiple lines of evidence contribute to the strength of scientific theories of natural selection and evolution. ● Students can describe extensive scientific evidence ranging from the fossil record to genetic relationships among species that support the theory of biological evolution. ● Students can use models, analyze data, and produce scientific communications about evolution.	● Analyze and interpret data to scientific and engineering questions and problems, using digital tools when applicable. ● Construct explanations and design solutions based on valid and reliable evidence obtained from a variety of sources and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Engage in arguments from evidence and evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Communicate scientific information in multiple formats	**To answer the question:** ● "How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms? How does biodiversity affect humans?"

Windham School District Curriculum

Life Science: Natural Selection and Evolution - Grade 10

<table>
<tr><th colspan="2">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Students will be introduced to the ecological and genetic events that lead to natural selection and evolution.

Competencies (Standards):

Content Standards:
• HS-LS4-1
• HS-LS4-2
• HS-LS4-3
• HS-LS4-4
• HS-LS4-5</td><td>Transfer</td></tr>
<tr><td>Students will be able to:
● Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
● Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment .
● Apply concepts of probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
● Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
● Discuss evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species (2) the extinction of other species.</td></tr>
<tr><td>Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Evolution is a continuously occurring process and can explain changes over time and the variety of life forms

ESSENTIAL QUESTIONS
● How has the diversity of life been shaped by ongoing evolutionary change and our understanding of the relatedness of organisms has been a direct result of observation and technology?
● How does the process of science helps biologists investigate how nature works at all levels, from the molecules in cells to the</td></tr>
</table>

		biosphere and follows a logical sequence of events? ● How does DNA provide the raw material upon which Natural Selection can act? ● What evidence demonstrates that groups of organisms have changed over time? ● What characteristics do all living things share and how does variation upon these characteristics create the diversity of life on the planet? ● How are humans similar to all life on the planet and how are they different?
	Acquisition	
	Students will know… ● Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. ● Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. ● The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. ● Evolution is a consequence of the interaction of four factors: (1) the	**Students will be skilled at…** ● Analyzing and interpreting data while applying concepts of probability to scientific questions and problems, using digital tools when feasible. ● Constructing explanations based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Engaging in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Obtaining, evaluating, and communicating scientific information in multiple formats

	potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. ● Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically , behaviorally , and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. ● Adaptation also means that the distribution of traits in a population can change when conditions change. ● Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and	(including orally, graphically, textually, and mathematically).

	sometimes the extinction–of some species. ● Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.	
Used in Content Area Standards		**21st Century Skills**
not applicable		● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	**Assessment Evidence**
	ASSESSMENT: ● Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. ● Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment . ● Apply concepts of probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. ● Construct an explanation based on evidence for how natural selection leads to adaptation of populations. ● Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species and (2) the extinction of other species.
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum:</u> **Biology - Structure and Function**

Unit Name	What	How	Why
Structure and Function Topics in which this unit appears: ● Cell Structure & Function ● Photosynthesis ● Cellular Respiration ● Cell Growth & Division ● DNA, RNA ● Anatomy	● Students are able to investigate explanations for the structure and function of cells as the basic units of life, the hierarchical systems of organisms, and the role of specialized cells for maintenance and growth. ● Students demonstrate understanding of how systems of cells function together to support the life processes. ● Students demonstrate their understanding through critical reading, presentations, using models, conducting and analyzing investigations	● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. ● Construct an explanation based on valid and reliable evidence obtained from a variety of sources and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Analyze and interpret data using written explanations, technology and/or models in order to make a valid and reliable scientific claim ● Communicate Information in written reports, posters and presentations	**To answer the question:** ● How do the structures of organisms enable life's functions? ● How are cell structures adapted to their functions? ● How do cellular and subcellular structures carry out the process of photosynthesis? ● How do cellular and subcellular structures carry out the process of cellular respiration and fermentation? ● How do cellular structures and molecules carry out cellular growth and development? ● How does the structure of DNA/RNA allow it to carry out their functions? ● How do anatomical structures, organs and organ systems carry out biological processes?

Windham School District Curriculum

Biology - Structure and Function - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-LS1-1
HS-LS1-2
HS-LS1-3</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy , matter, and information flows—within and between systems at different scales.
Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</td><td>ESSENTIAL QUESTIONS
What characteristics do all living things share and how does variation upon these characteristics create the diversity of life on the planet?
How does the process of science help biologists investigate how nature works at all levels, from the molecules in cells to the biosphere and follows a logical sequence of events?
What is the relationship between structure and function in molecules, organs, and living systems?</td></tr>
</table>

	Acquisition: DCI/SEP	
	Students will know… ● Systems of specialized cells within organisms help them perform the essential functions of life. ● All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. ● Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. ● Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.	**Students will be skilled at…** ● Developing and using models based on evidence to illustrate the relationships between systems or between components of a system. ● Planning and carrying out investigations individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. ● Constructing explanations and designing solutions based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● What characteristics do all cells share in common and what makes each type of cell unique? ● How do cellular process provide the energy and basic structure organisms need to survive?

		● What happens when communication, on a cellular level, breaks down or is incorrect
Used in Content Area Standards		***21st Century Skills***
not applicable		● collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Construct an explanation for how the structure of DNA determines the structure of proteins ● Develop a model to illustrate the hierarchical organization of interacting systems that provide specific functions within a cell and within multicellular organisms. ● Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. ● Summative tests
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Biology - Matter and Energy in Ecosystems**

Unit Name	What	How	Why
Matter and Energy in Organisms and Ecosystems **Topics in which this unit appears:** ● Cell Structure ● Cell Functions ● Cell Respiration ● Photosynthesis ● Ecology	● Students can construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. ● They can apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration and develop models to communicate these explanations. ● They can relate the nature of science to how explanations may change in light of new evidence and the implications for our understanding of the tentative nature of science. ● Students understand organisms' interactions with each other and their physical environment, how organisms obtain resources, change the environment, and how these changes affect both organisms and ecosystems.	● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. ● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**To answer the question:** ● "How do organisms obtain and use energy they need to live and grow? How do matter and energy move through ecosystems?"

Windham School District Curriculum

Biology: Matter and Energy in Organisms and Ecosystems - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
• HS-LS1-5
• HS-LS1-6
• HS-LS1-7
• HS-LS2-3
• HS-LS2-4
• HS-LS2-5</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
● Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
● Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
● Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
● Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
● Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—</td><td>ESSENTIAL QUESTIONS
● How does the process of science help biologists investigate how nature works at all levels, from the molecules in cells to the biosphere and follows a logical sequence of events?</td></tr>
</table>

	within and between systems at different scales. ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. ● Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. ● Energy drives the cycling of matter within and between systems.	● How and why does energy flow but matter recycle through an ecosystem? ● How do humans shape the planet on a global scale to better meet their needs?
	Acquisition	
	Students will know… ● The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. ● The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. ● As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. ● As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which	**Students will be skilled at…** ● Developing and using a model based on evidence to illustrate the relationships between systems or components of a system. ● Using mathematics and computational thinking to create and use mathematical representations of phenomena or design solutions to support claims. ● Constructing and revising an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● How do the relationships between components of an ecosystem shape it? ● What roles do each of the components in an ecosystem play?

	the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. ● Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. ● Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (Qualitative analysis only) ● Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere,	● How do environmental and cellular changes affect humans?

	oceans, and geosphere through chemical, physical, geological, and biological processes. ● The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. ● Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. ● Construct an explanation for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. ● Use a model to illustrate that cellular respiration is a chemical process resulting in a net transfer of energy. ● Construct an explanation for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. ● Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. ● Summative tests
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: **Biology - Interdependent Relationships in Ecosystems**

Unit Name	What	How	Why
Interdependent Relationships in Ecosystems **Topics in which this unit appears:** ● Ecology ● Photosynthesis ● Cell Respiration	● Students demonstrate an ability to investigate the role of biodiversity in ecosystems and the role of animal behavior on survival of individuals and species. ● Students have increased understanding of interactions among organisms and how those interactions influence the dynamics of ecosystems.	● Use mathematics and computational thinking to create and use mathematical and/or computational representations of phenomena or design solutions to support explanations. (In the form of graphing) ● Use mathematical representations of phenomena or design solutions to support and revise explanations. ● Create or revise a simulation of a phenomenon, designed device, process, or system. ● Construct explanations and design solutions to complex real-world problems, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. ● Engage in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	**To answer the question:** ● "How do organisms interact with the living and non-living environment to obtain matter and energy?"

Windham School District Curriculum

Biology: Interdependent Relationships in Ecosystems - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards?):
Content Standards:
• HS-LS2-1
• HS-LS2-2
• HS-LS2-6
• HS-LS2-7
• HS-LS2-8
• HS-LS4-6</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
● Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
● Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
● Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
● Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
● Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td><td>ESSENTIAL QUESTIONS
● How do humans shape the planet on a global scale to better meet their needs?
● How do the relationships between components of an ecosystem shape it?
● What roles do each of the components in an ecosystem play?</td></tr>
</table>

	• The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. • Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. • Much of science deals with constructing explanations of how things change and how they remain stable.	• How do environmental and cellular changes affect humans?
	Acquisition	
	Students will know… • Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as	**Students will be skilled at…** • Using mathematics and computational thinking to create and use mathematical and/or computational representations of phenomena or design solutions to support explanations. • Use mathematical representations of phenomena or design solutions to support and revise explanations. • Create or revise a simulation of a phenomenon, designed device, process, or system. • Constructing explanations and designing solutions to complex real-world problems, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. • Engaging in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

	opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. ● Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. ● Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. ● Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. ● Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). ● Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation,	

	habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ● Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.	

Used in Content Area Standards	***21st Century Skills***
not applicable	● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. ● Use mathematical representations to support explanations about factors affecting biodiversity and populations in ecosystems of different scales. ● Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. ● Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. ● Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. ● Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. ● Summative tests
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: Biology - Inheritance and Variation of Traits

Unit Name	What	How	Why
Inheritance and Variation of Traits **Topics in which this unit appears:** ● Mendelian Genetics ● Molecular Genetics	● Students demonstrate understanding of the relationship of DNA and chromosomes in the processes of cellular division that pass traits from one generation to the next. ● Students can determine why individuals of the same species vary in how they look, function, and behave. Students can develop conceptual models for the role of DNA in the unity of life on Earth and use statistical models to explain the importance of variation within populations for the survival and evolution of species. ● Ethical issues related to genetic modification of organisms and the nature of science can be described. ● Students can explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation.	● Ask questions and define problems that arise from examining models or a theory to clarify relationships. ● Develop and use models based on evidence to illustrate the relationships between systems or between components of a system. ● Analyze and interpret data while applying concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● Engage in arguments from evidence and evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	**To answer the question:** ● "How are the characteristics from one generation related to the previous generation?"

Windham School District Curriculum

Biology: Inheritance and Variation of Traits - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-LS1-4
HS-LS3-1
HS-LS3-2
HS-LS3-3</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
● Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
● Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
● Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
● Scale, Proportion, and Quantity Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
● Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and</td><td>ESSENTIAL QUESTIONS
● How does DNA control heredity?
● How does an organism’s DNA, along with the environment, determine an organism’s characteristics?
● How does the study of Mendelian Genetics allow us to determine and predict patterns of inheritance?
● How does the manipulation of genetics, reproduction, development and evolution affect the quality of human life?</td></tr>
</table>

	interactions—including energy , matter, and information flows— within and between systems at different scales.	
	Acquisition	
	Students will know… ● All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. ● In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. ● Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA . The instructions for forming species' characteristics are carried in DNA . All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural	**Students will be skilled at…** ● Asking questions and defining problems that arise from examining models or a theory to clarify relationships. ● Developing and using models based on evidence to illustrate the relationships between systems or between components of a system. ● Analyzing and interpreting data while applying concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● Engaging in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

	functions, and some have no as-yet known function. ● In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. ● Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical thinking ● Creativity ● Analyzing

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. ● Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for inherited characteristic traits. ● Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. ● Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. ● Summative tests
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: Biology - Natural Selection and Evolution

Unit Name	What	How	Why
Natural Selection and Evolution **Topics in which this unit appears:** ● Cell Structure ● Cell Function ● Photosynthesis ● Cell Respiration ● Anatomy ● Evolution ● Ecology	● Students can investigate patterns to find the relationship between the environment and natural selection. ● Students demonstrate understanding of the factors causing natural selection and the process of evolution of species over time. ● They demonstrate understanding of how multiple lines of evidence contribute to the strength of scientific theories of natural selection and evolution. ● Students can describe extensive scientific evidence ranging from the fossil record to genetic relationships among species that support the theory of biological evolution. ● Students can use models, analyze data, and produce scientific communications about evolution.	● Analyze and interpret data to scientific and engineering questions and problems, using digital tools when applicable. ● Construct explanations and design solutions based on valid and reliable evidence obtained from a variety of sources and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Engage in arguments from evidence and evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Communicate scientific information in multiple formats	**To answer the question:** ● How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms? How does biodiversity affect humans?

Windham School District Curriculum

Biology: Natural Selection and Evolution - Grade 10

<table>
<tr><th colspan="2">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-LS4-1
HS-LS4-2
HS-LS4-3
HS-LS4-4
HS-LS4-5</td><th>Transfer</th></tr>
<tr><td>Students will be able to:
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment .
Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.</td></tr>
<tr><td><table><tr><th colspan="2">Meaning</th></tr><tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Evolution is supported by many areas of evidence
Environmental factors determine changes in populations over long periods of time.</td><td>ESSENTIAL QUESTIONS
How has the diversity of life been shaped by ongoing evolutionary change and our understanding of the relatedness of organisms has been a direct result of observation and technology?
How does the process of science helps biologists investigate how nature works at all</td></tr></table></td></tr>
</table>

		levels, from the molecules in cells to the biosphere and follows a logical sequence of events? ● How does DNA provide the raw material upon which Natural Selection can act?
	Acquisition	

	Students will know… ● Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. ● Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. ● The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. ● Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to surv iv e and reproduce, and (4) the ensuing proliferation of those organisms that are better able to surv iv e and reproduce in that environment. ● Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically , behaviorally , and physiologically well suited to surv iv e and reproduce in a	**Students will be skilled at…** ● Analyzing and interpreting data while applying concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● Constructing explanations and designing solutions based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Engaging in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Obtaining, evaluating, and communicating scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). ● What evidence demonstrates that groups of organisms have changed over time?

	specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. ● Adaptation also means that the distribution of traits in a population can change when conditions change. ● Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. ● Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.	● What characteristics do all living things share and how does variation upon these characteristics create the diversity of life on the planet? ● How does homeostasis coordinate the diverse and complex functions of the human body? ● How are humans similar to all life on the planet and how are they different?

Used in Content Area Standards	21st Century Skills
not applicable	● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	**Assessment Evidence**
	ASSESSMENT: ● Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. ● Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment . ● Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. ● Construct an explanation based on evidence for how natural selection leads to adaptation of populations. ● Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. ● Summative tests
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Grade 10: Honors Biology - Structure and Function**

Unit Name	What	How	Why
Structure and Function **Topics in which this unit appears:** ● Biochemistry ● Cell Structure & Function ● Photosynthesis ● Cellular Respiration ● Cell Growth & Division ● DNA, RNA ● Anatomy	● Students are able to investigate explanations for the structure and function of cells as the basic units of life, the hierarchical systems of organisms, and the role of specialized cells for maintenance and growth. ● Students demonstrate understanding of how systems of cells function together to support the life processes. ● Students demonstrate their understanding through critical reading, presentations, using models, conducting and analyzing investigations	● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence. ● Construct an explanation based on valid and reliable evidence obtained from a variety of sources and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Analyze and interpret data using written explanations, technology and/or models in order to make a valid and reliable scientific claim ● Communicate Information in written reports, scientific posters research paper(s) and presentations	**To answer the question:** ● How does the chemical basis of life support living systems? ● How do the properties of carbon contribute to life's molecular diversity? ● How do the major macromolecules of living systems sustain life within life's hierarchy? ● How do the structures of organisms enable life's functions? ● How are cell structures adapted to their functions? ● How do cellular and subcellular structures carry out the process of photosynthesis? ● How do cellular and subcellular structures carry out the process of cellular respiration and fermentation? ● How do cellular structures and molecules carry out cellular growth and development? ● How does the structure of DNA/RNA allow it to carry out their functions? ● How do anatomical structures, organs and organ systems carry out biological processes?

Windham School District Curriculum

Honors Biology: Structure and Function - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Structure and Function
Content Standards:
• HS-LS1-1
• HS-LS1-2
• HS-LS1-3</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
● Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy , matter, and information flows—within and between systems at different scales.
● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
● Students are able to investigate explanations for the structure and</td><td>ESSENTIAL QUESTIONS
● What characteristics do all living things share and how does variation upon these characteristics create the diversity of life on the planet?
● How does the process of science help biologists investigate how nature works at all levels, from the molecules in cells to the biosphere and follows a logical sequence of events?
● How do emergent properties at each level of life contribute to the complexity of the subsequent level? (For example, the properties of an atom dictate the types of bonds it can form to make a molecule.)</td></tr>
</table>

	function of cells as the basic units of life, the hierarchical systems of organisms, and the role of specialized cells for maintenance and growth. ● Students demonstrate understanding of how systems of cells function together to support the life processes. ● Students demonstrate their understanding through critical reading, presentations, using models, conducting and analyzing investigations	
	Acquisition: DCI/SEP	

	Students will know… ● Systems of specialized cells within organisms help them perform the essential functions of life. ● All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. ● Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. Students will also connect those systems and processes via modeling. ● Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. ● Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. ● How do the structures of organisms enable life's functions? ● How are cell structures adapted to their functions?	**Students will be skilled at…** ● Developing and using models based on evidence to illustrate the relationships between systems or between components of a system. ● Planning and carrying out investigations individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. ● Constructing explanations and designing solutions based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● What is the relationship between structure and function in molecules, organs, and living systems? ● What characteristics do all cells share in common and what makes each type of cell unique? ● How do cellular process provide the energy and basic structure organisms need to survive?

	● How do cellular and subcellular structures carry out the process of photosynthesis? ● How do cellular and subcellular structures carry out the process of cellular respiration and fermentation? ● How do cellular structures and molecules carry out cellular growth and development? ● How does the structure of DNA/RNA allow it to carry out their functions?	● What happens when communication, on a cellular level, breaks down or is incorrect? ● How do cellular organelles harness and transform potential and kinetic energy to fuel life processes? ● How does the chemical basis of life support living systems? ● How do the properties of carbon contribute to life's molecular diversity? ● How do the major macromolecules of living systems sustain life within life's hierarchy?

Used in Content Area Standards	***21st Century Skills***
not applicable	● Collaboration ● Communication ● Critical thinking ● Creativity ● Analyzing

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Sketch, illustrate and/or model cellular and subcellular structures and how they function as a system ● Construct an explanation for how the structure of DNA determines the structure of proteins ● Develop a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. ● Summative tests
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Grade 10: Honors Biology - Matter and Energy in Ecosystems**

Unit Name	What	How	Why
Matter and Energy in Organisms and Ecosystems **Topics in which this unit appears:** • Cell Structure • Cell Functions • Cell Respiration • Photosynthesis • Ecology • Atomic structure • Ionic, polar and nonpolar bonds • Emergent properties of water	• Students can construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. • They can apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration and develop models to communicate these explanations. • They can relate the nature of science to how explanations may change in light of new evidence and the implications for our understanding of the tentative nature of science. • Students understand organisms' interactions with each other and their physical environment, how organisms obtain resources, change the environment, and how these changes affect both organisms and ecosystems.	• Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. • Use mathematics and computational thinking to create and use mathematical representations of phenomena or design solutions to support claims. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**To answer the question:** • "How do organisms obtain and use energy they need to live and grow? How do matter and energy move through ecosystems?" • What is the hierarchy of life? What exists at each level? • What are the major structures found within a cell? • What are the major components found within an ecosystem?

Windham School District Curriculum

Honors Biology: Matter and Energy in Organisms and Ecosystems - Grade 10

<table>
<tr><th colspan="2">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
• HS-LS1-5
• HS-LS1-6
• HS-LS1-7
• HS-LS2-3
• HS-LS2-4
• HS-LS2-5</td><td colspan="1">Transfer</td></tr>
<tr><td>Students will be able to
● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
● Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
● Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
● Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
● Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
● Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.</td></tr>
<tr><td>Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows— within and between systems at different scales.

ESSENTIAL QUESTIONS
● How does the process of science help biologists investigate how nature works at all levels, from the molecules in cells to the biosphere and follows a logical sequence of events?
● How and why does energy flow but matter recycle through an ecosystem?</td></tr>
</table>

	• Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. • Energy drives the cycling of matter within and between systems.	• How do humans shape the planet on a global scale to better meet their needs?
	Acquisition	
	Students will know… • The chemical process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. • The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. • As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen	**Students will be skilled at…** • Developing and using a model based on evidence to illustrate the relationships between systems or components of a system. • Using mathematics and computational thinking to create and use mathematical representations of phenomena or design solutions to support claims. • Constructing and revising an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • "How do organisms obtain and use energy they need to live and grow? How do matter and energy move through ecosystems?"

	molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. ● Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. ● Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. Quantitative analysis will be performed on food webs. ● "How do organisms obtain and use energy they need to live and grow? How do matter and energy move through ecosystems?"	● What is the hierarchy of life? What exists at each level? ● What are the major structures found within a cell? ● What are the major components found within an ecosystem? ● How do the relationships between components of an ecosystem shape it? ● What roles do each of the components in an ecosystem play? ● How do environmental and cellular changes affect humans?

	• What is the hierarchy of life? What exists at each level? • What are the major structures found within a cell? • What are the major components found within an ecosystem? • Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. • The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. • Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Communication • Critical thinking • Creativity • Analyzing

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. ● Construct an explanation for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. ● Use a model to illustrate that cellular respiration is a chemical process resulting in a net transfer of energy. ● Construct an explanation for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. ● Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. ● Summative tests
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Grade 10: Honors Biology - Interdependent Relationships in Ecosystems**

Unit Name	What	How	Why
Interdependent Relationships in Ecosystems **Topics in which this unit appears:** ● Ecology ● Photosynthesis ● Cell Respiration ● Nutrient cycling	● Students demonstrate an ability to investigate the role of biodiversity in ecosystems and the role of animal behavior on survival of individuals and species. ● Students have increased understanding of interactions among organisms and how those interactions influence the dynamics of ecosystems. ● Students can generate mathematical comparisons, conduct investigations, use models, and apply scientific reasoning to link evidence to explanations about interactions and changes within ecosystems.	● Use mathematics and computational thinking to create and use mathematical and/or computational representations of phenomena or design solutions to support explanations. ● Use mathematical representations of phenomena or design solutions to support and revise explanations. ● Create or revise a simulation of a phenomenon, designed device, process, or system. ● Construct explanations and design solutions to complex real-world problems, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. ● Engage in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.	**To answer the question:** ● "How do organisms interact with the living and non-living environment to obtain matter and energy?" ● How does photosynthesis fuel the biosphere? ● How are cell respiration and photosynthesis interrelated? ● What are the major steps in Cells Respiration? ● What are the major steps in photosynthesis? ● What are the reactants and products in both the photosynthesis and cell respiration equation?

Windham School District Curriculum

Honors Biology: Interdependent Relationships in Ecosystems - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
• HS-LS2-1
• HS-LS2-2
• HS-LS2-6
• HS-LS2-7
• HS-LS2-8
• HS-LS4-6</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
● Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
● Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
● Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
● Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
● Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
● The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.</td><td>ESSENTIAL QUESTIONS
● How do humans shape the planet on a global scale to better meet their needs?
● How do the relationships between components of an ecosystem shape it?
● What roles do each of the components in an ecosystem play?
● How do environmental and cellular changes affect humans?</td></tr>
</table>

	• Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. • Much of science deals with constructing explanations of how things change and how they remain stable.	
	Acquisition	
	Students will know… • Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population,	**Students will be skilled at…** • Using mathematics and computational thinking to create and use mathematical and/or computational representations of phenomena or design solutions to support explanations. • Use mathematical representations of phenomena or design solutions to support and revise explanations. • Create or revise a simulation of a phenomenon, designed device, process, or system. • Constructing explanations and designing solutions to complex real-world problems, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. • Engaging in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • "How do organisms interact with the living and non-living environment to obtain matter and energy?"

	however, can challenge the functioning of ecosystems in terms of resources and habitat availability. ● Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. ● Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. ● Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. ● Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). ● Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining	● How does photosynthesis fuel the biosphere? ● How are cell respiration and photosynthesis interrelated? ● What are the major steps in Cells Respiration? ● What are the major steps in photosynthesis? ● What are the reactants and products in both the photosynthesis and cell respiration equation?

	biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ● Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical thinking ● Creativity ● Analyzing

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. ● Use mathematical representations to support explanations about factors affecting biodiversity and populations in ecosystems of different scales. ● Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. ● Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. ● Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. ● Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. ● Summative tests
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: Grade 10: Honors Biology - Inheritance and Variation of Traits

Unit Name	What	How	Why
Inheritance and Variation of Traits **Topics in which this unit appears:** ● Mendelian Genetics ● Central Dogma/ Protein Synthesis ● Mutations and related diseases ● Mendelian Genetic ● Pedigree charts	● Students demonstrate understanding of the relationship of DNA and chromosomes in the processes of cellular division that pass traits from one generation to the next. ● Students can determine why individuals of the same species vary in how they look, function, and behave. ● Students can develop conceptual models for the role of DNA in the unity of life on Earth and use statistical models to explain the importance of variation within populations for the survival and evolution of species. ● Ethical issues related to genetic modification of organisms and the nature of science can be described. Students can explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expression.	● Ask questions and define problems that arise from examining models or a theory to clarify relationships. ● Develop and use models based on evidence to illustrate the relationships between systems or between components of a system. ● Analyze and interpret data while applying concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● Engage in arguments from evidence and evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	**To answer the question:** ● "How are the characteristics from one generation related to the previous generation?" ● What is the central dogma of biology? ● Why do mutations occur? where do they originate? ● What are the steps of protein synthesis? ● What are the jobs of proteins and enzymes in the body/ cell? ● What are the layers of folding found in a protein? ● What is a single gene mutation and what are some diseases that are caused by single gene mutations?

Windham School District Curriculum

Life Science: Inheritance and Variation of Traits - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
• HS-LS1-4
• HS-LS3-1
• HS-LS3-2
• HS-LS3-3</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
● Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
● Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
● Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
● Scale, Proportion, and Quantity Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).</td><td>ESSENTIAL QUESTIONS
● How does DNA control heredity?
● How does an organism’s DNA, along with the environment, determine an organism’s characteristics?
● How does the study of Mendelian Genetics allow us to determine and predict patterns of inheritance?
● How does the manipulation of genetics, reproduction, development and evolution affect the quality of human life?</td></tr>
</table>

	• Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy , matter, and information flows— within and between systems at different scales.	
	Acquisition	
	Students will know… • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. • In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA . The instructions for forming species' characteristics are carried in DNA . All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated	**Students will be skilled at…** • Asking questions and defining problems that arise from examining models or a theory to clarify relationships. • Developing and using models based on evidence to illustrate the relationships between systems or between components of a system. • Analyzing and interpreting data while applying concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. • Engaging in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

	in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. ● In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. ● Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. ● Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for inherited characteristic traits. ● Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. ● Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. ● Summative tests
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Honors Biology - Natural Selection and Evolution**

Unit Name	What	How	Why
Natural Selection and Evolution **Topics in which this unit appears:** ● Cell Structure ● Cell Function ● Photosynthesis ● Cell Respiration ● Central Dogma/ Protein Synthesis ● Anatomy ● Evolution ● Ecology	● Students can investigate patterns to find the relationship between the environment and natural selection. ● Students demonstrate understanding of the factors causing natural selection and the process of evolution of species over time. ● They demonstrate understanding of how multiple lines of evidence contribute to the strength of scientific theories of natural selection and evolution. ● Students can demonstrate an understanding of the processes that change the distribution of traits in a population over time and describe extensive scientific evidence ranging from the fossil record to genetic relationships among species that support the theory of biological evolution. ● Students can use models, apply statistics, analyze data, and produce scientific communications about evolution.	● Analyze and interpret data while applying concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● Construct explanations and design solutions based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Engage in arguments from evidence and evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Communicate scientific information in multiple formats	**To answer the question:** ● "How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms? How does biodiversity affect humans?" ● What is artificial selection? How is it related to natural selection? ● Who is Darwin and what contributions did he make to the living world? ● How has the diversity of life been shaped by evolution? ● What characteristics do all living things share? ● What scientific evidence supports natural selection?

Windham School District Curriculum

Honors Biology: Natural Selection and Evolution - Grade 10

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
• HS-LS2-1
• HS-LS2-2
• HS-LS2-6
• HS-LS2-7
• HS-LS2-8
• HS-LS4-6</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to:
● Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
● Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment .
● Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
● Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
● Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and</td><td>ESSENTIAL QUESTIONS
● How has the diversity of life been shaped by ongoing evolutionary change and our understanding of the relatedness of organisms has been a direct result of observation and technology?
● How does the process of science helps biologists investigate how nature works at all levels, from the molecules in cells to the</td></tr>
</table>

	sometimes the extinction–of some species. ● Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.	biosphere and follows a logical sequence of events?
	Acquisition	
	Students will know… ● Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. ● Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. ● The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. ● Evolution is a consequence of the interaction of four factors: (1) the	**Students will be skilled at…** ● Analyzing and interpreting data while applying concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● Constructing explanations and designing solutions based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Engaging in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

	potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. ● Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically , behaviorally , and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. ● Adaptation also means that the distribution of traits in a population can change when conditions change.	● Obtaining, evaluating, and communicating scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). ● "How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms? How does biodiversity affect humans?" ● What is artificial selection? How is it related to natural selection? ● Who is Darwin and what contributions did he make to the living world? ● How has the diversity of life been shaped by evolution? ● What characteristics do all living things share? ● What scientific evidence supports natural selection? ● How does DNA provide the raw material upon which Natural Selection can act? ● What evidence demonstrates that groups of organisms have changed over time? ● What characteristics do all living things share and how does variation upon these characteristics create the diversity of life on the planet? ● How does homeostasis coordinate the diverse and complex functions of the human body?

		● How are humans similar to all life on the planet and how are they different?
Used in Content Area Standards		***21st Century Skills***
not applicable		● collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	**Assessment Evidence**
	ASSESSMENT: ● Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. ● Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment . ● Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. ● Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification ● Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. ● Summative tests

<u>Title of Curriculum</u>: CP Chemistry: Properties of Matter - Grade 11

Unit Name	What	Why	How
Properties of Matter	Students will learn that... ● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.	● By understanding the structure and properties of matter, students gain the necessary background to study chemistry. The properties and concepts learned in this unit are frequently referenced and used in future topics to explain how bulk scale observations relate to the atomic scale structure.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

CP Chemistry: Properties of Matter - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
● HS-PS1-1
● HS-PS1-8</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
● Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
● Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</td><td>ESSENTIAL QUESTIONS
● How can one explain the structure and properties of matter?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
● The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns.</td><td>Students will be skilled at…
● Use a model to predict the relationships between systems or between components of a system.
● Develop a model based on evidence to illustrate the relationships between systems or between components of a system.</td></tr>
</table>

	The repeating patterns of this table reflect patterns of outer electron states. ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use the periodic table as a model to predict the relative properties of elements ● Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. ● Summative Assessments: Unit or sub-unit tests, ● Formal lab report
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: CP Chemistry: Electrical Forces in Chemistry - Grade 11

Unit Name	What	Why	How
Electrical Forces in Chemistry	Students will learn that... ● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. ● Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.	● By understanding the forces involved between atoms and molecules, students become able to predict the transformations that matter undergoes and can explain the mechanics behind them. Students become able to relate physical and chemical properties to the electrical attraction and repulsion between atoms.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

CP Chemistry: Electrical Forces in Chemistry - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
• HS-PS1-3
• HS-PS2-6</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
• Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
• Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena
• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</td><td>ESSENTIAL QUESTIONS
• “How can one explain the structure and properties of matter?”</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
• The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
• Attraction and repulsion between electric charges at the atomic scale explain the</td><td>Students will be skilled at…
• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to</td></tr>
</table>

	structure, properties, and transformations of matter, as well as the contact forces between material objects.	produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly ● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. ● Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. ● Summative Assessments: Unit or sub-unit tests ● Research Project
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: CP Chemistry: Chemical Reactions - Grade 11

Unit Name	What	Why	How
Chemical Reactions	Students will learn that... ● The repeating patterns of the periodic table can be used to predict chemical reactivity. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	● Students in this unit will learn how chemical reactions take place and how to predict their outcomes. Students will apply concepts that they learned in prior units in order to predict common reaction patterns and to create exact amounts of targeted chemicals in a reaction.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

CP Chemistry: Chemical Reactions - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-PS1-2
HS-PS1-7</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Construct and revise an explanation for the outcome with outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
The total amount of energy and matter in closed systems is conserved.
Science assumes the universe is a vast single system in which basic laws are consistent.</td><td>ESSENTIAL QUESTIONS
How do substances combine or change (react) to make new substances?
How does one characterize and explain these reactions and make predictions about them?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
The periodic table orders elements horizontally by the number of protons in</td><td>Students will be skilled at…
Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including</td></tr>
</table>

	the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	students' own investigations, models, theories, simulations, and peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Use mathematical representations of phenomena to support claims.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Construct and revise an explanation for the outcome of a simple chemical reaction. ● Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. ● Summative Assessments: Unit or sub-unit tests ● Performance lab assessment
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: **CP Chemistry: Energy - Grade 11**

Unit Name	What	Why	How
Energy	Students will learn that... ● A stable molecule has less energy than the set of individual atoms that make it up; one must provide at least this energy in order to take the molecule apart. ● Chemical processes, their rates, and whether or not energy is stored or released in a process can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules. Consequent changes in the sum of all bond energies in a set of molecules are matched by changes in kinetic energy.	● In this unit, students will learn energy's role in chemical reactions and how it can cause heat or light to be released or absorbed during a chemical reaction. Students will also learn how to manipulate the rate of a reaction.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

CP Chemistry: Energy - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-PS1-4
HS-PS1-5
HS-PS1-6</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Develop a model to illustrate that the release of absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
● Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
● Much of science deals with constructing explanations of how things change and how they remain stable.</td><td>ESSENTIAL QUESTIONS
● How do substances combine or change (react) to make new substances?
● How does one characterize and explain these reactions and make predictions about them?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● A stable molecule has less energy than the same set of atoms separated; one must</td><td>Students will be skilled at…
● Develop a model based on evidence to illustrate the relationships between</td></tr>
</table>

	provide at least this energy in order to take the molecule apart. ● Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	systems or between components of a system. ● Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. ● Refine a solution to a complex real world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.

Used in Content Area Standards	***21st Century Skills***
not applicable	● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop a model to illustrate that the release of absorption of energy from a chemical reaction system depends upon the changes in total bond energy. ● Apply scientific principles and evidence to provide an explanation about the rate at which a reaction occurs. ● Summative Assessments: Unit or sub-unit tests ● Lab data analysis
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Honors Chemistry: Properties of Matter -Grade 11

Unit Name	What	Why	How
Properties of Matter	Students will learn that... ● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy, and can be modeled mathematically. The total number of neutrons plus protons does not change in any nuclear process.	● By understanding the structure and properties of matter, students gain the necessary background to study chemistry. The properties and concepts learned in this unit are frequently referenced and used in future topics to explain how bulk scale observations relate to the atomic scale structure.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Honors Chemistry: Properties of Matter - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
● HS-PS1-1
● HS-PS1-8</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
● Develop conceptual and mathematical models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</td><td>ESSENTIAL QUESTIONS
● How can one explain the structure and properties of matter conceptually and mathematically?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
● The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with</td><td>Students will be skilled at…
● Using conceptual and mathematical models to predict the relationships between systems or between components of a system.
● Developing conceptual and mathematical models based on evidence to illustrate the</td></tr>
</table>

	similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.	relationships between systems or between components of a system.

Used in Content Area Standards	***21st Century Skills***
not applicable	● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use the periodic table as a model to predict the relative properties of elements ● Develop conceptual and mathematical models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. ● Summative Assessments: Unit or sub-unit tests, ● Formal lab report
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Honors Chemistry: Electrical Forces in Chemistry - Grade 11

Unit Name	What	Why	How
Electrical Forces in Chemistry	Students will learn that... ● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. ● Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.	● By understanding the forces involved between atoms and molecules, students become able to predict the transformations that matter undergoes and can explain the mechanics behind them. Students become able to relate physical and chemical properties to the electrical attraction and repulsion between atoms.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Honors Chemistry: Electrical Forces in Chemistry - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
• HS-PS1-3
• HS-PS2-6</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
● Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena
● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</td><td>ESSENTIAL QUESTIONS
● "How can one explain the structure and properties of matter conceptually and mathematically?"</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
● Attraction and repulsion between electric charges at the atomic scale explain the</td><td>Students will be skilled at…
● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to</td></tr>
</table>

	structure, properties, and transformations of matter, as well as the contact forces between material objects.	produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly ● Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. ● Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. ● Summative Assessments: Unit or sub-unit tests ● Research Project
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Honors Chemistry: Chemical Reactions - Grade 11

Unit Name	What	Why	How
Chemical Reactions	Students will learn that... ● The repeating patterns of the periodic table can be used to predict chemical reactivity. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	● Students in this unit will learn how chemical reactions take place and how to predict their outcomes. Students will apply concepts that they learned in prior units in order to predict common reaction patterns and to create exact amounts of targeted chemicals in a reaction.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Honors Chemistry: Chemical Reactions - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-PS1-2
HS-PS1-7</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Construct and revise an explanation for the outcome of chemical reactions based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
The total amount of energy and matter in closed systems is conserved.
Science assumes the universe is a vast single system in which basic laws are consistent.</td><td>ESSENTIAL QUESTIONS
How do substances combine or change (react) to make new substances?
How does one characterize and explain these reactions and make predictions about them?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
The periodic table orders elements horizontally by the number of protons in</td><td>Students will be skilled at…
Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including</td></tr>
</table>

	the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	students' own investigations, models, theories, simulations, and peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Use mathematical representations of phenomena to support claims.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Construct and revise an explanation for the outcome of a simple chemical reaction. ● Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. ● Summative Assessments: Unit or sub-unit tests ● Performance lab assessment
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Honors Chemistry: Energy - Grade 11

Unit Name	What	Why	How
Energy	Students will learn that... ● A stable molecule has less energy than the set of individual atoms that make it up; one must provide at least this energy in order to take the molecule apart. ● Chemical processes, their rates, and whether or not energy is stored or released in a process can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules. Consequent changes in the sum of all bond energies in a set of molecules are matched by changes in kinetic energy. ● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. ● Electromagnetic waves including radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, x-rays, and gamma rays, interact with matter.	● In this unit, students will learn energy's role in chemical reactions and how it can cause heat or light to be released or absorbed during a chemical reaction. Students will learn how light interacts with matter. Students will also learn how to manipulate the rate of chemical reactions using these concepts.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Honors Chemistry: Energy - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-PS1-4
HS-PS1-5
HS-PS1-6
HS-PS4-1
HS-PS4-3
HS-PS4-4
HS-PS4-5</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Apply an understanding of the wave and particle nature of light to describe how light interacts with matter.
● Develop a model to illustrate that the release of absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
● Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Changes of energy and matter in a system can be described mathematically in terms of energy and matter flows into, out of, and within that system.
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
● Much of science deals with constructing explanations of how things change and how they remain stable.</td><td>ESSENTIAL QUESTIONS
● How do substances combine or change (react) to make new substances?
● How does one characterize and explain these reactions and make predictions about them?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
</table>

	● A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. ● Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	● Develop a conceptual and mathematical model based on evidence to illustrate the relationships between systems or between components of a system. ● Apply scientific principles and evidence to provide a conceptual and mathematical explanation of phenomena and solve design problems, taking into account possible unanticipated effects. ● Refine a solution to a complex real world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop a model to illustrate that the release of absorption of energy from a chemical reaction system depends upon the changes in total bond energy. ● Apply scientific principles and evidence to provide an explanation about the rate at which a reaction occurs. ● Summative Assessments: Unit or sub-unit tests ● Lab data analysis
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: CP Physics - Forces and Interactions

Unit Name	What	How	Why
Forces and Interactions	Students will learn… ● How Newton's Laws of Motion, Gravitation and Coulomb's Law act at different scales and can be used to predict how objects will move.	● Unit and summative assessments ● Performance assessments predicting interactions between objects ● Unit specific research labs, research papers and projects	● Newton's second law accurately predicts changes in the motion of macroscopic objects

Windham School District Curriculum

CP Physics: Forces and Interactions - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

NGSS Content Standards:
• HS-PS2-1
• HS-PS2-2
• HS-PS2-3
• HS-PS2-4
• HS-PS2-5
• HS-ETS1-1
• HS-ETS1-2
• HS-ETS1-3</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
● Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system
● Apply scientific and engineering ideas to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision
● Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and electrostatic forces between objects
● Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current
● Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering
● Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability and aesthetics, as well as possible social, cultural and environmental impacts</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena</td><td>ESSENTIAL QUESTIONS
● What causes the motion of an object?
● How is motion described?
● What relationships exist between position, velocity, and acceleration?</td></tr>
</table>

	• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Systems can be designed to cause a desired effect. • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.	• How are free-body diagrams (FBD) used to explain outcomes of force interactions? • What is the strength and range of gravitational interactions? • How is work related to force, displacement and changes in energy? • How is energy transformed in open and closed systems? • How do charged objects interact and move from one place to another? • How do electrical circuits distribute charge in useful ways? • How is electricity generated and distributed and what are its environmental and economic costs?
	Acquisition	
	Students will know… • Newton's second law accurately predicts changes in the motion of macroscopic objects • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. • "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents.	**Students will be skilled at…** • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Use mathematical representations of phenomena to describe explanations.

	● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. ● Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability and aesthetics, and to consider social, cultural and environmental impacts	● Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. - Accident reconstruction - Trebuchet project
Used in Content Area Standards		***21st Century Skills***
		● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments predicting interactions between objects ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: CP Physics - Energy

Unit Name	What	How	Why
Energy	Students will learn... ● That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.	● Unit and summative assessments ● Unit specific research labs, research papers and projects	● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.

Windham School District Curriculum

CP Physics: Energy - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">ESTABLISHED GOALS:

Competencies (Standards):

NGSS Content Standards:
• HS-PS3-1
• HS-PS3-2
• HS-PS3-3
• HS-PS3-4
• HS-PS3-5
• HS-ETS1-1
• HS-ETS1-2
• HS-ETS1-3</td><td colspan="2">Transfer

Students will be able to
● Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
● Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
● Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
● Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
● Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants
● Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering
● Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability and aesthetics, as well as possible social, cultural and environmental impacts</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…</td><td>ESSENTIAL QUESTIONS
● What is energy and how does it interact with matter?</td></tr>
</table>

	• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. • Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. • Modern civilization depends on major technological systems. • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology	
	Acquisition	
	Students will know…	**Students will be skilled at…**

	● Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. ● Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. ● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. ● Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. ● The availability of energy limits what can occur in any system. ● When two objects interacting through a field change relative position, the energy stored in the field is changed.	● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. ● Create a computational model or simulation of a phenomenon, designed device, process, or system. ● Design, evaluate and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. ● Create a computational model or simulation of a phenomenon, design device, process or system. ● Analyze complex real-world problems by specifying criteria and constraints for successful solutions ● Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems ● Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence,

	● Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment ● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. ● Humanity faces major global challenges today, such as the need for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability and aesthetics, and to consider social, cultural and environmental impacts	prioritized criteria, and trade-off considerations ● Alternative Energy Project - Persuasive speech - Debates
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: CP Physics - Waves and Electromagnetic Radiation

Unit Name	What	How	Why
Waves and Electromagnetic Radiation	Students will learn... ● The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.	● Unit and summative assessments ● Unit specific research labs, research papers and projects	● Information can be digitized. in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.

Windham School District Curriculum

CP Physics: Waves and Electromagnetic Radiation - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

NGSS Content Standards:
• HS-PS4-1
• HS-PS4-2
• HS-PS4-3
• HS-PS4-4
• HS-PS4-5</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● Evaluate questions about the advantages of using a digital transmission and storage of information.
● Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other
● Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
● Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by</td><td>ESSENTIAL QUESTIONS
● What are the characteristics and behaviors of different types of waves?
● What is a standing wave and how does that relate to various musical instruments?
● How do waves interact with matter (including our eyes)?</td></tr>
</table>

	examining what is known about smaller scale mechanisms within the system. ● Systems can be designed to cause a desired effect. ● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows— within and between systems at different scales. ● Systems can be designed for greater or lesser stability. ● Science and engineering complement each other in the cycle known as research and development (R&D). ● Modern civilization depends on major technological systems. ● Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.	
	Acquisition	
	Students will know… ● Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. ● The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.	**Students will be skilled at…** ● Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. ● Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.

	• Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. • Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) • Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. • When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. • Photoelectric materials emit electrons when they absorb light of a high-enough frequency.	• Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. • Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

	• Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Unit and summative assessments • Unit specific research labs, research papers and projects
	OTHER EVIDENCE: • Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: Honors Physics - Forces and Interactions

Unit Name	What	How	Why
Forces and Interactions	Students will learn… ● how Newton's Laws of Motion, Gravitation and Coulomb's Law act at different scales and can be used to predict how objects will move.	● Unit and summative assessments ● Performance assessments predicting interactions between objects ● Unit specific research labs and projects	● Newton's second law accurately predicts changes in the motion of macroscopic objects

Windham School District Curriculum

Honors Physics: Forces and Interactions - Grade 11-12

Stage 1 Desired Results		
ESTABLISHED GOALS: *Competencies (Standards):* *NGSS Content Standards:* • HS-PS2-1 • HS-PS2-2 • HS-PS2-3 • HS-PS2-4 • HS-PS2-5 • HS-ETS1-1 • HS-ETS1-2 • HS-ETS1-3 • HS-ETS1-3	***Transfer*** *Students will be able to* ● Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration ● Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system ● Apply scientific and engineering ideas to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision ● Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects ● Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current ● Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering ● Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability and aesthetics, as well as possible social, cultural and environmental impacts	
	Meaning	
	ENDURING UNDERSTANDINGS **Students will understand that…** ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena	ESSENTIAL QUESTIONS ● How can one explain and predict interactions between systems? ● How can we predict the future? ● What causes the motion of an object? ● How is motion described?

	• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Systems can be designed to cause a desired effect. • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.	• What relationships exist between position, velocity, and acceleration? • How are free-body diagrams (FBD) used to explain outcomes of force interactions? • What is the strength and range of gravitational interactions? • How is work related to force, displacement and changes in energy? • How is energy transformed in open and closed systems? • How can collisions be classified as either elastic or inelastic? • Why do some collisions conserve both linear momentum and kinetic energy and some only conserve momentum? • How is impulse related to momentum? • What are the characteristics of different types of collisions? • How do charged objects interact and move from one place to another? • How do electrical circuits distribute charge in useful ways? • How is electricity generated and distributed and what are its environmental and economic costs?
	Acquisition	
	Students will know… • Newton's second law accurately predicts changes in the motion of macroscopic objects • Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object	**Students will be skilled at…** • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of

	• If a system interacts with objects outside itself, the total momentum of the system can change • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. • "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. • When evaluating solutions, it is important to take into account a range of constraints, including cost, safety,	the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Use mathematical representations of phenomena to describe explanations. ○ Forensic physics • Students will analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. Students organize data that represent the net force on a macroscopic object, its mass (which is held constant), and its acceleration (e.g., via tables, graphs, charts, vector drawings). • Students use tools, technologies, and/or models to analyze the data and identify relationships within the datasets. • Students use the analyzed data as evidence to describe that the relationship between the observed quantities is accurately modeled across the range of data by the formula $a = \Sigma F/m$. • Students use the data as empirical evidence to distinguish between causal and correlational relationships linking force, mass, and acceleration.

	reliability and aesthetics, and to consider social, cultural and environmental impacts	• Students clearly define the system of the interacting objects that is mathematically represented. • Using the given mathematical representations, students identify and describe the gravitational attraction between two objects as the product of their masses divided by the separation distance squared (Fg = −G m1m2 /d2), where a negative force is understood to be attractive. • Students correctly use the given mathematical formulas to predict the gravitational force between objects. • Students use vector math to analyze forces and changes in motion in two-dimensions (including uniform circular motion). • Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. ○ Trebuchet project
Used in Content Area Standards		***21st Century Skills***
		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments predicting interactions between objects ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Honors Physics - Energy**

Unit Name	What	How	Why
Energy	Students will learn... ● That there is a single quantity called energy. It is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.	● Unit and summative assessments ● Unit specific research labs, research papers and projects	● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.

Windham School District Curriculum

Honors Physics: Energy - Grade 11-12

<table>
<tr><th colspan="2">Stage 1 Desired Results</th></tr>
<tr><td rowspan="2">ESTABLISHED GOALS:

Competencies (Standards):

NGSS Content Standards:
• HS-PS3-1
• HS-PS3-2
• HS-PS3-3
• HS-PS3-4
• HS-PS3-5
• HS-ETS1-1
• HS-ETS1-2
• HS-ETS1-3</td><td>Transfer</td></tr>
<tr><td>Students will be able to
● Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
● Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
● Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
● Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).
● Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
● Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants
● Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering
● Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability and aesthetics, as well as possible social, cultural and environmental impacts</td></tr>
</table>

	Meaning	
	ENDURING UNDERSTANDINGS **Students will understand that…** ● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. ● When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. ● Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. ● Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. ● Modern civilization depends on major technological systems. Engineers continuously modify these technological systems. ● New technologies can have deep impacts on society and the environment, including	ESSENTIAL QUESTIONS ● What is energy and how does it interact with matter?

	some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology	
	Acquisition	
	Students will know… ● Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. ● These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.	**Students will be skilled at…** ● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. ● Create a computational model or simulation of a phenomenon, designed device, process, or system. ● Design, evaluate and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. ● Create a computational model or simulation of a phenomenon, design device, process or system. ● Analyze complex real-world problems by specifying criteria and constraints for successful solutions

	• Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. • Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. • The availability of energy limits what can occur in any system. • Uncontrolled systems always evolve toward more stable states— that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). • When two objects interacting through a field change relative position, the energy stored in the field is changed. • Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment • Criteria and constraints also include satisfying any requirements set by society,	• Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems • Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations

	such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. ● Humanity faces major global challenges today, such as the need for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability and aesthetics, and to consider social, cultural and environmental impacts	
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Honors Physics - Waves and Electromagnetic Radiation

Unit Name	What	How	Why
Waves and Electromagnetic Radiation	Students will learn... ● The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.	● Unit and summative assessments ● Unit specific research labs, research papers and projects	● Information can be digitized. in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.

Windham School District Curriculum

Honors Physics: Waves and Electromagnetic Radiation - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

NGSS Content Standards:
• HS-PS4-1
• HS-PS4-2
• HS-PS4-3
• HS-PS4-4
• HS-PS4-5</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
● Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● Evaluate questions about the advantages of using a digital transmission and storage of information.
● Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other
● Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
● Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by</td><td>ESSENTIAL QUESTIONS
● What are the characteristics and behaviors of different types or waves?
● What is a standing wave and how does that relate to various musical instruments?
● How are images formed by various mirrors and lenses?</td></tr>
</table>

	examining what is known about smaller scale mechanisms within the system. ● Systems can be designed to cause a desired effect. ● Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales. ● Systems can be designed for greater or lesser stability. ● Science and engineering complement each other in the cycle known as research and development (R&D). ● Modern civilization depends on major technological systems. ● Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.	● How do I see and why do I wear glasses or contact lenses? ● What is color and why are some things in nature certain colors?
	Acquisition	
	Students will know… ● Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. ● The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.	**Students will be skilled at…** ● Students identify and describe the relevant components in the mathematical representations. ● Students describe the stability and importance of the systems that employ digital information as they relate to the advantages and disadvantages of digital transmission and storage of information.

	• Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. • Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) • Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. • When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. • Photoelectric materials emit electrons when they absorb light of a high-enough frequency.	• Students identify and evaluate the given explanation that is to be supported by the claims, evidence, and reasoning to be evaluated, and that includes the following idea: Electromagnetic radiation can be described either by a wave model or a particle model, and for some situations one model is more useful than the other. • Evaluate the given evidence for interference behavior of electromagnetic radiation to determine how it supports the argument that electromagnetic radiation can be described by a wave model. • Evaluate the phenomenon of the photoelectric effect to determine how it supports the argument that electromagnetic radiation can be described by a particle model. • Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. • Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible.

	• Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.	• Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). • A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

Used in Content Area Standards	***21st Century Skills***
not applicable	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Unit and summative assessments • Unit specific research labs, research papers and projects
	OTHER EVIDENCE: • Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Human Anatomy & Physiology - Introduction

Unit Name	What	Why	How
Introduction to Human Anatomy & Physiology	Students will learn… ● define anatomy and physiology and explain how the two areas of study are related. ● define homeostasis and explain how the different body systems work to maintain it. ● explain the hierarchy of structural organization in the human body. ● name and locate on a diagram the nine abdominal regions and the four abdominal quadrants. ● list and locate on a drawing, torso model, and cat the major organs associated with each region or quadrant.	● What is the relationship between structure and function in the human body? ● How do the individual organ systems work together to maintain homeostasis? ● What is the universal language used in Anatomy & Physiology?	● Using Anatomical language to locate an object ● explain the hierarchy of structural organization in the human body.

Windham School District Curriculum

Anatomy & Physiology: Introduction to Anatomy & Physiology - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-LS1-2
HS-LS1-3

NGSS: Crosscutting Concepts
Patterns
Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Scale, proportion, and quantity
In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
Systems and system models
Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Use anatomical language correctly
Describe homeostasis and feedback loops
Identify the systems of the human body and describe their functions</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.
Anatomy and physiology are separate but closely related topics. A slight change in anatomy can have a significant effect on physiology (ex. Sickle Cell Anemia)
Feedback loops in the nervous and endocrine systems regulate conditions in the body and maintain homeostasis.
There is a universal language used in Anatomy & Physiology to prevent miscommunication.</td><td>ESSENTIAL QUESTIONS
What is the relationship between structure and function in the human body?
How do the individual organ systems work together to maintain homeostasis?
What is the universal language used in Anatomy & Physiology?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
</table>

understanding and testing ideas that are applicable throughout science and engineering. **Structure and function** ● The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and change** ● For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.	**Students will know…** How to: ● define anatomy and physiology and explain how the two areas of study are related. ● define homeostasis and explain how the different body systems work to maintain it. ● explain the hierarchy of structural organization in the human body. ● name and locate on a diagram the nine abdominal regions and the four abdominal quadrants. ● list and locate on a drawing, torso model, and cat the major organs associated with each region or quadrant. ● describe the different body planes and sections. ● list, describe, and locate on a diagram or cat the major surface landmarks, using proper anatomical terminology. ● describe the dorsal and ventral body cavities and explain the sub-cavities of each. ● construct a chart of the ten systems of the human body and the major function(s) and organs for each. ● describe and demonstrate the proper anatomical position.	**Students will be skilled at…** ● Using Anatomical language to locate an object
Used in Content Area Standards		***21st Century Skills***
		● one to one technology ● collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments locating parts of the body ● Unit specific research labs, research papers and projects ● Case studies
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Human Anatomy & Physiology - Skeletal System**

Unit Name	What	Why	How
The Skeletal System and Articulations	Students will learn… • There are 206 bones in the adult skeleton, each with their own markings. These can be divided into axial and appendicular skeletons. • There are distinct differences with the fetal skull (compared to the adult) to accommodate childbirth and brain growth. • There are several differences between the male and female pelvis to allow for childbirth • There are four main classifications of bones: long, short, flat, and irregular. • Living bone is both flexible and hard due to the components of its matrix • There are 3 functional categories of joints: synarthrotic, amphiarthrotic, and diarthrotic based on the amount of movement allowed by each. • There are 3 structural categories of joints: fibrous, cartilaginous, or synovial based on the material found separating the bones.	• How does the skeletal system contribute to homeostasis? • How does the structure of bone tissue reflect its function? • What are the essential functions of osseous tissue that are necessary for maintaining life? • How are the adult and fetal skeletons different? • How does the structure of the female pelvis reflect its function?	• Identifying the axial vs. appendicular skeleton. • Listing the functions of the skeletal system. • Distinguishing between the four main types of bones. • Learning the terms for different types of bone markings and be able to identify these on bones/drawings. • Identifying the major anatomical areas of long bones. • Identifying the microscopic anatomy of osseous (bone) tissue • Naming and describing the various types of fractures • Describing the process of fracture repair. • Identifying and name the bones of the skull on a human skull/drawing. • Contrasting the skull of an infant to the skull of an adult; explain the function of fontanels.

Windham School District Curriculum

Anatomy & Physiology: The Skeletal System & Articulations - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-LS1-2
HS-LS1-3
NGSS: Crosscutting Concepts
Patterns
● Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect
● Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
Systems and system models
● Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Distinguish between the axial and appendicular skeleton
● Explain how bones change over a person’s lifetime due to environmental factors
● Explain the different types of bones and how they develop
● Identify the different parts of bones and their significance in forming joints and making locomotion possible.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that...

● The skeletal system provides an internal framework for the body, protects organs, and anchors skeletal muscles to facilitate movement.
● Articulations hold bones together and allow movement.
● Bones are remodeled throughout life in response to hormones and mechanical stress.
● Many parts of bones are vitally important as sites of muscle attachment or sites of articulation with other bones.</td><td>ESSENTIAL QUESTIONS
● How does the skeletal system contribute to homeostasis?
● How does the structure of bone tissue reflect its function?
● What are the essential functions of osseous tissue that are necessary for maintaining life?
● How are the adult and fetal skeletons different?
● How does the structure of the female pelvis reflect its function?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
</table>

	Students will know…	Students will be skilled at…
Structure and function ● The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and change** ● For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.	● There are 206 bones in the adult skeleton, each with their own markings. These can be divided into axial and appendicular skeletons. ● There are distinct differences with the fetal skull (compared to the adult) to accommodate childbirth and brain growth. ● There are several differences between the male and female pelvis to allow for childbirth ● There are four main classifications of bones: long, short, flat, and irregular. ● Living bone is both flexible and hard due to the components of its matrix ● There are 3 functional categories of joints: synarthrotic, amphiarthrotic, and diarthrotic based on the amount of movement allowed by each. ● There are 3 structural categories of joints: fibrous, cartilaginous, or synovial based on the material found separating the bones.	● Identifying the axial vs. appendicular skeleton. ● Listing the functions of the skeletal system. ● Distinguishing between the four main types of bones. ● Learning the terms for different types of bone markings and be able to identify these on bones/drawings. ● Identifying the major anatomical areas of long bones. ● Identifying the microscopic anatomy of osseous (bone) tissue ● Naming and describing the various types of fractures ● Describing the process of fracture repair. ● Identifying and name the bones of the skull on a human skull/drawing. ● Contrasting the skull of an infant to the skull of an adult; explain the function of fontanels. ● Naming the parts of a typical vertebra and explain how the cervical, thoracic, and lumbar vertebrae differ from one another. ● Discussing the importance of intervertebral discs and spinal curvatures.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessment of skull bone identification and function ● Unit specific research labs, research papers and projects ● Case studies
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Human Anatomy & Physiology - Muscular System

<table>
<tr><th>Unit Name</th><th>What</th><th>Why</th><th>How</th></tr>
<tr>
<td>The Muscular System</td>
<td>Students will learn…
There are over 600 muscles in the human body which all provide movement, maintain posture, generate heat, and stabilize joints.
Describe the connective tissue wrappings of skeletal muscles and their purpose
Skeletal muscles are attached at least two points (origin & insertion) and they produce movement by shortening and pulling on the insertion.
Skeletal muscle is arranged in bundles with several layers of connective tissue.
Skeletal muscle is striated due to its microscopic arrangement.
Calcium ions play an important role in muscle contraction.
The Sliding Filament Theory describes the series of events, beginning with the release of ACh, that must occur in order for a muscle to contract.
oxygen is required for muscle contraction; in the absence of oxygen they will continue to work until they enter oxygen debt, leading to muscle fatigue.</td>
<td>How does the muscular system contribute to homeostasis?
How does the structure of muscle cells reflect their function?
How does exercise affect skeletal muscles?
How do the skeletal and muscular system work closely together to produce movement?</td>
<td>comparing and contrasting the 3 types of muscle (skeletal, smooth, & cardiac) with respect to structure, function, and location in the human body.
describing the microscopic anatomy of skeletal muscle
discussing the chemistry of a muscle contraction, including the action potential and sliding filament theory.
explaining the all-or none law and the different graded responses produced by skeletal muscle (twitch, tetanus)
explaining what the molecule ATP is and the 3 possible pathways through which muscles obtain energy for muscle contraction.
describing and locating (on model, diagram, cat/mink) the origin, insertion, and action of a selected number of skeletal muscles.</td>
</tr>
</table>

Windham School District Curriculum

Anatomy & Physiology: Muscular System - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards):
Content Standards:
HS-LS1-2,
HS-LS1-3
NGSS: Crosscutting Concepts
Patterns
● Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect
● Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
Systems and system models
● Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
● discuss the effects of aerobic and resistance exercise on skeletal muscles.
● describe the different types of skeletal muscles (prime mover, antagonist, synergist, fixator)
● discuss the concept of muscle fatigue and oxygen debt.
● compare and contrast the different types of muscle contractions (isotonic, isometric)
● explain what muscle tone is
● establish relationships between the location and function of various muscles and muscle group</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Skeletal muscles are attached to bones and voluntarily controlled.
● Muscles respond to a stimulus with graded responses.
● ATP is the main source of energy for muscles.
● Muscles work in antagonistic pairs to make complex movements possible.</td><td>ESSENTIAL QUESTIONS

● How does the muscular system contribute to homeostasis?
● How does the structure of muscle cells reflect their function?
● How does exercise affect skeletal muscles?
● How do the skeletal and muscular system work closely together to produce movement?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
</table>

<table>
<tr><td>

Structure and function

- The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Stability and change

- For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

</td><td>

Students will know…

- There are over 600 muscles in the human body which all provide movement, maintain posture, generate heat, and stabilize joints.
- Describe the connective tissue wrappings of skeletal muscles and their purpose
- Skeletal muscles are attached at least two points (origin & insertion) and they produce movement by shortening and pulling on the insertion.
- Skeletal muscle is arranged in bundles with several layers of connective tissue.
- Skeletal muscle is striated due to its microscopic arrangement.
- Calcium ions play an important role in muscle contraction.
- The Sliding Filament Theory describes the series of events, beginning with the release of ACh, that must occur in order for a muscle to contract.
- oxygen is required for muscle contraction; in the absence of oxygen they will continue to work until they enter oxygen debt, leading to muscle fatigue.

</td><td>

Students will be skilled at…

- comparing and contrasting the 3 types of muscle (skeletal, smooth, & cardiac) with respect to structure, function, and location in the human body.
- describing the microscopic anatomy of skeletal muscle
- discussing the chemistry of a muscle contraction, including the action potential and sliding filament theory.
- explaining the all-or none law and the different graded responses produced by skeletal muscle (twitch, tetanus)
- explaining what the molecule ATP is and the 3 possible pathways through which muscles obtain energy for muscle contraction.
- describing and locating (on model, diagram, cat/mink) the origin, insertion, and action of a selected number of skeletal muscles.

</td></tr>
<tr><td colspan="2">

Used in Content Area Standards

</td><td>

21st Century Skills

</td></tr>
<tr><td colspan="2">

not applicable

</td><td>

- one to one technology
- collaboration
- communication
- critical thinking
- creativity

</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessment of muscle identification (electronic scrapbook) ● Unit specific research labs, research papers and projects ● Case studies
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Human Anatomy & Physiology - Human Blood & Cardiovascular System**

Unit Name	What	Why	How
Human Blood & Cardiovascular System	Students will learn… • How to describe the composition of blood • How to describe the composition of plasma and discuss its importance in the human body. • All the cell types making up the formed elements of blood, their relative numbers, and the functions of each. • That blood is composed of nonliving fluid matrix (plasma) and formed elements (cells). • That there are several specific types of formed elements, each with its own specific function. • That any change in the normal range of numbers for formed elements will result in a physiological disorder. • The role of WBCs in immunity. • That all formed elements arise from a common stem cell in red bone marrow. • That ABO blood groups are classified based on the basis of antigens on the surface of most RBCs. • The immune implications of the Rh factor on RBCs,	• How does blood contribute to maintaining homeostasis in the human body? • How does the structure of blood reflect its function? • How does inheritance affect the ABO blood groups? • How does the cardiovascular system contribute to homeostasis? • How is the cardiovascular system central to all other systems? • How has medical technology impacted people living with cardiovascular issues?	• Explain the process by which blood cells are formed. • Describe the ABO and Rh blood groups. • Describe several homeostatic imbalances associated with blood and the effects each would have on the body (anemia, polythemia, leukopenia, leukocytosis, etc) • Apply the concepts and knowledge of genetics and ABO blood groups to perform a blood typing lab. • Trace the pathway of blood through the heart, including all chambers, vessels, and valves. • Compare the pulmonary and systemic circuits of blood flow. • Explain how the heart valves operate and what may occur when they do not operate properly. • Name the elements of the intrinsic conduction system and explain the pathway that electrical impulses follow through the heart. • Identify some of the major arteries and veins on a diagram or model. • Explain what blood pressure is and how various factors, such as heart rate, exercise, and posture, affect it. • Define pulse and be able to locate the major pulse points.

	especially during pregnancy and childbirth. • The terminology associated with the cardiac cycle, including systole, diastole, stroke volume, and cardiac output. • The difference and similarities in the structure and function of arteries, veins, and capillaries. • The “double-pump” mechanism of the heart; the right side is a pulmonary pump and the left is a systemic pump. • The events that occur from one heartbeat to the next as part of the cardiac cycle. • That arteries bring blood away from the heart and veins bring blood back to the heart. • That capillaries are important sites of gaseous exchange with tissue cells. • The factors that affect heart physiology including height, weight, general health, emotions, medications, posture, etc		

Windham School District Curriculum

Anatomy & Physiology: Human Blood & Cardiovascular System- Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr>
<td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-LS1-2
HS-LS1-3
NGSS: Crosscutting Concepts
Patterns
Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect
Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
Systems and system models
Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.</td>
<td colspan="2">Transfer</td>
</tr>
<tr>
<td colspan="2">Students will be able to
Define structure and function of blood and its common elements
Predict the result of mixed blood groups
Describe the life cycle of red and white blood cells
Describe the location of the heart in the body and identify its major anatomical areas on a model or diagram.
Discuss several diseases and disorders associated with the cardiovascular system.</td>
</tr>
<tr>
<td colspan="2">Meaning</td>
</tr>
<tr>
<td>ENDURING UNDERSTANDINGS
Students will understand that…
Blood serves as a vehicle for distributing body heat, transporting nutrients, respiratory gases, and other substances throughout the body.
Blood is composed of nonliving fluid matrix (plasma) and formed elements (cells).
Blood exerts pressure on blood vessels, and this pressure can be affected by many factors</td>
<td>ESSENTIAL QUESTIONS
How does blood contribute to maintaining homeostasis in the human body?
How does the structure of blood reflect its function?
How does inheritance affect the ABO blood groups?
How does the cardiovascular system contribute to homeostasis?
How is the cardiovascular system central to all other systems?
How has medical technology impacted people living with cardiovascular issues?</td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…</td>
<td>Students will be skilled at…</td>
</tr>
</table>

Structure and function ● The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and change** ● For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.	● How to describe the composition of blood ● How to describe the composition of plasma and discuss its importance in the human body. ● All the cell types making up the formed elements of blood, their relative numbers, and the functions of each. ● That blood is composed of nonliving fluid matrix (plasma) and formed elements (cells). ● That there are several specific types of formed elements, each with its own specific function. ● That any change in the normal range of numbers for formed elements will result in a physiological disorder. ● The role of WBCs in immunity. ● That all formed elements arise from a common stem cell in red bone marrow. ● That ABO blood groups are classified based on the basis of antigens on the surface of most RBCs. ● The immune implications of the Rh factor on RBCs, especially during pregnancy and childbirth. ● The terminology associated with the cardiac cycle, including systole, diastole, stroke volume, and cardiac output. ● The difference and similarities in the structure and function of arteries, veins, and capillaries. ● The “double-pump” mechanism of the heart; the right side is a pulmonary pump and the left is a systemic pump. ● The events that occur from one heartbeat to the next as part of the cardiac cycle. ● That arteries bring blood away from the heart and veins bring blood back to the heart.	● Explain the process by which blood cells are formed. ● Describe the ABO and Rh blood groups. ● Describe several homeostatic imbalances associated with blood and the effects each would have on the body (anemia, polythemia, leukopenia, leukocytosis, etc) ● Apply the concepts and knowledge of genetics and ABO blood groups to perform a blood typing lab. ● Trace the pathway of blood through the heart, including all chambers, vessels, and valves. ● Compare the pulmonary and systemic circuits of blood flow. ● Explain how the heart valves operate and what may occur when they do not operate properly. ● Name the elements of the intrinsic conduction system and explain the pathway that electrical impulses follow through the heart. ● Identify some of the major arteries and veins on a diagram or model. ● Explain what blood pressure is and how various factors, such as heart rate, exercise, and posture, affect it. ● Define pulse and be able to locate the major pulse points.

	• That capillaries are important sites of gaseous exchange with tissue cells. • The factors that affect heart physiology including height, weight, general health, emotions, medications, posture, etc.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Unit and summative assessments • Performance assessment of blood typing • Performance assessment of identifying structures and functions on a cow heart • Unit specific research labs, research papers and projects • Case studies
	OTHER EVIDENCE: • Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Human Anatomy & Physiology - Digestive System**

Unit Name	What	Why	How
Digestive System	Students will learn… ● That the digestive system breaks down food into particles small enough to be absorbed into the blood. ● That metabolism produces cellular energy (ATP) and accounts for all cellular activities in the body. ● The metabolic changes that occur in endurance athletes when they "hit the wall." ● The organs that make up the digestive system, including the GI tract and accessory organs such as the pancreas. ● That foods must be mechanically and chemically broken down to their building blocks to be absorbed. ● The key role that enzymes play in digestion. ● The specificity of enzymes; they are specific to one substrate and need appropriate pH & temperature to function properly. ● The major enzymes and the foodstuffs on which they act. ● How to define enzyme, metabolism, anabolism, and catabolism.	● How does the digestive system contribute to homeostasis? ● How are digestion and nutrition related? ● What occurs as food travels through the digestive system?	● Describing the gross and microscopic anatomy of the major digestive system organs and the selected accessory organs. ● Tracing a piece of food through the digestive system, indicating all organs used and the physical and chemical changes made to the food. ● Identifying on a cat, torso model, or in a diagram, all the organs of the alimentary canal and accessory organs. ● Describing the overall function of the digestive system and the general activities of each digestive system organ. ● Describing the composition and function of saliva. ● Describing the processes involved in breaking down each type of major macromolecule for energy or raw materials.

Windham School District Curriculum

Anatomy & Physiology: Digestive System- Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-LS1-2
HS-LS1-3
HS-LS1-6

NGSS: Crosscutting Concepts
Patterns
Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect
Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
Systems and system models
Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Define and distinguish between digestion and metabolism.
Discuss mechanical and chemical digestion of food and the absorption of the end products.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
each organ of the digestive system has a specific role and the general activities of each digestive system organ.
each type of food chemical has a different end product (protein, fat and carbohydrate)</td><td>ESSENTIAL QUESTIONS
How does the digestive system contribute to homeostasis?
How are digestion and nutrition related?
What occurs as food travels through the digestive system?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
That the digestive system breaks down food into particles small enough to be absorbed into the blood.
That metabolism produces cellular energy (ATP) and accounts for all cellular activities in the body.
The metabolic changes that occur in endurance athletes when they “hit the wall.”
The organs that make up the digestive system, including the GI tract and accessory organs such as the pancreas.</td><td>Students will be skilled at…
Describing the gross and microscopic anatomy of the major digestive system organs and the selected accessory organs.
Tracing a piece of food through the digestive system, indicating all organs used and the physical and chemical changes made to the food.
Identifying on a cat, torso model, or in a diagram, all the organs of the alimentary canal and accessory organs.
Describing the overall function of the digestive system and the general activities of each digestive system organ.</td></tr>
</table>

Structure and function ● The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and change** ● For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.	● That foods must be mechanically and chemically broken down to their building blocks to be absorbed. ● The key role that enzymes play in digestion. ● The specificity of enzymes; they are specific to one substrate and need appropriate pH & temperature to function properly. ● The major enzymes and the foodstuffs on which they act. ● How to define enzyme, metabolism, anabolism, and catabolism.	● Describing the composition and function of saliva. ● Describing the processes involved in breaking down each type of major macromolecule for energy or raw materials.

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessment to chemically identify different food chemicals ● Unit specific research labs, research papers and projects ● Case studies
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Human Anatomy & Physiology - Nutrition & Body Metabolism

Unit Name	What	Why	How
Nutrition & Body Metabolism	Students will learn… • Lipids insulate, protect, build cell structures, and provide energy; in the absence of carbohydrates fats will be used to produce ATP; Excess dietary fat is stored in the subcutaneous tissue. • Proteins form the bulk of cell structure and are carefully conserved by body cells. Amino acids will be used to make ATP when there is no other energy source available. • The liver is the body's key metabolic organ. • Basal metabolic rate is the total amount of energy used by the body at resting state; several factors affect the BMR. • How to critique their own eating and exercise habits and suggest ways to improve for a healthier lifestyle. • How to develop and defend a logical argument about the role of fast food and obesity in the United States	• How does nutrition contribute to homeostasis? • How does poor nutrition affect the other body systems?	• define nutrient and kilocalorie • list six major nutrient categories • Identify important dietary sources of nutrients and their main cellular uses in the body. • define: enzyme, metabolism, anabolism, and catabolism. • describe the metabolic role of the liver • explain the importance of energy balance in the body and predict the consequences of energy imbalance. • List several factors that influence metabolic rate and discuss the effects of each. • Assess their caloric intake over a 24 hour period

Windham School District Curriculum

Anatomy & Physiology: Nutrition & Body Metabolism- Grade 11-12

<table>
<tr><th colspan="2">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-LS1-2
HS-LS1-3
HS-LS1-6

NGSS: Crosscutting Concepts
Patterns
● Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect
● Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
Systems and system models
● Defining the system under study—specifying its boundaries and making explicit a model of</td>
<td>Transfer

Students will be able to

● Define metabolism, which includes all the chemical reactions that occur in the body to maintain life.
● Name the body's major energy fuel and how other food chemicals are used by the body</td></tr>
<tr><td>Meaning</td></tr>
<tr><td><table><tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● A dynamic balance exists between
● energy uptake and energy output. Interference with this balance may result in malnutrition or obesity.
● Total metabolic rate is the number of calories used by the body to accomplish ongoing daily activities. If TMR equals the total caloric intake body weight will stay the same.</td><td>ESSENTIAL QUESTIONS

● How does nutrition contribute to homeostasis?
● How does poor nutrition affect the other body systems?</td></tr></table></td></tr>
<tr><td>Acquisition</td></tr>
</table>

that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering. **Structure and function** ● The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and change** ● For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.	*Students will know…* 1. Lipids insulate, protect, build cell structures, and provide energy; in the absence of carbohydrates fats will be used to produce ATP; Excess dietary fat is stored in the subcutaneous tissue. 2. Proteins form the bulk of cell structure and are carefully conserved by body cells. Amino acids will be used to make ATP when there is no other energy source available. 3. The liver is the body's key metabolic organ. 4. Basal metabolic rate is the total amount of energy used by the body at resting state; several factors affect the BMR. 5. How to critique their own eating and exercise habits and suggest ways to improve for a healthier lifestyle. 6. How to develop and defend a logical argument about the role of fast food and obesity in the United States	*Students will be skilled at…* ● define nutrient and kilocalorie ● list six major nutrient categories ● Identify important dietary sources of nutrients and their main cellular uses in the body. ● define: enzyme, metabolism, anabolism, and catabolism. ● describe the metabolic role of the liver ● explain the importance of energy balance in the body and predict the consequences of energy imbalance. ● List several factors that influence metabolic rate and discuss the effects of each. ● Assess their caloric intake over a 24 hour period
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessment to create a nutritional plan for a desired effect ● Unit specific research labs, research papers and projects ● Case studies
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Human Anatomy & Physiology - Nervous Systems & Special Senses**

Unit Name	What	Why	How
Nervous System & Special Senses	Students will learn... • All nervous system structures are classified as part of the CNS or PNS. • Motor nerves of the PNS are classified on the basis of whether they stimulate skeletal muscle (somatic) or smooth/cardiac muscle and glands (autonomic) • A neuron influences other neurons by releasing neurotransmitters. • The brain is located in the cranial cavity of the skull and consists of cerebral hemispheres, diencephalon, brain stem, and cerebellum. • Several functional lobes of the cerebral hemispheres have been identified. • A nerve is a bundle of neuron processes wrapped in connective tissue coverings. • There are 12 pairs of cranial nerves, each with a specific name and function. • There are 31 pairs of spinal nerves, each with specific names and functions. • The autonomic nervous system has two subdivisions: parasympathetic and sympathetic. • The sympathetic division is involved with the "fight or flight" response.	• How does the nervous system contribute to homeostasis? • How does the nervous system interact with the other body systems? • How does the structure of a neuron reflect its function? • How do the special senses keep us informed of our surroundings? • How to the special senses work together with the nervous system? • What are the effects of aging on the functioning of the special senses?	• Explain the functional and structural classification of the nervous system. • List the major parts of the central nervous system and peripheral nervous system. • List the types of general sensory receptors and describe their functions. • Summarize the events that lead to the generation of a nerve impulse and its conduction from one neuron to another. • Identify and indicate the functions of major regions of the cerebral hemispheres, diencephalon, brain stem, and cerebellum on a human brain model, diagram, or sheep brain (dissection). • Name and describe the 3 meningeal layers and their functions. • Describe spinal cord structure and function. • Trace the pathway of light through the eye, to the retina, and then to the optic cortex of the brain. • Describe common diseases and disorders and the effects of aging associated with the special senses. • Explain the effect of legal and illegal drugs on brain chemistry, especially those that affect the dopamine reward pathways in the brain.

	• Describe the general structure of a neuron and relate structure to function. • identify the major cranial nerves by number and name. • List the major functions of prominent cranial nerves • Identify and describe the functions of the parts of an eye on a diagram, model, or sheep eye. • Compare and contrast rods and cones. • External/accessory structures of the eye include: extrinsic eye muscles, lacrimal apparatus, eyelids, & conjunctiva. • The exit of the optic nerve from the retina creates a blind spot. • Two fluids found in the eye are aqueous humor and vitreous humor. • The occipital lobe of the brain is involved with vision. • Eye reflexes include photopupillary reflex, accommodation, and convergence. • Neurotransmitters help to facilitate communication between neurons in the nervous system. • Many drugs affect levels of dopamine in the brain, changing the brain's reward system.		

Windham School District Curriculum

Anatomy & Physiology: Nervous System & Special Senses- Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-LS1-2
HS-LS1-3
HS-LS1-6

NGSS: Crosscutting Concepts
Patterns
● Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect
● Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
Systems and system models
● Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● List the general functions of the nervous system.
● Explain how the nervous system maintains body homeostasis with electrical signals; provides for sensation, higher mental functioning, and emotional response; and activates muscles and glands.
● Describe the structure of a neuron and how is it modified for its particular function.
● trace the pathway of light through the eye, to the retina, and then to the optic cortex of the brain.
● Identify the major structures of the brain and eye and relate these structures to their respective functions.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● A nerve impulse is an electrochemical event that causes changes in the neuron's plasma membrane permeability.
● The structure of a neuron is highly modified to allow it to conduct an electrical impulse over long distances.
● The special senses respond to different types of stimuli involved in vision, hearing, balance, smell, and taste.
● The lens is the major light bending structure of the eye.</td><td>ESSENTIAL QUESTIONS

● How does the nervous system contribute to homeostasis?
● How does the nervous system interact with the other body systems?
● How does the structure of a neuron reflect its function?
● How do the special senses keep us informed of our surroundings?
● How to the special senses work together with the nervous system?
● What are the effects of aging on the functioning of the special senses?</td></tr>
</table>

applicable throughout science and engineering. **Structure and function** ● The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and change** ● For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.		
	Acquisition	
	Students will know… ● All nervous system structures are classified as part of the CNS or PNS. ● Motor nerves of the PNS are classified on the basis of whether they stimulate skeletal muscle (somatic) or smooth/cardiac muscle and glands (autonomic) ● A neuron influences other neurons by releasing neurotransmitters. ● The brain is located in the cranial cavity of the skull and consists of cerebral hemispheres, diencephalon, brain stem, and cerebellum. ● Several functional lobes of the cerebral hemispheres have been identified. ● A nerve is a bundle of neuron processes wrapped in connective tissue coverings. ● There are 12 pairs of cranial nerves, each with a specific name and function. ● There are 31 pairs of spinal nerves, each with specific names and functions.	*Students will be skilled at…* ● Explain the functional and structural classification of the nervous system. ● List the major parts of the central nervous system and peripheral nervous system. ● List the types of general sensory receptors and describe their functions. ● Summarize the events that lead to the generation of a nerve impulse and its conduction from one neuron to another. ● Identify and indicate the functions of major regions of the cerebral hemispheres, diencephalon, brain stem, and cerebellum on a human brain model, diagram, or sheep brain (dissection). ● Name and describe the 3 meningeal layers and their functions. ● Describe spinal cord structure and function.

	• The autonomic nervous system has two subdivisions: parasympathetic and sympathetic. • The sympathetic division is involved with the "fight or flight" response. • Describe the general structure of a neuron and relate structure to function. • identify the major cranial nerves by number and name. • List the major functions of prominent cranial nerves • Identify and describe the functions of the parts of an eye on a diagram, model, or sheep eye. • Compare and contrast rods and cones. • External/accessory structures of the eye include: extrinsic eye muscles, lacrimal apparatus, eyelids, & conjunctiva. • The exit of the optic nerve from the retina creates a blind spot. • Two fluids found in the eye are aqueous humor and vitreous humor. • The occipital lobe of the brain is involved with vision. • Eye reflexes include photopupillary reflex, accommodation, and convergence. • Neurotransmitters help to facilitate communication between neurons in the nervous system. • Many drugs affect levels of dopamine in the brain, changing the brain's reward system.	• Trace the pathway of light through the eye, to the retina, and then to the optic cortex of the brain. • Describe common diseases and disorders and the effects of aging associated with the special senses. • Explain the effect of legal and illegal drugs on brain chemistry, especially those that affect the dopamine reward pathways in the brain.
Used in Content Area Standards		***21st Century Skills***

not applicable	- One to one technology - Collaboration - Communication - Critical thinking - Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: - Unit and summative assessments - Unit specific labs, research papers and projects - Case studies
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Human Anatomy & Physiology - Endocrine System

Unit Name	What	Why	How
Endocrine System	Students will learn… • The major glands of the endocrine system and the hormones they secrete. • That the production and secretion of hormones is influenced by other glands or by the concentration of certain substances in blood. • That hormone cascades are found all over the endocrine system, and a problem in any step in a given cascade can result in disease. • That the female reproductive system is very sensitive to levels of both sex steroids (estrogen and progesterone) and gonadotropins (FSH and LH). • That the tropic hormones secreted by the pituitary gland are vitally important in influencing the behavior of other endocrine glands.	• Why do we call the pituitary gland the "master gland?" • How do the nervous and endocrine systems work together to maintain homeostasis? • How does the over- or under-production of certain hormones lead to disease? • What purpose does the menstrual cycle serve in reproduction? •	• Identify on a model and/or diagram the location of the major glands of the endocrine system • Identify on a model and/or diagram the organs of the male and female reproductive systems. • Describe the steps in a hormone cascade, especially as they relate to the pituitary-hypothalamic axis. • Describe numerous negative feedback mechanisms involving the endocrine system • Describe the effect of FSH and LH on the function of the testes and the ovaries. • Describe the phases and events of the menstrual cycle. • Graph the levels of sex steroids and gonadotropins and their changes throughout the menstrual cycle.

Windham School District Curriculum

Anatomy & Physiology: Endocrine System - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-LS1-2
HS-LS1-3
NGSS: Crosscutting Concepts
Patterns
Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect
Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
Systems and system models
Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to...
Summarize the role of the endocrine system in regulating body functions.
Discuss the ways in which the nervous and endocrine systems work together to carry out negative feedback mechanisms.
Identify the major glands of the endocrine system and the hormones they secrete.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
The endocrine system and the nervous system both facilitate communication within the systems of the body, but in different ways
Many important negative feedback mechanisms involve interactions between the nervous and endocrine systems used to maintain homeostasis.
Changes in levels of hormones in the female reproductive system during the menstrual cycle allow for the proper development and birth of a child.</td>
<td>ESSENTIAL QUESTIONS
Why do we call the pituitary gland the “master gland?”
How do the nervous and endocrine systems work together to maintain homeostasis?
How does the over- or under-production of certain hormones lead to disease?
What purpose does the menstrual cycle serve in reproduction?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
The major glands of the endocrine system and the hormones they secrete.</td>
<td>Students will be skilled at…
Identify on a model and/or diagram the location of the major glands of the endocrine system</td></tr>
</table>

Structure and function ● The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. **Stability and change** ● For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.	● That the production and secretion of hormones is influenced by other glands or by the concentration of certain substances in blood. ● That hormone cascades are found all over the endocrine system, and a problem in any step in a given cascade can result in disease. ● That the female reproductive system is very sensitive to levels of both sex steroids (estrogen and progesterone) and gonadotropins (FSH and LH). ● That the tropic hormones secreted by the pituitary gland are vitally important in influencing the behavior of other endocrine glands.	● Identify on a model and/or diagram the organs of the male and female reproductive systems. ● Describe the steps in a hormone cascade, especially as they relate to the pituitary-hypothalamic axis. ● Describe numerous negative feedback mechanisms involving the endocrine system ● Describe the effect of FSH and LH on the function of the testes and the ovaries. ● Describe the phases and events of the menstrual cycle. ● Graph the levels of sex steroids and gonadotropins and their changes throughout the menstrual cycle.

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific labs, research papers and projects ● Case studies
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Advanced Placement Computer Science Principles - Global Impact**

Unit Name	What	Why	How
Global Impact	Students will learn… ● How computing innovations affect communication, interaction, and cognition. ● How computing has impacted innovations in other fields.	● How does computing enhance human communication, interaction, and cognition? ● How does computing enable innovation? ● What are some potential beneficial and harmful effects of computing? ● How do economic, social, and cultural contexts influence innovation and the use of computing?	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects.

Windham School District Curriculum

Advanced Placement Computer Science Principles: Global Impact

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
Big Idea 1: Creativity
Computing is a creative activity.

Big Idea 3: Data and Information

● Data and information facilitate the creation of knowledge. Managing and interpreting an overwhelming amount of raw data is part of the foundation of our information society and technology.

Big Idea 6: The Internet

● The Internet and systems built on it have a profound impact on society. It pervades modern computing.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Explain how computing innovations affect communication, interaction, and cognition.
● Explain how computing has impacted innovations in other fields.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Computing enhances communication, interaction, and cognition.
● Computing enables innovation in nearly every field.
● Computing has a global effect - both beneficial and harmful - on people and society.
● Computing innovations influence and are influenced by the economic, social, and cultural contexts in which they are designed and used.</td><td>ESSENTIAL QUESTIONS
● How does computing enhance human communication, interaction, and cognition?
● How does computing enable innovation?
● What are some potential beneficial and harmful effects of computing?
● How do economic, social, and cultural contexts influence innovation and the use of computing?</td></tr>
<tr><td colspan="2">Acquisition
</td></tr>
<tr><td></td><td>Students will know…
● The definition of ASCII, audio compression, bandwidth, binary search, bits, ciphers, cookies, cryptography, data</td><td>Students will be skilled at…
● Explain how people participate in a problem-solving process that scales.</td></tr>
</table>

Big Idea 7: Global Impact ● *Computation has changed the way people think, work, live, and play..* *TECH.8.1.12.A.CS1- [Content Statement] - Understand and use technology systems.* *TECH.8.1.12.C.CS1- [Content Statement] - Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.* *TECH.8.1.12.C.CS3- [Content Statement] - Develop cultural understanding and global awareness by engaging with learners of other cultures.* *TECH.8.1.12.D.CS1- [Content Statement] - Advocate and practice safe, legal, and responsible use of information and technology.* *TECH.8.1.12.D.1- [Cumulative Progress Indicator] - Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.* *TECH.8.1.12.D.2- [Cumulative Progress Indicator] - Evaluate consequences of unauthorized electronic access (e.g., hacking) and disclosure, and on dissemination of personal information.* *TECH.8.1.12.D.3- [Cumulative Progress Indicator] - Compare and contrast policies on filtering and censorship both locally and globally.* *TECH.8.1.12.D.4- [Cumulative Progress Indicator] - Research and understand the positive and negative impact of one's digital footprint.* *TECH.8.1.12.D.5- [Cumulative Progress Indicator] - Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.* *12.9.3.ST-SM.3- [Standard Statement] - Analyze the impact that science and mathematics has on society.* *12.9.3.ST-SM.4- [Standard Statement] - Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.*	mining, decryption, encryption, HTML, indexes, Internet, IP, ISP, metadata, modelling, Moore's Law, networks, packets, peer-to-peer architecture, queries, router, spectrum, TCP, WPA. ● Various technologies that have affected communication, interaction, and cognition, including email, SMS, video chat, social media, cloud computing, public data, search trends, GPA, sensor networks, assistive technologies, and the Internet. ● Scaling is an important part of digital problem solving. ● Access to digital information raises legal and ethical concerns. ● The innovation and impact of social media and online access varies in different countries and in different socioeconomic groups.	● Analyze the beneficial and harmful effects of computing. ● Explain the connections between computing and economic, social, and cultural contexts.
Used in Content Area Standards		***21st Century Skills***

not applicable	● Critical thinking ● Creativity ● Collaboration ● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Performance assessments/projects ● Summative Assessments: Unit or sub-unit tests, ● Formal lab report
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Advanced Placement Computer Science Principles - Digital Information

Unit Name	What	Why	How
Digital Information	Students will learn... ● Digital data is represented by abstractions at different levels which, at its lowest level, is represented by bits. ● Number bases, including binary, decimal, and hexadecimal are used to represent and investigate digital data. ● There are trade-offs when representing information as digital data. ● A variety of abstractions built on binary sequences can be used to represent all data.	● How are vastly different kinds of data, physical phenomena, and mathematical concepts represented on a computer?	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Computer Science Principles: Digital Information

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

Big Idea 1: Creativity

● Computing is a creative activity.

Big Idea 2: Abstraction

● Abstraction is a central problem-solving technique in computer science.

Big Idea 5: Programming

● Programming enables problem solving, human expression, and creation of knowledge. It results in the creation of software, and it facilitates the creation of computational artifacts, including music, images, and visualizations.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Describe the variety of abstractions used to represent data.
● Explain how binary sequences are used to represent digital data.
● Analyze how data representation, storage, security, and transmission of data involve computational manipulation of information.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● A variety of abstractions built on binary sequences can be used to represent all data.
● Multiple levels of abstraction are used to write programs or create other computational artifacts.
● Computing facilitates exploration and the discovery of connections in information.
● There are trade-offs when representing information as digital data.</td><td>ESSENTIAL QUESTIONS
●
● How can computing extend traditional forms of human expression and experience?
● How are vastly different kinds of data, physical phenomena, and mathematical concepts represented on a computer?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
</table>

Big Idea 6: The Internet ● *The Internet and systems built on it have a profound impact on society. It pervades modern computing.* *TECH.8.1.12.A.1- [Cumulative Progress Indicator] - Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.* *TECH.8.1.12.A.3- [Cumulative Progress Indicator] - Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.* *TECH.8.2.12.A.2- [Cumulative Progress Indicator] - Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.* *TECH.8.2.12.E.1- [Cumulative Progress Indicator] - Demonstrate an understanding of the problem-solving capacity of computers in our world.* *TECH.8.2.12.E.2- [Cumulative Progress Indicator] - Analyze the relationships between internal and external computer components.* *TECH.8.2.12.E.4- [Cumulative Progress Indicator] - Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).* *12.9.3.ST-SM.2- [Standard Statement] - Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.*	● Digital data is represented by abstractions at different levels which, at its lowest level, is represented by bits. ● Number bases, including binary, decimal, and hexadecimal are used to represent and investigate digital data. ● A finite representation is used to model the infinite mathematical concept of a number. ● In many programming languages, the fixed number of bits used to represent characters or integers limits the range of integer values and mathematical operations; this limitation can result in overflow or other errors. ● Large data sets provide opportunities and challenges for extracting information and knowledge. ● Computing tools facilitate the discovery of connections in information within large data sets. ● Metadata is data about data. ● Digital data representations involve trade-offs related to storage, security, and privacy concerns. ● Data is stored in many formats depending on its characteristics.	● Using relevant skills to effectively collaborate with peers. ● Understanding and using various number bases to represent digital data. ● Developing an abstraction when writing a program. ● Extracting relevant information from large data sets.

12.9.3.ST-ET.2- [Standard Statement] - Display and communicate STEM information.		

Used in Content Area Standards	***21st Century Skills***
not applicable	● Critical thinking ● Creativity ● Collaboration ● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs ● Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests, ● Research Project
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Advanced Placement Computer Science Principles - The Internet

Unit Name	What	Why	How
The Internet	Students will learn... • Digital data representations involve trade-offs related to storage, security, and privacy concerns. • Data is stored in many formats depending on its characteristics. • The Internet connects devices and networks all over the world. • An end-to-end architecture facilitates connecting new devices and networks on the Internet.	• What is the Internet? • How is it built? • How does it function?	• Formative assessments such as: homework, quizzes, mini-labs and lab investigations • Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Computer Science Principles: The Internet

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

Big Idea 6: The Internet

The Internet and systems built on it have a profound impact on society. It pervades modern computing.

Big Idea 7: Global Impact
Computation has changed the way people think, work, live, and play..</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
● Analyze how data representation, storage, security, and transmission of data involve computational manipulation of information.
● Explain the abstractions in the Internet and how the Internet functions.
● Explain characteristics of the Internet and the systems built on it.
● Explain how the characteristics of the Internet influence the systems built on it.
● Identify existing cybersecurity concerns and potential options to address these issues with the Internet and the systems built on it.
● Analyze the beneficial and harmful effects of computing.
● Explain the connections between computing and economic, social, and cultural contexts.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that...
● There are trade-offs when representing information as digital data.
● The Internet is a network of autonomous systems.
● Characteristics of the Internet influence the systems built on it.
● Cybersecurity is an important concern for the Internet and the systems built on it.
● Computing has a global effect - both beneficial and harmful - on people and society.</td><td>ESSENTIAL QUESTIONS
● How can computation be employed to help people process data and information to gain insight and knowledge?
● How can computation be employed to facilitate exploration and discovery when working with data?
● What considerations and trade-offs arise in the computational manipulation of data?
● What is the Internet? How is it built? How does it function?
● What aspects of the Internet's design and development have helped it scale and flourish?</td></tr>
</table>

	• Computing innovations influence and are influenced by the economic, social, and cultural contexts in which they are designed and used.	• How is cybersecurity impacting the ever-increasing number of Internet users? • How does computing enhance human communication, interaction, and cognition? • How does computing enable innovation? • What are some potential beneficial and harmful effects of computing? • How do economic, social, and cultural contexts influence innovation and the use of computing?
	Acquisition	
	Students will know… • Digital data representations involve trade-offs related to storage, security, and privacy concerns. • Data is stored in many formats depending on its characteristics. • The Internet connects devices and networks all over the world. • An end-to-end architecture facilitates connecting new devices and networks on the Internet. • Connecting new devices to the Internet is enabled by assignment of an Internet protocol (IP) address. • The Internet is built on evolving standards, including those for addresses and names (i.e. DNS, IPv6, HTTP, SMTP). • The Internet and the systems built on it are hierarchical and redundant. • Hierarchy and redundancy help systems scale.	Students will be skilled at… • Understanding the positive and negative aspects of the Internet. • Identifying security concerns related to the Internet and how these concerns compare to the pre-Internet world. • Trace the evolution of the Internet in terms of its standards and security protocols. • Understanding how issues related to the Internet differ in the developing world.

	- Interfaces and protocols enable widespread use of the Internet. - Open standards fuel the growth of the Internet. - The Internet is a packet-switched system through which digital data is sent by breaking the data into blocks of bits called packets, which contain both the data being transmitted and control information for routing the data. - The bandwidth of a system is a measure of bit rate - the amount of data (measured in bits) that can be sent in a fixed amount of time. - The trust model of the Internet involves trade-offs. - Implementing cybersecurity has software, hardware, and human components. - Cyber warfare and cyber crime have widespread and potentially devastating effects. - Access to digital information raises legal and ethical concerns. - The innovation and impact of social media and online access varies in different countries and in different socioeconomic groups.	

Used in Content Area Standards	***21st Century Skills***
not applicable	- Critical thinking - Creativity - Collaboration - Communication - Information literacy

	● Technology literacy ● Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests ● Performance lab assessment
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Advanced Placement Computer Science Principles - Programming

Unit Name	What	Why	How
Programming	Students will learn... ● Creating computational artifacts employs an iterative and often exploratory process to translate ideas into tangible form. ● A computational artifact is something created by a human using a computer and can be, but is not limited to, a program, an image, audio, video, a presentation, or a Web page file. ● Creating computational artifacts requires understanding of and use of software tools and services.	● How can computing and the use of computational tools foster creative expression? ● How can computing extend traditional forms of human expression and experience? ● How are vastly different kinds of data, physical phenomena, and mathematical concepts represented on a computer? ● How does abstraction help us in writing programs, creating computational artifacts, and solving problems?	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Computer Science Principles: Programming

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

Big Idea 2: Abstraction

- *Abstraction is a central problem-solving technique in computer science.*

Big Idea 4: Algorithms

- *Algorithms are used to develop and express solutions to computational problems. They are fundamental to even the most basic everyday task.*

Big Idea 5: Programming

- *Programming enables problem solving, human expression, and creation of knowledge. It results in the creation of software, and it facilitates the creation of*

Transfer

Students will be able to

- Apply a creative development process when creating computational artifacts.
- Create a computational artifact for creative expression
- Collaborate in the creation of computational artifacts.
- Use computing tools and techniques for creative expressions
- Develop an abstraction when writing a program or creating other computational artifacts.
- Use multiple levels of abstraction to write programs.

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- Creative development can be an essential process for creating computational artifacts.
- Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem.
- Computing can extend traditional forms of human expression and experience.
- A variety of abstractions built on binary sequences can be used to represent all data.
- Multiple levels of abstraction are used to write programs or create other computational artifacts.

ESSENTIAL QUESTIONS

- How can a creative development process affect the creation of computational artifacts?
- How can computing and the use of computational tools foster creative expression?
- How can computing extend traditional forms of human expression and experience?
- How are vastly different kinds of data, physical phenomena, and mathematical concepts represented on a computer?
- How does abstraction help us in writing programs, creating computational artifacts, and solving problems?
- How can computational models and simulations help generate new understanding and knowledge?

computational artifacts, including music, images, and visualizations.	● Algorithms are precise sequences for instructions for processes that can be executed by a computer and are implemented using programming languages. ● Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge, or to solve problems (to help people, organizations, or society). ● Programming is facilitated by appropriate abstractions.	● How are algorithms implemented and executed on computers and computational devices? ● Why are some languages better than others when used to implement algorithms? ● What kinds of problems are easy, what kinds are difficult, and what kinds are impossible to solve algorithmically? ● How are algorithms evaluated? ● How are programs developed to help people, organizations, or society solve problems? ● How are programs used for creative expression, to satisfy personal curiosity, or to create new knowledge? ● How do computer programs implement algorithms? ● How does abstraction make the development of computer programs possible? ● How do people develop and test computer programs? ● Which mathematical and logical concepts are fundamental to computer programming?
	Acquisition	
	Students will know… ● A creative process in the development of a computational artifact can include, but is not limited to, employing nontraditional, non-prescribed techniques; the use of novel combinations of artifacts, tools, and techniques; and the exploration of personal curiosities. ● Creating computational artifacts employs an iterative and often exploratory process to translate ideas into tangible form.	Students will be skilled at… ● Creating computational artifacts using various tools and techniques. ● Collaborating with others to create engaging artifacts of various types. ● Analyzing the components of successful computational artifacts to determine how to use them in other work. ● Developing software using multiple levels of abstractions.

	- A computational artifact is something created by a human using a computer and can be, but is not limited to, a program, an image, audio, video, a presentation, or a Web page file. - Creating computational artifacts requires understanding of and use of software tools and services. - A collaboratively created computational artifact reflects effort by more than one person. - Effective collaborative teams practice interpersonal communication, consensus building, conflict resolution, and negotiation. - Creating digital effects, images, audio, video, and animations has transformed industries. - The process of developing an abstraction involves removing detail and generalizing functionality. - Software is developed using multiple levels of abstractions, such as constants, expressions, statements, procedures, and libraries. - Sequencing, selection, and iteration are building blocks of algorithms. - Sequencing is the application of each step of an algorithm in the order in which the statements are given. - Different algorithms can be developed to solve the same problem. - Programs are developed and used in a variety of ways by a wide range of people	Developing different algorithms to solve the same problem.

	depending on the goals of the programmer. ● Additional desired outcomes may be realized independently of the original purpose of the program. ● A computer program or the results of running a program may be rapidly shared with a large number of users and can have widespread impact of individuals, organizations, and society. ● Collaboration can decrease the size and complexity of tasks required of individual programmers. ● Collaboration in the iterative development of a program requires different skills than developing a program alone. ● Procedures are reusable programming abstractions.	

Used in Content Area Standards	***21st Century Skills***
not applicable	● Critical thinking ● Creativity ● Collaboration ● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs ● Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests ● Lab data analysis
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: **Advanced Placement Computer Science Principles - Data**

Unit Name	What	Why	How
Data	Students will learn... ● Digital data representations involve trade-offs related to storage, security, and privacy concerns. ● Data is stored in many formats depending on its characteristics.	● How does computing enable innovation? ● How can computation be employed to help people process data and information to gain insight and knowledge? ● How can computation be employed to facilitate exploration and discovery when working with data? ● What considerations and trade-offs arise in the computational manipulation of data? ● What opportunities do large data sets provide for solving problems and creating knowledge?	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Computer Science Principles: Data

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):
Content Standards:

Big Idea 1: Creativity
Computing is a creative activity.

Big Idea 2: Abstraction
Abstraction is a central problem-solving technique in computer science.
Big Idea 3: Data and Information
Data and information facilitate the creation of knowledge. Managing and interpreting an overwhelming amount of raw data is part of the foundation of our information society and technology.
Big Idea 5: Programming
Programming enables problem solving, human expression, and creation of</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to...
Use computers to process information, find patterns, and test hypotheses about digitally processed information to gain insight and knowledge.
Explain the insight and knowledge gained from digitally processed media by using appropriate visualizations, notations, and precise language.
Extract information from data to discover and explain connections, patterns, or trends.
Analyze how data representation, storage, security, and transmission of data involve computational manipulation of information.
Identify existing cybersecurity concerns and potential options to address these issues with the Internet and the systems built on it.
Analyze the beneficial and harmful effects of computing.
Explain the connections between computing and economic, social, and cultural contexts.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that...
People use computer programs to process information to gain insight and knowledge.
Computing facilitates exploration and the discovery of connections in information.
There are trade-offs when representing information as digital data.
Programs can be developed for creative expression, to satisfy personal curiosity, to</td><td>ESSENTIAL QUESTIONS
How does computing enable innovation?
How can computation be employed to help people process data and information to gain insight and knowledge?
How can computation be employed to facilitate exploration and discovery when working with data?
What considerations and trade-offs arise in the computational manipulation of data?</td></tr>
</table>

<table>
<tr>
<td rowspan="3">knowledge. It results in the creation of software, and it facilitates the creation of computational artifacts, including music, images, and visualizations.

Big Idea 6: The Internet

● The Internet and systems built on it have a profound impact on society. It pervades modern computing.

Big Idea 7: Global Impact

● Computation has changed the way people think, work, live, and play..</td>
<td>create new knowledge, or to solve problems (to help people, organizations, or society).
● Cybersecurity is an important concern for the Internet and the systems built on it.
● Computing has a global effect - both beneficial and harmful - on people and society.
● Computing innovations influence and are influenced by the economic, social, and cultural contexts in which they are designed and used.</td>
<td>● What opportunities do large data sets provide for solving problems and creating knowledge?
● How can computing and the use of computational tools foster creative expression?</td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…
● Creating computational artifacts employs an iterative and often exploratory process to translate ideas into tangible form.
● Digital data is represented by abstractions at different levels which, at its lowest level, is represented by bits.
● The process of developing an abstraction involves removing detail and generalizing functionality.
● Large data sets provide opportunities and challenges for extracting information and knowledge.
● Computing tools facilitate the discovery of connections in information within large data sets.
● Digital data representations involve trade-offs related to storage, security, and privacy concerns.
● Data is stored in many formats depending on its characteristics.</td>
<td>Students will be skilled at…
● Collaborating with peers to create computational artifacts that collect or aggregate data.
● Understanding the limitations of algorithms in collecting and interpreting data.
● Understanding the ethical implications of data collection through computational artifacts.
● Creating a web app that collects data of some kind about its users.</td>
</tr>
</table>

	● Creating computational artifacts requires understanding of and use of software tools and services. ● Software is developed using multiple levels of abstractions, such as constants, expressions, statements, procedures, and libraries.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical thinking ● Creativity ● Collaboration ● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs ● Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests
	OTHER EVIDENCE: ● Computer programs/code creation

Title of Curriculum: **Advanced Placement Computer Science Principles - Performance Tasks**

Unit Name	What	Why	How
Performance Tasks	Students will learn... ● Creating computational artifacts uses an iterative and often exploratory process to translate ideas into tangible form. ● A collaboratively created computational artifact reflects effort by more than one person. ● Effective collaborative teams practice interpersonal communication, consensus building, conflict resolution, and negotiation.	● How are algorithms implemented and executed on computers and computational devices? ● What kinds of problems are easy, what kinds are difficult, and what kinds are impossible to solve algorithmically?	● Formative assessments such as: homework, quizzes ● Summative assessments - produce a computational artifact

Windham School District Curriculum

Advanced Placement Computer Science Principles: Performance Tasks

Stage 1 Desired Results	
ESTABLISHED GOALS: *Competencies (Standards):* *Content Standards:* Big Idea 1: Creativity Computing is a creative activity. Big Idea 2: Abstraction *Abstraction is a central problem-solving technique in computer science.* *Big Idea 3: Data and Information* *Data and information facilitate the creation of knowledge. Managing and interpreting an overwhelming amount of raw data is part of the foundation of our information society and technology.* *Big Idea 4: Algorithms* ● *Algorithms are used to develop and express solutions to computational problems. They*	***Transfer*** *Students will be able to* ● Create a computational artifact for creative expression. ● Create a computational artifact using computing tools and techniques to solve a problem. ● Create a new computational artifact by combining or modifying existing artifacts. ● Collaborate in the creation of computational artifacts. ● Analyze the correctness, usability, functionality, and suitability of computational artifacts. ● Develop an abstraction when writing a program or other computational artifacts. ● Use multiple levels of abstraction to write programs. ● Analyze how data representation, storage, security, and transmission of data involve computational manipulation of information. ● Develop an algorithm for implementation in a program. ● Express an algorithm in a language. ● Develop a program for creative expression, to satisfy personal curiosity, or to create new knowledge. ● Develop a correct program to solve problems. ● Collaborate to develop a program. ● Explain how programs implement algorithms. ● Use abstraction to manage complexity in programs. ● Evaluate the correctness of a program. ● Employ appropriate mathematical and logical concepts in programming. ● Explain how computing innovations affect communication, interaction, and cognition. ● Explain how computing has impacted innovations in other fields. ● Analyze the beneficial and harmful effects of computing. ● Explain the connections between computing and economic, social, and cultural contexts.

are fundamental to even the most basic everyday task. *Big Idea 5: Programming* ● *Programming enables problem solving, human expression, and creation of knowledge. It results in the creation of software, and it facilitates the creation of computational artifacts, including music, images, and visualizations.* *Big Idea 6: The Internet* ● *The Internet and systems built on it have a profound impact on society. It pervades modern computing.* *Big Idea 7: Global Impact* ● *Computation has changed the way people think, work, live, and play..*		
	Meaning	
	ENDURING UNDERSTANDINGS Students will understand that… ● Computing enables people to use creative development processes to create computational artifacts for creative expression or to solve a problem. ● Multiple levels of abstraction are used to write programs or create other computational artifacts. ● There are trade-offs when representing information as digital data. ● Algorithms are precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages. ● Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge, or to solve problems (to help people, organizations, or society). ● People write programs to execute algorithms. ● Programming is facilitated by appropriate abstractions. ● Programs are developed, maintained, and used by people for different purposes. ● Programming uses mathematical and logical concepts. ● Computing enhances communication, interaction, and cognition.	ESSENTIAL QUESTIONS ● How are algorithms implemented and executed on computers and computational devices? ● What kinds of problems are easy, what kinds are difficult, and what kinds are impossible to solve algorithmically? ● How are programs developed to help people, organizations, or society solve problems? ● How are programs used for creative expression, to satisfy personal curiosity, or to create new knowledge? ● How do computer programs implement algorithms? ● How do people develop and test computer programs? ● What aspects of the Internet’s design and development have helped it scale and flourish? ● How does computing enable innovation? ● How can computation be employed to help people process data and information to gain insight and knowledge? ● How can computation be employed to facilitate exploration and discovery when working with data? ● What considerations and trade-offs arise in the computational manipulation of data? ● What opportunities do large data sets provide for solving problems and creating knowledge?

	• Computing enables innovation in nearly every field. • Computing has a global effect - both beneficial and harmful - on people and society. • Computing innovations influence and are influenced by the economic, social, and cultural contexts in which they are designed and used.	• How does abstraction help us in writing programs, creating computational artifacts, and solving problems? • How can a creative development process affect the creation of computational artifacts? • How can computing and the use of computational tools foster creative expression?
	Acquisition	
	Students will know… • Creating computational artifacts uses an iterative and often exploratory process to translate ideas into tangible form. • A collaboratively created computational artifact reflects effort by more than one person. • Effective collaborative teams practice interpersonal communication, consensus building, conflict resolution, and negotiation. • Digital data is represented by abstractions at different levels which, at its lowest level, is represented by bits. • The process of developing an abstraction involves removing detail and generalizing functionality. • Large data sets provide opportunities and challenges for extracting information and knowledge. • Computing tools facilitate the discovery of connections in information within large data sets.	Students will be skilled at… • Completing the "Create" and "Explore" Performance Tasks, as defined by the College Board. • Consolidating all the skills learned throughout the year to create detailed computational artifacts, both individually and in collaboration with peers.

	- Digital data representations involve trade-offs related to storage, security, and privacy concerns. - Data is stored in many formats depending on its characteristics. - A creative process in the development of a computational artifact can include, but is not limited to, employing nontraditional, non-prescribed techniques; the use of novel combinations of artifacts, tools, and techniques; and the exploration of personal curiosities. - Creating computational artifacts employs an iterative and often exploratory process to translate ideas into tangible form. - A computational artifact is something created by a human using a computer and can be, but is not limited to, a program, an image, audio, video, a presentation, or a Web page file. - Creating computational artifacts requires understanding of and use of software tools and services. - Software is developed using multiple levels of abstractions, such as constants, expressions, statements, procedures, and libraries. - Sequencing, selection, and iteration are building blocks of algorithms. - Sequencing is the application of each step of an algorithm in the order in which the statements are given. - Different algorithms can be developed to solve the same problem.	

	• Programs are developed and used in a variety of ways by a wide range of people depending on the goals of the programmer.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Creativity • Collaboration • Communication • Information literacy • Technology literacy • Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Common pre-assessment Checkpoint exercises • Computer programs/code creation/computational artifact • Summative Assessments: Unit or sub-unit tests
	OTHER EVIDENCE: • Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: **Advanced Placement Computer Science A - Computer Systems**

Unit Name	What	Why	How
Computer Systems	Students will learn… ● explain the binary language of computing ● describe the major components of a computing system	● How are numbers represented in different number bases? ● How is a new Java application created, compiled, and executed? ● How is a Java application tested and debugged?	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects.

Windham School District Curriculum

Advanced Placement Computer Science A: Computer Systems

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Computer Science A Curriculum Learning Objectives I-V</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● explain the binary language of computing
● describe the major components of a computing system</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Computers consist of hardware and software.
● Computer programs provide a means to solve problems.
● The syntax rules of a programming language dictate the form of a program.
● Comments aid in understanding a program and have no effect on a program’s processing.
● A Java program must use correct syntax or the compiler will produce errors.</td><td>ESSENTIAL QUESTIONS
● How are numbers represented in different number bases?
● How is a new Java application created, compiled, and executed?
● How is a Java application tested and debugged?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● How to write Numerical representations
● The limitations of finite representations
● Binary number bases and conversion to base 10</td><td>Students will be skilled at…
● Convert numbers to different base representations.
● Determine the number of unique representations for a specific number of bits.</td></tr>
</table>

	● Hardware (primary and secondary memory) ● Programming languages- Java ● How to use language interpreters and compilers	● Identify correct versus incorrect syntax of the Java Programming Language including comments, identifiers, and reserved words. Implement, compile, execute and test a simple Java program. ● Test and debug a simple Java program after introducing errors.

Used in Content Area Standards	***21st Century Skills***
not applicable	● Critical thinking ● Creativity ● Collaboration ● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Performance assessments/projects ● Summative Assessments: Unit or sub-unit tests, ● Formal lab report
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Advanced Placement Computer Science A - Objects & Primitive Data

Unit Name	What	Why	How
Objects & Primitive Data	Students will learn... ● To understand properties at the atomic scale that can help explain macroscopic properties of the world we observe.	Forces and interactions among atoms, ions, and molecules explain observable macroscopic properties.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Computer Science A: Objects and Primitive Data

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Computer Science A Curriculum Learning Objectives I</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Create simple Java programs that uses assignment, classes, objects and outputs</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● The information in a Java program is represented as either primitive data or as objects
● A variable is a name for a memory location used to store a value of a specified data type.
● The Java standard class library is a set of classes that can be used to write Java programs.</td><td>ESSENTIAL QUESTIONS
● What is the difference between primitive data and objects?
● How are variables declared and used in Java?
● How are mathematical computations expressed in Java?
● How are objects created, and what are their uses?
● What is the difference between a Java application and a Java applet?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● Simple data types
● Variable and constant declarations
● Assignment and arithmetic expressions
● Console output
● Primitive data types versus objects
● Using classes to create objects
● References</td><td>Students will be skilled at…
● Identify the primary concepts behind object-oriented programming.
● Implement a Java application which uses variable declarations, assignment, and arithmetic expressions with multiple data types.</td></tr>
</table>

	• Java library classes • Creating random numbers	• Analyze a code fragment and determine the output using the Java rules for order of operations. • Implement a Java application which uses the print and println methods. • Implement a Java application that utilizes objects. • Implement a Java application that utilizes the Random class
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Creativity • Collaboration • Communication • Information literacy • Technology literacy • Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Common pre-assessment Checkpoint exercises • Projects and labs • Computer programs/code creation • Summative Assessments: Unit or sub-unit tests, • Research Project
	OTHER EVIDENCE: • Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: **Advanced Placement Computer Science A - Program Statements: Conditional**

Unit Name	What	Why	How
Program Statements: Conditional	Students will learn... ● Software development process ● Control flow (sequential and conditional) ● Boolean expressions and truth tables ● Using conditional expressions in if, if-else, and nested if statements ● More operators (increment, decrement, and assignment)	● What are the basic steps of program development? ● How do conditional statements control the flow of execution through a method? How are logical, increment, decrement, and assignment operators used?	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Computer Science A: Program Statements, Conditional

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
AP® Chemistry Computer Science A Curriculum Learning Objectives II.A-B

Transfer

Students will be able to

- Write conditional “if” statements in a Java program
- Write “if-else” statements
- Use other logical operators to return a Boolean value

Meaning

ENDURING UNDERSTANDINGS
Students will understand that...

- An if statement allows a program to either execute a statement or not based on whether a condition is true or false.
- An if-else statement allows a program to do one of two actions based on whether the condition is true or false.
- Logical operators return a Boolean value.

ESSENTIAL QUESTIONS

- What are the basic steps of program development?
- How do conditional statements control the flow of execution through a method?
- How are logical, increment, decrement, and assignment operators used?

Acquisition

Students will know…

- Software development process
- Control flow (sequential and conditional)
- Boolean expressions and truth tables
- Using conditional expressions in if, if-else, and nested if statements
- More operators (increment, decrement, and assignment)

Students will be skilled at…

- Identify the basic steps of the software development process.
- Analyze a code fragment containing conditional statements and determine the output.
- Create a truth table for a program statement containing Boolean operators.
- Write, test, and debug Java applications which use conditional control flow.

		● Write multiple program statements that implement the same expression using arithmetic, increment/decrement, and assignment operators.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical thinking ● Creativity ● Collaboration ● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests ● Performance lab assessment
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: **Advanced Placement Computer Science A - Program Statements: Iteration**

Unit Name	What	Why	How
Program Statements: Iteration	Students will learn... ● Control flow (iteration) ● Using while and for statements ● Infinite and nested loops ● Analysis of algorithms	● How do iterative statements (loops) control the flow of execution through a method? ● What is an infinite loop?	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Computer Science A: Program Statements, Iterations

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
AP® Computer Science A Curriculum
Learning Objectives II.B</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Write a program that uses an iterative loop
Use loop conditions when running multiple loops</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
A while statement allows a program to execute the same statement multiple times (iteratively).
The body of an iterative loop must eventually make the loop condition false to avoid an infinite loop.
The body of a loop may contain another (nested) loop.
A for statement is typically used when a loop will be executed a set number of times.</td><td>ESSENTIAL QUESTIONS
How do iterative statements (loops) control the flow of execution through a method?
What is an infinite loop?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Control flow (iteration)
Using while and for statements
Infinite and nested loops
Analysis of algorithms</td><td>Students will be skilled at…
Analyze a code fragment containing iterative statements and determine the output.
Write, test, and debug Java applications which use while statements, for statements, and nested loops.</td></tr>
</table>

		● Debug a program that has errors resulting from an infinite loop. ● Write pseudocode to develop and evaluate algorithms as part of the software development process.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical thinking ● Creativity ● Collaboration ● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs ● Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests ● Lab data analysis
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: **Advanced Placement Computer Science A - Writing Classes**

Unit Name	What	Why	How
Writing Classes	Students will learn... ● Anatomy of classes, constructors, and methods ● Declarations (class, interface, instance variable, method, and parameter) ● Method overloading ● Method decomposition ● Object relationships ● Program reasoning (preconditions and postconditions) ● Data abstraction and encapsulation ● Designing and implementing a class	● What are the advantages of encapsulation and abstraction in a program? ● What is method overloading and when is it appropriate? ● What is method decomposition and when is it appropriate?	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Computer Science A: Writing Classes

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Computer Science A Curriculum Learning Objectives II.C, III A-B</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Write a program that uses objects and classes, accepts parameters and produces an output</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that...
Objects have a state defined by variables and a set of behaviors defined by methods.
A class is a blueprint for an object. The scope of a variable is the part of the program over which the variable name can be referenced.
A method invoked through an object may take as a parameter another object created from the same class due to object association.
An aggregate object is composed of other objects, resulting in a “has-a” relationship.</td><td>ESSENTIAL QUESTIONS
What are the advantages of encapsulation and abstraction in a program?
What is method overloading and when is it appropriate?
What is method decomposition and when is it appropriate?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Anatomy of classes, constructors, and methods</td><td>Students will be skilled at…
Write methods that accept parameters, perform a function, and return the result.</td></tr>
</table>

	- Declarations (class, interface, instance variable, method, and parameter) - Method overloading - Method decomposition - Object relationships - Program reasoning (preconditions and postconditions) - Data abstraction and encapsulation - Designing and implementing a class	- Overload methods such as the one in the previous benchmark to perform an equivalent function when different input parameters are provided. - Design and implement a class that encapsulates data and provides methods necessary to accomplish a Java program using objects. - Write, test, and debug a class with a main method that instantiates objects from the prior class to solve the problem statement. - Draw UML class and object diagrams for programs such as the one in the previous benchmark. - Analyze the use of public and private modifiers within a Java program to determine whether or not proper data encapsulation is being observed.
Used in Content Area Standards		***21st Century Skills***
not applicable		- Critical thinking - Creativity - Collaboration - Communication - Information literacy - Technology literacy - Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs ● Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests
	OTHER EVIDENCE: ● Computer programs/code creation

<u>Title of Curriculum</u>: Advanced Placement Computer Science A - Enhancing Classes

Unit Name	What	Why	How
Enhancing Classes	Students will learn... ● References, exceptions, and class design ● Passing objects as parameters ● Error handling (exception messages and throwing exceptions) ● Interfaces and abstract classes Java library classes (the Comparable and List interfaces)	● What is the difference between a static variable and an instance variable? ● What is an interface and how is it implemented?	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Computer Science A: Enhancing Classes

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Computer Science A Curriculum Learning Objectives III.B-D</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Analyze a segment of code to determine the output
Design a class that implements a Java interface</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
An object reference variable stores the address of an object.
The “null” identifier is a Java reserved word which represents a reference that does not point to a valid object.
The “this” reference is a Java reserved word which always refers to the object which is currently executing.
Several references can refer to the same object. These references are aliases of each other.
A static variable is shared among all instances of a class.
A static method (a.k.a. class method) can only be called through the class name (not through an instantiated object).</td><td>ESSENTIAL QUESTIONS
What is the difference between a static variable and an instance variable?
What is an interface and how is it implemented?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
</table>

	• References, exceptions, and class design • Passing objects as parameters • Error handling (exception messages and throwing exceptions) • Interfaces and abstract classes Java library classes (the Comparable and List interfaces) • Identifying reusable components from existing code using classes and class libraries	• Given a Java interface, design (1) a class that implements the interface, and (2) a driver class that instantiates objects from (1). • Analyze a code fragment containing object references which are aliased. Identify the aliased references and determine the output of the code fragment. • Design a class that implements the Comparable interface based on a given set of rules for the compareTo method. • Given a program description, describe the optimal class design in an object-oriented paradigm. • Analyze a code fragment and determine the line that will cause a common exception such as NullPointerException.
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Creativity • Collaboration • Communication • Information literacy • Technology literacy • Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs ● Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Advanced Placement Computer Science A - Arrays & Searching

Unit Name	What	Why	How
Arrays & Searching	• Use arrays in a program, properly declaring them. • Analyze and debug and segment of code using arrays	• When is it appropriate to use a binary searching algorithm versus a sequential searching algorithm?	• Common pre-assessment Checkpoint exercises • Projects and labs • Computer programs/code creation • Summative Assessments: Unit or sub-unit tests

Windham School District Curriculum

Advanced Placement Computer Science A: Arrays & Searching

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Computer Science A Curriculum Learning Objectives III.B-D</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
Use arrays in a program, properly declaring them.
Analyze and debug and segment of code using arrays</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
A one-dimensional array of size N is a list of N values, indexed from 0 to N-1.
In Java, all arrays are objects and must be declared using either the new operator or an initializer list.
Arrays can store either primitive data or references to objects.
Any object stored in array must be instantiated separately from the array instantiation.
Two-dimensional arrays have values in two dimensions akin to rows and columns of a table.
Arrays of any dimension are of a fixed size that cannot change after the array is declared.</td><td>ESSENTIAL QUESTIONS
When is it appropriate to use a binary searching algorithm versus a sequential searching algorithm?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
</table>

	• Declaring one- and two dimensional arrays • Using one- and two dimensional arrays (insertions, deletions, traversals, algorithms) • Arrays of objects • Searching algorithms and comparison (sequential and binary) • Choosing appropriate data representation and algorithms	• Describe the two methods for instantiating an array. • Describe how an array of objects is created. • Describe the steps of a sequential search. Describe the steps of a binary search. Explain the differences. • Analyze and debug a code segment that causes a bounds-checking exception. • Analyze a code segment that manipulates the contents of an array and determine the contents of the array at the output. • Given a list of array declarations, determine (1) which are valid, and (2) which instantiate an array object. • Write a method that accepts an array of floating point values and returns the sum of the values stored in the array. • Write a Java class that implements the sequential searching algorithm and another Java class that implements the binary searching algorithm. • Write a Java class with a main method that uses methods from the previously written Java classes to search through an array using both algorithms. • Display the results for each. Show that the binary search only works if the input array data is arranged sequentially.

Used in Content Area Standards	***21st Century Skills***
not applicable	• Critical thinking • Creativity • Collaboration

	● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs ● Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Advanced Placement Computer Science A - Lists, Array Lists and Sorting

Unit Name	What	Why	How
Lists, Array Lists, and Sorting	• Lists and ArrayLists (creation, insertions, deletions, traversals, algorithms) • Sorting algorithms and comparison (selection and insertion sorts) • Choosing appropriate data representation and algorithms	• What are the two basic sorting algorithms and how do they differ? • How is the efficiency of a given algorithm quantified? Which sorting algorithm is most efficient?	• Common pre-assessment Checkpoint exercises • Projects and labs • Computer programs/code creation • Summative Assessments: Unit or sub-unit tests

Windham School District Curriculum

Advanced Placement Computer Science A: Lists, Array Lists & Searching

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Computer Science A Curriculum
Learning Objectives III.E-F, IV</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● write code using two different ways of sorting algorithms</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● An ArrayList object is like an array, but the size of the array may be changed using methods of the ArrayList class.
● The content of an ArrayList object may contain only objects, not primitive type data.</td><td>ESSENTIAL QUESTIONS
● What are the two basic sorting algorithms and how do they differ?
● How is the efficiency of a given algorithm quantified? Which sorting algorithm is most efficient?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● Lists and ArrayLists (creation, insertions, deletions, traversals, algorithms)
● Sorting algorithms and comparison (selection and insertion sorts)
● Choosing appropriate data representation and algorithms</td><td>Students will be skilled at…
● Describe the steps of a selection sort. Describe the steps of an insertion sort. Explain the differences.
● Explain the advantage and disadvantages of using ArrayList objects versus arrays.
● Compare a set of algorithms and determine the efficiency for each in terms of “n”. Which is most efficient?
● Write a Java class that implements the selection sort algorithm and another Java class that implements the insertion sort algorithm.</td></tr>
</table>

		● Write both classes so that they sort values in descending order. ● Change the binary search Java class from the previous unit so that it works with an input array sorted in descending order. ● Write a driver class that utilizes this binary search class and the sort classes to binary search through an array of previously unsorted data.

Used in Content Area Standards	***21st Century Skills***
not applicable	● Critical thinking ● Creativity ● Collaboration ● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs ● Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: Advanced Placement Computer Science A - Inheritance

Unit Name	What	Why	How
Inheritance	• Analyze code with multiple Java classes to draw hierarchy diagram • write a segment of code using inherited variables	• What is an abstract class and how is it declared? What are the rules for a class with an abstract parent? • What is a polymorphic reference?How is it determined which version of a method is invoked if the method call is polymorphic?	• Common pre-assessment Checkpoint exercises • Projects and labs • Computer programs/code creation • Summative Assessments: Unit or sub-unit tests

Windham School District Curriculum

Advanced Placement Computer Science A: Inheritance

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Computer Science A Curriculum Learning Objectives IV</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Analyze code with multiple Java classes to draw hierarchy diagram
write a segment of code using inherited variables</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Inheritance is how a new class is created from an existing class. Public (but not private) inherited variables and methods can be used in a derived class as if they had been declared locally.
The “super” reference is a Java reserved word which always refers to the parent class when used in a child class
A child class can override the parent class’ definition of an inherited method.
The child of one class can be the parent of one or more other classes, creating a class hierarchy.
All Java classes are derived, directly or indirectly, from the Object class in the Java standard class library.</td><td>ESSENTIAL QUESTIONS
What is an abstract class and how is it declared? What are the rules for a class with an abstract parent?
What is a polymorphic reference?How is it determined which version of a method is invoked if the method call is polymorphic?</td></tr>
</table>

	• A reference variable can refer to any object created from any class related to it by inheritance	
	Acquisition	
	Students will know… • Creating subclasses • Overriding methods • Class hierarchies • Polymorphism • Designing for inheritance and class hierarchy • Interfaces and abstract classes • Java library classes (the Object class)	Students will be skilled at… • Explain how inheritance supports (1) software reuse, and (2) polymorphism. • Analyze a code listing for multiple Java classes, and (1) draw an inheritance hierarchy diagram for all parent/child classes, and (2) determine the output of the driver class that references the parent/child classes in the hierarchy. • Given a programming assignment, (1) determine a class hierarchy that maximizes code reuse, (2) code and debug a set of classes that implements the hierarchy. • Use modifiers consistent with inheritance programming good practice. • Given a programming assignment and a corresponding parent class, code and debug a subclass that overrides the methods from the parent class to satisfy the assignment. • Use the "super" reference when programming a class hierarchy. • Analyze code fragments using inherited methods and variables, and determine which lines will cause a compile error. • Analyze a class hierarchy code listing containing polymorphic references and determine which version of the reference is invoked at runtime.
Used in Content Area Standards		***21st Century Skills***

not applicable	• Critical thinking • Creativity • Collaboration • Communication • Information literacy • Technology literacy • Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Common pre-assessment Checkpoint exercises • Projects and labs • Computer programs/code creation • Summative Assessments: Unit or sub-unit tests
	OTHER EVIDENCE: • Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Advanced Placement Computer Science A - Recursion

Unit Name	What	Why	How
Recursion	• Identify recursive thinking, programming, and sorting • Control the flow of a process(recursion) • Sorting algorithms (merge and quick)	• Compare recursion versus iteration. When is it appropriate to use each? • What is the difference between direct and indirect recursion?	• Common pre-assessment Checkpoint exercises • Projects and labs • Computer programs/code creation • Summative Assessments: Unit or sub-unit tests

Windham School District Curriculum

Advanced Placement Computer Science A: Recursion

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Computer Science A Curriculum
Learning Objectives IV</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Identify recursive thinking, programming, and sorting
● Control the flow of a process(recursion)
● Sorting algorithms (merge and quick)</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Recursion is when a method calls itself.
● Recursive methods must have a nonrecursive part, called the base case, which lets the recursion eventually end.
● The merge sort algorithm divides a list in half, recursively sorts the two sublists, and then merges them together.
● The quick sort algorithm partitions a list into two sublists, then recursively sorting each sublist.</td><td>ESSENTIAL QUESTIONS
● Compare recursion versus iteration. When is it appropriate to use each?
● What is the difference between direct and indirect recursion?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● How to analyze a recursive method and determine (1) the base case, (2) the recursive case, (3) the output for a specific input value, (4) which line’s removal</td><td>Students will be skilled at…
● Draw a diagram that traces a recursive method and shows the advancement of the loop index and the resultant data.
● Designing and implementing a recursive program that solves a 3D maze.</td></tr>
</table>

	causes an infinite recursion, and (5) the type of recursion (direct or indirect). ● How to write a recursive method for each of the following: (1) x y , (2) x * y, and (3) N! ● How to describe a strategy for choosing a pivot value in quicksort so that the list will always be partitioned in two equal halves. ● How to describe how this affects the time efficiency of quick sort.	● Design and implement a recursive program to print the Nth line of Pascal's triangle.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical thinking ● Creativity ● Collaboration ● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs ● Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: **Advanced Placement Computer Science A - Ethical and Social Implications of Computer Use**

Unit Name	What	Why	How
Ethical and Social Implications of Computer Use	• Responsible use of computer systems System reliability • Privacy • Intellectual properties • Legal issues • Social and ethical ramifications of computer use	• How can you protect yourself from phishing? • What rights are included in a copyright? • What are the OECD Fair Information Practices principles for privacy?	• Common pre-assessment Checkpoint exercises • Projects and labs • Computer programs/code creation • Summative Assessments: Unit or sub-unit tests

Windham School District Curriculum

Advanced Placement Computer Science A: Ethical and Social Implications of Computer Use

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Computer Science A Curriculum Learning Objectives IV</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Responsible use of computer systems System reliability
Privacy
Intellectual properties
Legal issues
Social and ethical ramifications of computer use</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Viruses can be caught through a variety of means, including email attachments, copying software, peer-to-peer exchange, and distribution of new software.
The two main threats to privacy are government and business.</td><td>ESSENTIAL QUESTIONS
How can you protect yourself from phishing?
What rights are included in a copyright?
What are the OECD Fair Information
Practices principles for privacy?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Redundancy and “burn in” techniques can be used to alleviate hardware failures. The two main threats to privacy are government and business.</td><td>Students will be skilled at…
Researching different virus-checking software (i.e. McAfee, Norton, etc) and choose one that seems the most efficient and report on it.</td></tr>
</table>

	● Software licenses gives you use of the software while the company still owns the rights. ● Creating intellectual properties of your own is the best way to ensure non-violation of the copyright law.	● Researching a copyright infringement case and explore ways in which the defendant could have avoided committing the crime.

Used in Content Area Standards	***21st Century Skills***
not applicable	● Critical thinking ● Creativity ● Collaboration ● Communication ● Information literacy ● Technology literacy ● Flexibility

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Common pre-assessment Checkpoint exercises ● Projects and labs ● Computer programs/code creation ● Summative Assessments: Unit or sub-unit tests
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: AP Biology- Cellular Processes: Energy and Communication

Unit Name	What	How	Why
Cellular Processes: Energy and Communication **Topics in which this unit appears:** ● Biochemistry ● Cell Structure & Function ● Cell Membrane Structure & Transport ● Photosynthesis ● Cellular Respiration ● Cell Growth & Division ● DNA, RNA ● Gene Expression ● Gene Regulation ● Cell Signal Transduction Pathways ● Evolution & Adaptations ● Anatomy ● Ecology	● Explain how internal membranes and organelles contribute to cell functions. ● Construct explanations as to how interactions of subcellular structures provide essential functions in energy transfer and cellular communication ● Use models to pose scientific questions about the properties of cell membranes and selective permeability based on molecular structure. ● Explain how cell size and shape affect the overall rate of nutrient intake and the rate of waste elimination. ● Explain the connection between the sequence and the subcomponents of a biological polymer and its properties.	● Make a prediction about the interactions of subcellular organelles. ● Use models to analyze how interactions of subcellular structures, which possess specialized functions, provide essential functions. ● Construct models that connect the movement of molecules across membranes with membrane structure and function. ● Use calculated surface area-to-volume ratios to predict which cell(s) might eliminate wastes or procure nutrients faster by diffusion. ● Represent graphically or model quantitatively the exchange of molecules between an organism and its environment, and the subsequent use of	**To answer the questions:** ● How is free energy used in biological systems to facilitate growth, reproduction, and homeostasis sustainability? ● How are external signals converted into cellular responses? ● How does the chemical basis of life support living systems? ● How do the properties of carbon contribute to life's molecular diversity? ● How do the major macromolecules of living systems sustain life within life's hierarchy? ● How do cellular and subcellular structures carry out the process of photosynthesis? ● How does the hierarchical organization of plant cells, tissues, organs allow for resource acquisition, transport and reproduction?

	● Construct explanations based on evidence of how variation in molecular units provides cells with a wider range of functions. ● Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today. ● Explain how biological systems use free energy that all organisms require constant energy input to maintain organization, to grow, and to reproduce. ● Cooperative interactions within organisms promote efficiency in the use of energy and matter. ● What mechanisms and structural features allow organisms to capture, store, and use free energy. ● Describe specific examples of conserved core biological processes and features shared by all domains or within one domain of life, and	these molecules to build new molecules that facilitate dynamic homeostasis, growth, and reproduction. ● Analyze data to identify how molecular interactions affect structure and function. ● Predict how changes in free energy availability affect organisms, populations, and ecosystems ● Construct explanations of the mechanisms and structural features of cells that allow organisms to capture, store, or use free energy ● Use models to describe features of a cell signaling pathway. ● Justify claims based on scientific evidence that changes in signal transduction pathways can alter cellular response ● Discuss, model, and present information demonstrating understanding of homeostatic processes	● How do cellular and subcellular structures carry out the process of cellular respiration and fermentation? ● How do catabolic and anabolic pathways maintain homeostasis in living systems? ● How do cellular structures and molecules carry out cellular growth and development? ● How does the structure of DNA/RNA allow it to carry out their functions? ● How is cellular communication involved in gene expression and the regulation of gene expression? ● How do specialized cells, tissues, organs and systems carry out homeostatic processes for thermoregulation, energy requirements, and evolutionary adaptations?

	how these shared, conserved core processes and features support the concept of common ancestry for all organisms. ● Describe basic chemical processes for cell communication shared across evolutionary lines of descent. ● Sketch, model, discuss the key elements of signal transduction pathways by which a signal is converted to a cellular response. ● Describe a model that expresses key elements to show how change in signal transduction can alter cellular response.		

Windham School District Curriculum

AP Biology: Cellular Processes - Energy and Communication

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):
The process of evolution explains the diversity and unity of life.
Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.
Living systems store, retrieve, transmit, and respond to information essential to life processes.
Biological systems interact, and these systems and their interactions possess complex properties.
Content Standards:
HS-LS1-5
HS-LS1-6
HS-LS1-7
HS-LS2-3
HS-LS2-4
HS-LS2-5</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
Use models to analyze how interactions of subcellular structures, which possess specialized functions, provide essential functions.
Construct explanations as to how interactions of subcellular structures provide essential functions in energy transfer and cellular communication</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.
As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.</td><td>ESSENTIAL QUESTIONS
How is free energy used in biological systems to facilitate growth, reproduction, and homeostasis sustainability?
How do the major macromolecules of living systems sustain life within life’s hierarchy?
How do specialized cells, tissues, organs and systems carry out homeostatic processes for thermoregulation, energy requirements and reproduction?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
The chemical process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.</td><td>Students will be skilled at…
Make predictions about the interactions of subcellular organelles.</td></tr>
</table>

	• The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. • As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. • Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. • Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. • The chemical elements that make up the molecules of organisms pass through food	• Construct models that connect the movement of molecules across membranes with membrane structure and function. • Use calculated surface area-to-volume ratios to predict which cell(s) might eliminate wastes or procure nutrients faster by diffusion. • Represent graphically or model quantitatively the exchange of molecules between an organism and its environment, and the subsequent use of these molecules to build new molecules that facilitate dynamic homeostasis, growth, and reproduction. • Analyze data to identify how molecular interactions affect structure and function. • Predict how changes in energy transfer affect organisms, populations, and ecosystems • Construct explanations of the mechanisms and structural features of cells that allow organisms to capture, store, or use free energy • Use models to describe features of a cell signaling pathway. • Make a prediction about the interactions of subcellular organelles. • Use models to analyze how interactions of subcellular structures, which possess specialized functions, provide essential functions. • Discuss biological processes that facilitate dynamic homeostasis, growth, and reproduction.

	webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. Quantitative analysis will be performed on food webs. ● Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. ● Use models to pose scientific questions about the properties of cell membranes and selective permeability based on molecular structure. ● Explain how cell size and shape affect the overall rate of nutrient intake and the rate of waste elimination. ● Construct explanations based on evidence of how variation in molecular units provides cells with a wider range of functions. ● Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today. ● Explain how biological systems use free energy that all organisms require constant energy input to maintain organization, to grow, and to reproduce.	

	- Cooperative interactions within organisms promote efficiency in the use of energy and matter. - What mechanisms and structural features allow organisms to capture, store, and use free energy. - Describe specific examples of conserved core biological processes and features shared by all domains or within one domain of life, and how these shared, conserved core processes and features support the concept of common ancestry for all organisms. - Describe basic chemical processes for cell communication shared across evolutionary lines of descent. - Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.	

Used in Content Area Standards	***21st Century Skills***
not applicable	- Collaboration - Communication - Critical thinking - Creating - Analyzing

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT:

	● Construct an explanation for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. ● Use a model to illustrate that cellular respiration is a chemical process resulting in a net transfer of energy. ● Construct an explanation for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● Model DNA replication to demonstrate the process of mitotic division and ● Illustrate signal transduction pathways in cellular communication ● Illustrate metabolic pathways in energy acquisition ● Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. ● Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. ● Use statistical and quantitative data to support scientific claims on factors affecting rates of photosynthesis and cellular respiration ● Summative assessments ● Formative assessments ● Free Response Questions
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: AP Biology-Genetics and Information Transfer

Unit Name	What	How	Why
Genetics and Information Transfer **Topics in which this unit appears:** ● Mitosis/Meiosis ● Mendelian Genetics ● Gene expression ● Cell growth and development	● Describe events that occur in the cell cycle. ● Construct an explanation as to how DNA in chromosomes is transmitted to the next generation via mitosis, or meiosis followed by fertilization. ● Pose questions about the ethical, social, or medical issues surrounding human genetic disorders. ● Determine Mendelian patterns of inheritance provided by data sets. ● Explain deviations from Mendel's model of the inheritance of traits. ● The influence of environmental factors on the phenotype of an organism. ● A variety of phenotypic responses to a single environmental factor can	● Represent the connection between meiosis and increased genetic diversity necessary for evolution. ● Evaluate evidence provided by data sets to support the claim that heritable information is passed from one generation to another through mitosis, or meiosis followed by fertilization ● Construct a representation that connects the process of meiosis to the passage of traits from parent to offspring. ● Describe models that that illustrate how genetic information is copied for transmission between generations. ● Describe representations and models illustrating how genetic information is translated into polypeptides.	**To answer the questions:** ● How are traits passed from one generation to the next? ● How do eukaryotic cells store, retrieve, and transmit genetic information? ● How does gene expression control the cell and determine its metabolism? ● What social and ethical issues are raised by advances in genetic engineering?"

	result from different genotypes within the population. ● DNA and RNA are the primary sources of heritable information. ● Predict how a change in a specific DNA or RNA sequence can result in changes in gene expression. ● Describe the connection between the regulation of gene expression and observed differences between different kinds of organisms. ● Explain how the regulation of gene expression is essential for the processes and structures that support efficient cell function. ● Illustrate how interactions between external stimuli and gene expression result in specialization of cells, tissues, and organs. ● Explain how signal pathways mediate gene expression,	● Create a visual representation to illustrate how changes in a DNA nucleotide sequence can result in a change in the polypeptide produced. ● Use representations to describe how gene regulation influences cell products and function. ● Justify a claim made about the effect(s) on a biological system at the molecular, physiological, or organismal level when given a scenario in which one or more components within a negative regulatory system is altered. ● Use a graph or diagram to analyze situations or solve problems (quantitatively or qualitatively) that involve timing and coordination of events necessary for normal development in an organism. ● Justify scientific claims with scientific evidence to show that timing and coordination of several events are necessary for normal development in an organism and that these events	

	including how this process can affect protein production. ● Describe mechanisms of the regulation of gene expression. ● Connect concepts to show that timing and coordination of specific events are necessary for normal development in an organism and that these events are regulated by multiple mechanisms. ● Describe the role of programmed cell death in development and differentiation, the reuse of molecules, and the maintenance of dynamic homeostasis. ● Explain the connection between genetic variations in organisms and phenotypic variations in populations.	are regulated by multiple mechanisms ● Justify the claim that humans can manipulate heritable information by identifying at least two commonly used technologies. ● Predict the effects of a change in an environmental factor on the genotypic expression of the phenotype. ● Predict how a change in genotype, when expressed as a phenotype, provides a variation that can be subject to natural selection.	

Windham School District Curriculum

AP Biology: Genetics and Information Transfer

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies (Standards):

- The process of evolution explains the diversity and unity of life.
- Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.
- Living systems store, retrieve, transmit, and respond to information essential to life processes.
- Biological systems interact, and these systems and their interactions possess complex properties.

Content Standards:

- HS-LS2-1
- HS-LS2-2
- HS-LS2-6
- HS-LS2-7
- HS-LS2-8
- HS-LS4-6

Transfer

Students will be able to:

- Describe events that occur in the cell cycle.
- Evaluate evidence provided by data sets to support the claim that heritable information is passed from one generation to another through mitosis, or meiosis followed by fertilization
- Determine Mendelian patterns of inheritance provided by data sets.
- Describe mechanisms of the regulation of gene expression.

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- Heritable information provides for continuity of life.
- Cells communicate by generating, transmitting and receiving chemical signals.
- Transmission of information results in changes within and between biological systems.

ESSENTIAL QUESTIONS

- How are traits passed from one generation to the next?
- How do eukaryotic cells store, retrieve, and transmit genetic information?
- How does gene expression control the cell and determine its metabolism?
- What social and ethical issues are raised by advances in “genetic engineering?”

Acquisition

Students will know…

- Construct an explanation as to how DNA in chromosomes is transmitted to the next generation via mitosis, or meiosis followed by fertilization.

Students will be skilled at….

- Represent the connection between meiosis and increased genetic diversity necessary for evolution.
- Construct a representation that connects the process of meiosis to the passage of traits from parent to offspring.

	- Pose questions about the ethical, social, or medical issues surrounding human genetic disorders. - Explain deviations from Mendel's model of the inheritance of traits. - The influence of environmental factors on the phenotype of an organism. - A variety of phenotypic responses to a single environmental factor can result from different genotypes within the population. - DNA and RNA are the primary sources of heritable information. - Predict how a change in a specific DNA or RNA sequence can result in changes in gene expression. - Describe the connection between the regulation of gene expression and observed differences between different kinds of organisms. - Explain how the regulation of gene expression is essential for the processes and structures that support efficient cell function. - Illustrate how interactions between external stimuli and gene expression result in specialization of cells, tissues, and organs. - Explain how signal pathways mediate gene expression, including how this process can affect protein production. - Connect concepts to show that timing and coordination of specific events are necessary for normal development in an organism and that these events are regulated by multiple mechanisms.	- Describe models that that illustrate how genetic information is copied for transmission between generations. - Describe representations and models illustrating how genetic information is translated into polypeptides. - Create a visual representation to illustrate how changes in a DNA nucleotide sequence can result in a change in the polypeptide produced. - Use representations to describe how gene regulation influences cell products and function. - The student is able to create a visual representation to describe how nervous systems transmit information - Justify a claim made about the effect(s) on a biological system at the molecular, physiological, or organismal level when given a scenario in which one or more components within a negative regulatory system is altered. - Use a graph or diagram to analyze situations or solve problems (quantitatively or qualitatively) that involve timing and coordination of events necessary for normal development in an organism. - Justify the claim that humans can manipulate heritable information by identifying at least two commonly used technologies. - Predict the effects of a change in an environmental factor on the genotypic expression of the phenotype.

	• Describe the role of programmed cell death in development and differentiation, the reuse of molecules, and the maintenance of dynamic homeostasis. • Explain the connection between genetic variations in organisms and phenotypic variations in populations.	• Predict how a change in genotype, when expressed as a phenotype, provides a variation that can be subject to natural selection.

Used in Content Area Standards	***21st Century Skills***
not applicable	• collaboration • communication • critical thinking • creativity • analyzing

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. • Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for inherited characteristic traits. • Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification • Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. • Models and/or presentations • Summative tests • Formative assessments • Free Response Questions

Title of Curriculum: AP Biology - Interactions

Unit Name	What	How	Why
Interactions **Topics in which this unit appears:** ● Biochemistry ● Cell processes ● Cell growth & development ● Anatomy ● Evolution ● Ecology	● Evaluate scientific questions based on hypotheses about the origin of life on Earth. ● Evaluate the accuracy and legitimacy of data to answer scientific questions about the origin of life on Earth. ● Justify the selection of geological, physical, and chemical data that reveal early Earth conditions. ● Construct an explanation of how viruses introduce genetic variation in host organisms. ● Connect how organisms use negative feedback to maintain their internal environments. ● Justify that positive feedback mechanisms amplify responses in organisms. ● Know the relevant mechanism that organisms	● Evaluate scientific hypotheses about the origin of life on Earth. ● Use representations and appropriate models to describe how viral replication introduces genetic variation in the viral population. ● Evaluate data that show the effect(s) of changes in concentrations of key molecules on negative feedback mechanisms. ● Make predictions about how positive feedback mechanisms amplify activities and processes in organisms based on scientific theories and models. ● Design a plan for collecting data to support the scientific claim that the timing and coordination of physiological events involve regulation. ● Use models to analyze the effects of disruptions to	**To answer the questions:** ● How do interactions between and within populations influence patterns of species distribution and abundance? ● How do living things use energy and matter to survive in an ecosystem? ● How do humans impact the biodiversity of ecosystems?

	use to respond to changes in their external environment. ● Justify scientific claims with evidence to show how timing and coordination of physiological events involve regulation. ● Explain how the distribution of ecosystems changes over time by identifying large-scale events that have resulted in these changes in the past. ● Connect differences in the environment with the evolution of homeostatic mechanisms. ● Complex biotic and abiotic interactions on all biological systems, from cells and organisms to populations, communities, and ecosystems. ● Describe how timing and coordination of behavioral events in organisms are regulated by several mechanisms. ● Predict how environmental factors affect responses to	dynamic homeostasis in biological systems. ● Analyze data to identify phylogenetic patterns or relationships, showing that homeostatic mechanisms reflect both continuity due to common ancestry and change due to evolution in different environments. ● Refine scientific models and questions about the effect of complex biotic and abiotic interactions on all biological systems, from cells and organisms to populations, communities, and ecosystems. ● Analyze data to identify possible patterns and relationships between a biotic or abiotic factor and a biological system (cells, organisms, populations, communities, or ecosystems) ● Design a plan for collecting data to show that all biological systems (cells, organisms, populations, communities, and ecosystems) are affected by	

	information and change behavior. ● Describe how organisms exchange information in response to internal changes or environmental cues. ● Describe how nervous systems detect external and internal signals. ● Describe how nervous systems transmit information. ● Describe how the vertebrate brain integrates information to produce a response. ● Create a visual representation to describe how the vertebrate brain integrates information to produce a response. ● Evaluate scientific questions concerning organisms that exhibit complex properties due to the interaction of their constituent parts. ● Predict the effects of a change in a component(s) of a biological system on the functionality of an organism(s).	complex biotic and abiotic interactions. ● Analyze data to identify possible patterns and relationships between a biotic or abiotic factor and a biological system ● Create a representation that describes how organisms exchange information in response to internal changes and external cues, and which can result in changes in behavior. ● Create models to describe immune responses. ● Create models to describe nonspecific immune defenses in plants and animals. ● Create a visual representation of complex nervous systems to describe/explain how these systems detect external and internal signals, transmit and integrate information, and produce responses. ● Predict the effects of a change in the community's populations on the community.	

	• illustrate biocomplexity due to interactions of the constituent parts. • Apply mathematical routines to quantities that describe communities composed of populations of organisms that interact in complex ways. • Use data analysis to refine observations and measurements regarding the effect of population interactions on patterns of species distribution and abundance.	• Predict the effects of a change of matter or energy availability on communities. • Predict consequences of human actions on both local and global ecosystems.	

Windham School District Curriculum

AP Biology : Interactions

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS
Competencies (Standards):
● The process of evolution explains the diversity and unity of life.
● Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.
● Living systems store, retrieve, transmit, and respond to information essential to life processes.
● Biological systems interact, and these systems and their interactions possess complex properties.

Content Standards:
● HS-LS1-4
● HS-LS3-1
● HS-LS3-2
● HS-LS3-3</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
● Evaluate scientific questions based on hypotheses about the origin of life on Earth.
● Know the relevant mechanism that organisms use to respond to changes in their external environment.
● Predict the effects of a change in a component(s) of a biological system on the functionality of an organism(s).
● Analyze data to identify possible patterns and relationships between a biotic or abiotic factor and a biological system
● Predict consequences of human actions on both local and global ecosystems.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● The distribution of ecosystems changes over time by identifying large-scale events that have resulted in these changes in the past.
● Describe how organisms exchange information in response to internal changes or environmental cues.
● Interactions within biological systems lead to complex properties.
● Competition and cooperation are important aspects of biological systems.
● Naturally occurring diversity among and between components within biological</td><td>ESSENTIAL QUESTIONS
● How do interactions between and within populations influence patterns of species distribution and abundance?
● How do living things use energy and matter to survive in an ecosystem?
● How do humans impact the biodiversity of ecosystems?
● How does biology explain ‘the whole is greater than the sum of its parts?’
● How do biological systems with greater complexity and diversity often exhibit an increased capacity to respond to changes in the environment?</td></tr>
</table>

	systems affects interactions with the environment.	● How does the coordination of life's hierarchical components allow for living systems to use matter and energy efficiently?
	Acquisition	
	Students will know… ● Evaluate the accuracy and legitimacy of data to answer scientific questions about the origin of life on Earth. ● Justify the selection of geological, physical, and chemical data that reveal early Earth conditions. ● Construct an explanation of how viruses introduce genetic variation in host organisms. ● Connect how organisms use negative feedback to maintain their internal environments. ● Justify that positive feedback mechanisms amplify responses in organisms. ● Justify scientific claims with evidence to show how timing and coordination of physiological events involve regulation. ● Explain how the distribution of ecosystems changes over time by identifying large-scale events that have resulted in these changes in the past. ● Connect differences in the environment with the evolution of homeostatic mechanisms. ● Complex biotic and abiotic interactions on all biological systems, from cells and organisms to populations, communities, and ecosystems.	**Students will be skilled at…** ● Evaluate scientific hypotheses about the origin of life on Earth. ● Use representations and appropriate models to describe how viral replication introduces genetic variation in the viral population. ● Evaluate data that show the effect(s) of changes in concentrations of key molecules on negative feedback mechanisms. ● Make predictions about how positive feedback mechanisms amplify activities and processes in organisms based on scientific theories and models. ● Design a plan for collecting data to support the scientific claim that the timing and coordination of physiological events involve regulation. ● Use models to analyze the effects of disruptions to dynamic homeostasis in biological systems. ● Analyze data to identify phylogenetic patterns or relationships, showing that homeostatic mechanisms reflect both continuity due to common ancestry and change due to evolution in different environments. ● Refine scientific models and questions about the effect of complex biotic and abiotic interactions on all biological systems, from

	● Describe how timing and coordination of behavioral events in organisms are regulated by several mechanisms. ● Predict how environmental factors affect responses to information and change behavior. ● Describe how nervous systems detect external and internal signals. ● Describe how nervous systems transmit information. ● Describe how the vertebrate brain integrates information to produce a response. ● Create a visual representation to describe how the vertebrate brain integrates information to produce a response. ● Evaluate scientific questions concerning organisms that exhibit complex properties due to the interaction of their constituent parts. ● illustrate biocomplexity due to interactions of the constituent parts. ● Apply mathematical routines to quantities that describe communities composed of populations of organisms that interact in complex ways. ● Use data analysis to refine observations and measurements regarding the effect of population interactions on patterns of species distribution and abundance.	cells and organisms to populations, communities, and ecosystems. ● Analyze data to identify possible patterns and relationships between a biotic or abiotic factor and a biological system (cells, organisms, populations, communities, or ecosystems) ● Design a plan for collecting data to show that all biological systems (cells, organisms, populations, communities, and ecosystems) are affected by complex biotic and abiotic interactions. ● Create a representation that describes how organisms exchange information in response to internal changes and external cues, and which can result in changes in behavior. ● Create models to describe immune responses. ● Create models to describe nonspecific immune defenses in plants and animals. ● Create a visual representation of complex nervous systems to describe/explain how these systems detect external and internal signals, transmit and integrate information, and produce responses. ● Predict the effects of a change in the community's populations on the community. ● Predict the effects of a change of matter or energy availability on communities. ● Predict consequences of human actions on both local and global ecosystems.

Used in Content Area Standards	***21st Century Skills***
not applicable	● Collaboration ● Communication ● Critical thinking ● Creativity ● Analyzing

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. ● Presentations and science posters ● Summative tests ● Formative assessments ● Free Response Questions
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: AP Biology - Evolution

Unit Name	What	How	Why
Evolution **Topics in which this unit appears:** ● Evolution ● Natural Selection ● Population genetics ● Genomes ● Phylogeny	● Evaluate evidence to investigate the role of natural selection in evolution. ● Apply mathematical methods to data from a population to predict what will happen to the population in the future. ● Evaluate data-based evidence that describes evolutionary changes in the genetic makeup of a population over time. ● Evaluate evidence from many scientific disciplines that support biological evolution. ● Connect scientific evidence from many scientific disciplines to support the modern concept of evolution. ● Analyze data related to questions of speciation and extinction throughout Earth's history. ● Describe speciation in an isolated population and connect it to a change in gene frequency, change in environment, natural selection, and/or genetic drift.	● Convert a data set from a table of numbers that reflect a change in the genetic makeup of a population over time and apply mathematical methods and conceptual understandings to investigate the cause(s) and effect(s) of this change. ● Analyze data to support the claim that responses to information and communication of information affect natural selection ● Apply mathematical methods to data from a real or simulated population to predict what will happen to the population in the future. ● Design a plan to answer scientific questions regarding how organisms have changed over time using information from morphology, biochemistry, genetics and geology.	**To answer the questions:** ● What role does evolution play in the organization of living things? ● What evidence supports our current models of the origin of life? ● How does the process of evolution drive diversity and the unity of life?

Windham School District Curriculum Template

AP Biology: Evolution

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):
The process of evolution explains the diversity and unity of life.
Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.
Living systems store, retrieve, transmit, and respond to information essential to life processes.
Biological systems interact, and these systems and their interactions possess complex properties.
Content Standards:
HS-LS4-1
HS-LS4-2
HS-LS4-3
HS-LS4-4
HS-LS4-5</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to:
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment .
Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
Connect scientific evidence from many scientific disciplines to support the modern concept of evolution.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Change in the genetic makeup of a population over time is evolution.

Natural selection is a major mechanism of evolution. Natural selection acts on</td><td>ESSENTIAL QUESTIONS
How has the diversity of life been shaped by ongoing evolutionary change?
How does the process of science help biologists investigate how nature works at all levels, from the molecules in cells to the biosphere?</td></tr>
</table>

	phenotypic variations in populations. Evolutionary change is also driven by random processes. Biological evolution is supported by scientific evidence from many disciplines, including mathematics. ● Organisms are linked by lines of descent from common ancestry. ● Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today. Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested. ● Life continues to evolve within a changing environment. Speciation and extinction have occurred throughout the Earth's history. Speciation may occur when two populations become reproductively isolated from each other. Populations of organisms continue to evolve. ● The origin of living systems is explained by natural processes. There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence. Scientific evidence from many different disciplines supports models of the origin of life.	● How does DNA provide the raw material upon which Natural Selection can act? ● How does homeostasis coordinate the diverse and complex functions of the human body? ● What evidence demonstrates that groups of organisms have changed over time? ● What characteristics do all living things share and how does variation upon these characteristics create the diversity of life on the planet? ● How are humans similar to all life on the planet and how are they different?
	Acquisition	
	Students will know… ● Genetic information provides evidence of evolution. DNA sequences vary among	**Students will be skilled at…** ● Analyzing and interpreting data while applying concepts of statistics and

	species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. ● Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. ● The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. ● Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. ● Natural selection leads to adaptation, that is, to a population dominated by	probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. ● Constructing explanations and designing solutions based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. ● Engaging in argument from evidence and evaluating the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. ● Obtaining, evaluating, and communicating scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). ● Convert a data set from a table of numbers that reflect a change in the genetic makeup of a population over time and to apply mathematical methods and

	organisms that are anatomically , behaviorally , and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. ● Adaptation also means that the distribution of traits in a population can change when conditions change. ● Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. ● Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.	conceptual understandings to investigate the cause(s) and effect(s) of this change. ● Evaluate evidence provided by data to qualitatively and quantitatively investigate the role of natural selection in evolution. ● Apply mathematical methods to data from a real or simulated population to predict what will happen to the population in the future. ● Use data from mathematical models based on the Hardy-Weinberg equilibrium to analyze genetic drift and effects of selection in the evolution of specific populations. ● Connect scientific evidence from many scientific disciplines to support the modern concept of evolution. ● Justify the scientific claim that organisms share many conserved core processes and features that evolved and are widely distributed among organisms today
Used in Content Area Standards		**21st Century Skills**
not applicable		● Collaboration ● Communication ● Critical thinking ● Creativity

	● Analyzing

Stage 2 - Evidence	
Evaluative Criteria	**Assessment Evidence**
	ASSESSMENT: ● Develop a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. ● Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. ● Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. ● Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. ● Summative tests ● Free Response Questions
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Advanced Placement Chemistry - Structure of Matter

Unit Name	What	Why	How
Structure of Matter	Students will learn… ● To understand structural features at the atomic scale that can help explain macroscopic structural features of the world we observe.	● The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects.

Windham School District Curriculum

Advanced Placement Chemistry: Structure of Matter

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Chemistry Curriculum
Learning Objectives 1.1 -1.20</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Use the periodic table and atomic theory to predict and understand structural features of matter.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that...
● All matter is made of atoms. There are a limited number of types of atoms; these are the elements.
● The atoms of each element have unique structures arising from interactions between electrons and nuclei. Elements display periodicity in their properties when the elements are organized according to increasing atomic number. This periodicity can be explained by the regular variations that occur in the electronic structures of atoms.
● Periodicity is a useful principle for understanding properties and predicting trends in properties. Its modern-day uses range from examining the composition of materials to generating ideas for designing new material.</td><td>ESSENTIAL QUESTIONS
● How is the position of an element on the Periodic Table related to that element's chemical and physical properties?
● How does the arrangement of subatomic particles dictate an element's chemical properties?
● How do we know so much about something (the atom) that we can't see? (history & interactions of matter)
● What information can be gleaned about an atom/element from its "box" on the Periodic Table?
● Do atoms exist or are they just concepts invented by scientists? What evidence is there in your everyday life for the existence of atoms?
● What is a mole and why do chemists use the mole concept?</td></tr>
</table>

	● Atoms are so small that they are difficult to study directly; atomic models are constructed to explain experimental data on collections of atoms. ● Atoms are conserved in physical and chemical processes.	● Why is the location of the electrons so important? How is the location of electrons related to chemistry/chemical reaction? ● What does light and the electromagnetic spectrum have to do with electrons and energy?
	Acquisition	
	Students will know… ● Atomic structure and the development of atomic models ● The relationship among periodic properties and structural features of the elements. ● The mole concept and how to apply it in problem solving.	Students will be skilled at… ● Applying the Law of Conservation of Mass to determine quantitative relationships in chemical compounds and chemical reactions. ● Using experimental data to identify the elements and the masses of various chemical species. ● Determining and applying electron configurations for explanation of observations of matter.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use the periodic table and atomic theory to explain features of matter arising from atomic structure. ● Develop conceptual and mathematical models to illustrate structural features of matter. ● Summative Assessments: Unit or sub-unit tests, ● Formal lab report
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: **Advanced Placement Chemistry - Properties of Matter**

Unit Name	What	Why	How
Properties of Matter	Students will learn... ● To understand properties at the atomic scale that can help explain macroscopic properties of the world we observe.	● Forces and interactions among atoms, ions, and molecules explain observable macroscopic properties.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Chemistry: Properties of Matter

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Chemistry Curriculum
Learning Objectives 2.1 - 2.32</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Use the periodic table as a model to predict and understand chemical and physical properties of matter.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Matter can be described by its physical properties. The physical properties of a substance generally depend on the spacing between the particles (atoms, molecules, ions) that make up the substance and the forces of attraction among them.
Forces of attraction between particles (including the noble gases and also different parts of some large molecules) are important in determining many macroscopic properties of a substance, including how the observable physical state changes with temperature.
The strong electrostatic forces of attraction holding atoms together in a unit are called chemical bonds.</td><td>ESSENTIAL QUESTIONS
What makes something a solid, liquid, or gas?
How are the types of forces different from each other?</td></tr>
</table>

	● The type of bonding in the solid state can be deduced from the properties of the solid state.	
	Acquisition	
	Students will know… ● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. ● Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.	Students will be skilled at… ● Applying Coulomb's Law to explain and understand observed properties of matter. ● Using and experimental data to explain observed properties of matter.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Apply Coulomb's Law to explain observed properties of matter. ● Develop conceptual and mathematical models to illustrate the properties of matter. ● Summative Assessments: Unit or sub-unit tests, ● Research Project
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: Advanced Placement Chemistry - Chemical Reactions

Unit Name	What	Why	How
Chemical Reactions	Students will learn... • Classification of a large diversity of possible chemical reactions; how to use this knowledge to achieve or understand the particular outcome of a reaction.	• Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons.	• Formative assessments such as: homework, quizzes, mini-labs and lab investigations • Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Chemistry: Chemical Reactions

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
AP® Chemistry Curriculum
Learning Objectives 3.1 - 3.13</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Construct and revise an explanation for the outcome of chemical reactions based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that...
Chemical changes are represented by a balanced chemical equation that identi es the ratios with which reactants react and products form.
Chemical reactions can be classified by considering what the reactants are, what the products are,or how they change from one into the other. Classes of chemical reactions include synthesis, decomposition, acid-base, and oxidation-reduction reactions.
Chemical and physical transformations may be observed in several ways and typically involve a change in energy.</td><td>ESSENTIAL QUESTIONS
How do you know a chemical reaction took place?
What are the qualitative and quantitative observations I can make during a chemical reaction?</td></tr>
</table>

	Acquisition	
	Students will know… ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	Students will be skilled at… ● Integrating the mole concept in conjunction with the Law of Conservation of Mass to determine quantitative relationships in chemical compounds and increasingly complex chemical reactions, including acid-base and redox reactions.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Construct and revise an explanation for the outcome of chemical reactions, including acid-base reactions, and redox reactions. ● Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. ● Summative Assessments: Unit or sub-unit tests ● Performance lab assessment
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Advanced Placement Chemistry - Kinetics

Unit Name	What	Why	How
Kinetics	Students will learn... • How to analyze concentration vs. time data to determine the rate law for a particular reaction. • How to design and/or interpret the results of an experiment regarding the factors that may influence the rate of a reaction. • How to make qualitative predictions regarding the relative temperature dependence of the reaction rate.	• The rates of chemical reactions can be explained and predicted by a set of variables that can be quantified.	• Formative assessments such as: homework, quizzes, mini-labs and lab investigations • Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Chemistry: Kinetics

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
AP® Chemistry Curriculum
Learning Objectives 4.1 - 4.9</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Apply scientific principles and evidence to provide an explanation about the effects of changing parameters in a reaction, including the temperature or concentration of the reacting particles, on the rate at which a reaction occurs.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Reaction rates that depend on temperature and other environmental factors are determined by measuring changes in concentration of reactants or products over time.
Elementary reactions are mediated by collisions between molecules. Only collisions having sufficient energy and proper relative orientation of reactants lead to products.
Many reactions proceed via a series of elementary reactions.
Reaction rates may be increased by the presence of a catalyst.</td><td>ESSENTIAL QUESTIONS
How does the temperature affect the rate of a reaction?
How does concentration affect the rate of reaction?
How do elementary reactions occur?
Why aren't all reactions occurring in one step?
How does the presence of a catalyst affect the rate of a reaction?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Chemical processes, their rates, and whether or not energy is stored or</td><td>Students will be skilled at…
Determining a rate law from experimental data.</td></tr>
</table>

	released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	● Understanding and applying rate laws to real life applications.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Construct and revise an explanation for the rates of chemical reactions. ● Use mathematical representations to describe rates of chemical reactions. ● Summative Assessments: Unit or sub-unit tests ● Lab data analysis
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: Advanced Placement Chemistry - Thermochemistry & Thermodynamics

Unit Name	What	Why	How
Thermochemistry & Thermodynamics	Students will learn... ● How to quantify energy inputs and outputs in chemical and physical processes. ● How to interpret and apply enthalpy, entropy, and free energy data.	● Energy is a driving force for all processes. By studying it, students can understand and even predict the conditions necessary for a process to spontaneously occur.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Chemistry: Thermochemistry & Thermodynamics

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

AP® Chemistry Curriculum
Learning Objectives 5.1 - 5.18</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Develop a model consistent with the Law of Conservation of Energy to illustrate that the release and absorption of energy in any process is conserved.
● Apply scientific principles and evidence to provide an explanation about the effects of changing thermodynamic parameters in a reaction on the resulting measurements of energy and matter.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that...
● Two systems with different temperatures that are in thermal contact will exchange energy. The quantity of thermal energy transferred from one system to another is called heat.
● Energy is neither created nor destroyed, but only transformed from one form to another.
● Breaking bonds requires energy, and making bonds releases energy.
● Electrostatic forces exist between molecules as well as between atoms or ions, and breaking the resultant intermolecular interactions requires energy.</td><td>ESSENTIAL QUESTIONS
● How is heat exchanged in a reaction or process?
● Why is energy conserved?
● How do bonds form and break in a reaction in terms of energy?
● How do you determine if a reaction/process is spontaneous?</td></tr>
</table>

<table>
<tr><td></td><td>Chemical or physical processes are driven by a decrease in enthalpy or an increase in entropy, or both.</td><td></td></tr>
<tr><td></td><td colspan="2">Acquisition</td></tr>
<tr><td></td><td>Students will know….
A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart.
Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.</td><td>Students will be skilled at…
Designing and/or interpreting the results of an experiment to determine the change in enthalpy of a process at constant pressure.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">not applicable</td><td>Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.</td></tr>
</table>

<table>
<tr><th colspan="2">Stage 2 - Evidence</th></tr>
<tr><td>Evaluative Criteria</td><td>Assessment Evidence</td></tr>
<tr><td></td><td>ASSESSMENT:
Develop a model to illustrate that the release of absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
Apply scientific principles and evidence to provide an explanation about the thermodynamic favorability of a process.
Summative Assessments: Unit or sub-unit tests
Lab data analysis</td></tr>
</table>

Title of Curriculum: **Advanced Placement Chemistry - Equilibrium**

Unit Name	What	Why	How
Equilibrium	Students will learn... • How to construct an explanation that connects the observations of a chemical reaction to the reversibility of the underlying chemical reactions or processes. • How to predictably influence reversible chemical reactions. • How to predict the solubility of a salt, given equilibrium data. • How to understand acids and bases in the context of chemical equilibrium.	• Many chemical reactions are reversible and follow a set of quantifiable variables.	• Formative assessments such as: homework, quizzes, mini-labs and lab investigations • Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Advanced Placement Chemistry: Equilibrium

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
AP® Chemistry Curriculum
Learning Objectives 6.1 - 6.25</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

Understand that reversible reactions can adopt a number of configurations that are constrained by the stoichiometry and that can be ordered by the extent to which the reactants have been converted to products.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Chemical equilibrium is a dynamic, reversible state in which rates of opposing processes are equal.
Systems at equilibrium are responsive to external perturbations, with the response leading to a change in the composition of the system.
Chemical equilibrium plays an important role in acid-base chemistry and in solubility.
The equilibrium constant is related to temperature and the difference in Gibbs free energy between reactants and products.</td><td>ESSENTIAL QUESTIONS
How is dynamic equilibrium represented?
How does a reaction or process at equilibrium react to an external perturbation?
How are acid and bases affected by equilibrium shift?</td></tr>
</table>

	Acquisition	
	Students will know… ● Many chemical processes are reversible and can be understood conceptually applying principles of kinetics, thermodynamics, and stoichiometry. ● A set of mathematical tools for understanding reversible reactions quantitatively.	Students will be skilled at… ● Qualitatively and quantitatively explaining a set of experimental observations regarding physical, chemical, biological, or environmental processes that are reversible in terms of the underlying chemical processes. ● Designing, and/or interpret data from, an experiment that uses titration to determine the concentration of an analyte in a solution.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Develop conceptual and mathematical models to illustrate reversible chemical processes. ● Predict and explain qualitatively and quantitatively the outcomes of dynamic equilibrium processes. ● Summative Assessments: Unit or sub-unit tests ● Lab data analysis
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Unit Name	What	How	Why
Earth Systems and Resources Topics in which this unit appears: • Earth Systems • Environmental Science: Studying the State of Our Earth • Environmental Systems • Ecosystem Ecology	**Earth Systems and Resources** • Earth Science Concepts (Geologic time scale; plate tectonics, earthquakes, volcanism; seasons; solar intensity and latitude) • The Atmosphere (Composition; structure; weather and climate; atmospheric circulation and the Coriolis Effect; atmosphere–ocean interactions; ENSO) • Global Water Resources and Use (Freshwater/saltwater; ocean circulation; agricultural, industrial, and domestic use; surface and groundwater issues; global problems; conservation) • Soil and Soil Dynamics (Rock cycle; formation; composition; physical and	**Environmental Issues Portfolio –** • Students will be responsible for starting an environmental portfolio at the beginning of the school year and add to the portfolio throughout the year. • Students will be required to find and add one article per week that focuses on a current environmental issue around the world. • Students will write a brief response to each article, including the article's source, bias, personal opinion, and importance in the scientific community as well as include a copy of the full article in their portfolios. Portfolios will be presented to the class at the end of the school year. **Ecosystem Field Walk** –	**To answer the questions:** • Define the field of environmental science and discuss its importance. • Identify ways in which humans have altered and continue to alter our environment. • Identify key environmental indicators and their trends over time. • Define sustainability and explain how it can be measured using the ecological footprint. • Explain the scientific method and its application to the study of environmental problems. • Describe some of the unique challenges and limitations of environmental science. • Describe how matter comprises atoms and molecules that move among different systems.

	chemical properties; main soil types; erosion and other soil problems; soil conservation)	● Students will observe an ecosystem in nature using the high school's forest trails. How Much Paper Do You Use? ● Students will evaluate how much paper they use and calculate the impact of this use on the environment. Weather Report Lab ● Students will record daily weather data including temperature, wind speeds, barometric pressure, humidity, and precipitation. The data will be plotted on graphs and used to compare yearly patterns and averages. ● Students will predict future local weather events by examining current global weather systems. **Hurricane Tracking Lab** – ● Students will track the path of an Atlantic or Pacific hurricane or tropical system. They will examine and record data on storm	● Explain why water is an important component of most environmental systems. ● Discuss how matter is conserved in chemical and biological systems. ● Describe how matter comprises atoms and molecules that move among different systems. ● Explain why water is an important component of most environmental systems. ● Discuss how matter is conserved in chemical and biological systems. ● Explain the concept of ecosystem boundaries. ● Describe the processes of photosynthesis and respiration. ● Explain the insights gained from watershed studies. ● Explain the intermediate disturbance hypothesis. ● Identify the five layers of the atmosphere.

		direction, wind speed, pressure, and precipitation. The data will be used to predict longevity, path of travel, and path as it relates to human populations. ● Students will also analyze the severity of hurricane landfall at specific locations. All data compiled will be added to a class database to be used in future investigations. **Biome Presentations –** ● Students will select a unique biome and create a brief PowerPoint or Prezi presentation including climatic characteristics and species diversity. Calculating the Diversity of Trail Mix Using Shannon's Index – ● Students will use the Shannon Weaver Index to compare diversity of ecosystems and to quantify species evenness and species richness in communities of trail mix.	● Explain how the movement of air currents over mountain ranges affects climates. ● Describe the patterns of surface ocean circulation. ● Explain the mixing of surface and deep ocean waters from thermohaline circulation. ● Identify the causes and consequences of the El Niño–Southern Oscillation. ● Explain how we define terrestrial biomes. ● Interpret climate diagrams. ● Explain the processes of allopatric and sympatric speciation. ● Understand the factors that affect the pace of evolution. ● Explain the difference between a fundamental and a realized niche. ● Describe how environmental change can alter species distributions. ● Discuss how environmental change can cause species extinctions. ● Explain how nature exists at several levels of complexity.

		How Large is your Home? – ● Students will consider how logging affects habitat loss by calculating how much lumber is used for an average house in the United States. Climate Change – ● Students observe the greenhouse effect and analyze its impact on Earth using models with bottles, light, and paper. **Measuring Your Impact:** GDP & Footprints – ● Students will calculate and determine the relationship between ecological footprint and the GDP for China, India, Japan, and the United States. ● Students will then discuss environmental equity between a developed nation and a less-developed nation and identify two goals of the United Nations Millennium Declaration that would assist a less-developed nation in environmental equity. **Coal Cookie Lab** –	● Discuss the characteristics of populations. ● Contrast the effects of density-dependent and density-independent factors on population growth. ● Describe the drivers of human population growth. ● Read and interpret an age structure diagram. ● Describe how demographic transition follows economic development. ● Explain how relationships among population size, economic development, and resource consumption influence the environment. ● Describe why sustainable development is a common but elusive goal

		• Students will model a coal mining organization. The goal of the project is to properly balance land and equipment acquisition with profit margins. • Students will relate the activity to a real coal mining operation examining potential assets and liabilities. **News Report Assignment** – • Students will conduct research on a particular tectonic event in history and develop a newscast explaining where the event took place, why it took place, how it affected manmade and natural environments, and how the event played a role in shaping our history.	

Windham School District Curriculum

AP Environmental Science: Earth Systems and Resources

Stage 1 Desired Results		
ESTABLISHED GOALS: ● *Science is a process.* ● *Energy conversions underlie all ecological processes.* *• Energy cannot be created; it must come from somewhere.* *• As energy flows through systems, at each step more of it becomes unusable.* ● *The Earth itself is one interconnected system.* *• Natural systems change over time and space.* *• Biogeochemical systems vary in ability to recover from disturbances.* ● *Humans alter natural systems.* *• Humans have had an impact on the environment for millions of years.* *• Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.* ● *Environmental problems have a cultural and social context.* *• Understanding the role of cultural, social, and economic factors is vital to the development of solutions.*	***Transfer: Performance Expectations*** ***Students will be able to:*** ● **Earth Systems and Resources** ● *Energy cannot be created; it must come from somewhere.* ● *As energy flows through systems, at each step more of it becomes unusable.*	
	Meaning: Crosscutting	
	ENDURING UNDERSTANDINGS **Students will understand that…** **What- concepts** ● Earth Science Concepts ● The Atmosphere ● Global Water Resources and Use ● Soil and Soil Dynamics	ESSENTIAL QUESTIONS ● Define the field of environmental science and discuss its importance. ● Identify ways in which humans have altered and continue to alter our environment. ● Identify key environmental indicators and their trends over time.
	Acquisition: DCI/SEP	

Human survival depends on developing practices that will achieve sustainable systems.	**Students will know…** - Freshwater/saltwater; ocean circulation; agricultural, industrial, and domestic use; surface and groundwater issues; global problems; conservation - Rock cycle; formation; composition; physical and chemical properties; main soil types; erosion and other soil problems; soil conservation - define sustainability and explain how it can be measured using the ecological footprint. - explain the scientific method and its application to the study of environmental problems. - describe some of the unique challenges and limitations of environmental science. - describe how matter comprises atoms and molecules that move among different systems. - explain why water is an important component of most environmental systems	**Students will be skilled at…** - Geologic time scale; plate tectonics, earthquakes, volcanism; seasons; solar intensity and latitude - Composition; structure; weather and climate; atmospheric circulation and the Coriolis Effect; atmosphere–ocean interactions; ENSO - Discuss how environmental change can cause species extinctions. - Explain how nature exists at several levels of complexity. - And resource consumption influence the environment. - Describe why sustainable development is a common but elusive goal. - Discuss how matter is conserved in chemical and biological systems. - Describe how matter comprises atoms and molecules that move among different systems. - Explain why water is an important component of most environmental systems. - Discuss how matter is conserved in chemical and biological systems. - Explain the concept of ecosystem boundaries. - Explain the insights gained from watershed studies. - Explain the intermediate disturbance hypothesis. - Identify the five layers of the atmosphere.

		• Explain how the movement of air currents over mountain ranges affects climates. • Describe the patterns of surface ocean circulation. • Explain the mixing of surface and deep ocean waters from thermohaline circulation. • Identify the causes and consequences of the El Niño–Southern Oscillation. • Explain how we define terrestrial biomes. • Interpret climate diagrams. • Explain the processes of allopatric and sympatric speciation. • Understand the factors that affect the pace of evolution. • Explain the difference between a fundamental and a realized niche. • Describe how environmental change can alter species distributions.

Used in Content Area Standards	*21st Century Skills*
not applicable	● Collaboration ● Communication ● Critical Thinking ● Analyzing ● Creativity

Stage 2 - Evidence

Evaluative Criteria	*Assessment Evidence*
	ASSESSMENT: ● Exam- AP Format Multiple Choice Free-Response Question
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: AP Environmental Science - The Living World

Unit Name	What	How	Why
The Living World **Topics in which this unit appears:** ● Land, Public and Private ● Feeding the World	**The Living World** ● Ecosystem Structure (Biological populations and communities; ecological niches; interactions among species; keystone species; species diversity and edge effects; major terrestrial and aquatic biomes) ● Energy Flow (Photosynthesis and cellular respiration; food webs and trophic levels; ecological pyramids) ● Ecosystem Diversity (Biodiversity; natural selection; evolution; ecosystem services) ● Natural Ecosystem Change (Climate shifts; species movement; ecological succession) ● Natural Biogeochemical Cycles (Carbon, nitrogen,	**Atmospheric Carbon Dioxide** ● Students will evaluate the effect of the presence of pollutants such as sewage and agricultural runoff on atmospheric carbon dioxide. Testing for Tropospheric Ozone Pollution – ● Students will prepare and carry out tests for tropospheric ozone pollution by making test strips. They will then analyze the ozone pollution test results for local variation and possible impact on human health. **Ozone Sampling –** ● Students will determine the amount of ozone present in different areas. What's In Our Trash? – ● Students will examine the types and amounts of waste they generate in a day.	**To answer the questions:** ● Describe the use of nonrenewable energy in the world and in the United States. ● Explain why different forms of energy are best suited for certain purposes. ● Understand the primary ways that electricity is generated in the United States. ● Discuss the uses of coal and its consequences. ● Discuss the uses of petroleum and its consequences. ● Discuss the uses of natural gas and its consequences. ● Discuss the uses of oil sands and liquefied coal and their consequences. ● Describe future prospects for fossil fuel use. ● Describe how nuclear energy is used to generate electricity. ● Discuss the advantages and disadvantages of using nuclear fuels to generate electricity.

	phosphorus, sulfur, water, conservation of matter)	**Solid Waste Composting –** ● Students will research the rate of decomposition of commonly used waste items. ● Students will collect data on percent decomposition at specific intervals throughout the year and plot the decomposition curve for each item. ● Students will use their data to interpret the effect product use has on the waste flow in the United States and analyze issues surrounding waste disposal and recycling as well as raw material usage. **Endangered Species Project** ● Students will select an endangered species from around the world and develop a presentation outlining location, habitat, niche requirements, and issues leading to the listing of the species on the Endangered Species List.	● Describe strategies to conserve energy and increase energy efficiency. ● Explain differences among the various renewable energy resources. ● Describe the various forms of biomass.

Windham School District Curriculum

AP Environmental Science: The Living World

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Science is a process.
● Science is a method of learning more about the world.
● Science constantly changes the way we understand the world.
Energy conversions underlie all ecological processes.
● Energy cannot be created; it must come from somewhere.
● As energy flows through systems, at each step more of it becomes unusable.
The Earth itself is one interconnected system.
● Natural systems change over time and space.
● Biogeochemical systems vary in ability to recover from disturbances.
Humans alter natural systems.
● Humans have had an impact on the environment for millions of years.
● Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.
Environmental problems have a cultural and social context.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● The Living World
● Humans have had an impact on the environment for millions of years.
● Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Ecosystem Structure
● Energy Flow
● Ecosystem Diversity
● Natural Ecosystem Change
● Natural Biogeochemical Cycles</td><td>ESSENTIAL QUESTIONS

● Identify species interactions that cause negative effects on one or both species.
● Describe the processes of photosynthesis and respiration.
● Carbon, nitrogen, phosphorus, sulfur, water, conservation of matter</td></tr>
</table>

<table>
<tr><td rowspan="2">Understanding the role of cultural, social, and economic factors is vital to the development of solutions.
Human survival depends on developing practices that will achieve sustainable systems.
• A suitable combination of conservation and develop</td><th colspan="2">Acquisition: DCI/SEP</th></tr>
<tr><td>Students will know…
Biological populations and communities; ecological niches; interactions among species; keystone species; species diversity and edge effects; major terrestrial and aquatic biomes
Photosynthesis and cellular respiration; food webs and trophic levels; ecological pyramids
Discuss the uses of coal and its consequences.
Discuss the uses of petroleum and its consequences.
Discuss the uses of natural gas and its consequences.
Discuss the uses of oil sands and liquefied coal and their consequences.
Dxplain differences among the various renewable energy resources.
Describe the various forms of biomass</td><td>Students will be skilled at…
Biodiversity; natural selection; evolution; ecosystem services
Climate shifts; species movement; ecological succession
Describe future prospects for fossil fuel use.
Describe how nuclear energy is used to generate electricity.
Discuss the advantages and disadvantages of using nuclear fuels to generate electricity.
Describe strategies to conserve energy and increase energy efficiency.</td></tr>
<tr><th colspan="2">Used in Content Area Standards</th><th>21st Century Skills</th></tr>
<tr><td colspan="2">not applicable</td><td>Collaboration
Communication
Critical Thinking
Analyzing
Creativity</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT ● Exam- AP Format Multiple Choice Free-Response Question
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: AP Environmental Science - Population

Unit Name	What	How	Why
Population **Topics in which this unit appears:** ● Evolution of Biodiversity ● Population and Community Ecology ● The Human Population	**III. Population** ● Population Biology Concepts (Population ecology; carrying capacity; reproductive strategies; survivorship) ● Human Population 1. Human population dynamics (Historical population sizes; distribution; fertility rates; growth rates and doubling times; demographic transition; age-structure diagrams) ● Population size (Strategies for sustainability; case studies; national policies) ● Impacts of population growth (Hunger; disease; economic effects; resource use; habitat destruction) ● Mining (Mineral formation; extraction;	**Brownfield Remediation –** ● Students will develop a detailed remediation plan for a Brownfield site in their community from the perspective of an environmental technician. The plan will outline dangers of contaminants in the area, potential impacts on the public, scope and sequence of testing, and future goals for the site. ● Students will ultimately compare their unique plans to actual ongoing remediation of the site. **Tracking Diseases Activity –** ● Students will analyze the spread of diseases born from environmental contamination by plotting confirmed cases on a map and examining the global impacts of the disease. How	**To answer the questions:** ● Discuss the characteristics of populations. ● Contrast the effects of density-dependent and density-independent factors on population growth. ● Describe the drivers of human population growth. ● Read and interpret an age structure diagram. ● Describe how demographic transition follows economic development. ● Understand how we estimate the number of species living on Earth. ● Quantify biodiversity. ● Describe patterns of relatedness among species using a phylogeny. ● Identify the processes that cause genetic diversity. ● Explain how evolution can occur through artificial selection. ●

	global reserves; relevant laws and treaties) ● Fishing (Fishing techniques; overfishing; aquaculture; relevant laws and treaties) ● Global Economics (Globalization; World Bank; Tragedy of the Commons; relevant laws and treaties)	Does Risk Affect Life Expectancy? ● Students will examine risky behaviors by determining how they can affect life expectancy. **Determining Population Size –** ● Students will use the quadrant method to study communities and to calculate the density and frequency of species in a particular community. **Salinization Study –** ● Students will design an experiment to test the effects salinization of soil has on germination of crop seeds. Through their investigation, students will determine salinization thresholds for specific crop seeds/plants relating their findings to soil salinity and water resource use in agricultural states. **Water Loss: Drop by Drop** – ● Students will estimate household water loss from common leaks and extrapolate water loss to the surrounding community to demonstrate	● Explain how evolution can occur through natural selection.

		how minor events, when occurring often, may result in large effects. **Eco Bottle –** ● Students will build and observe a land and water ecosystem. They will observe abiotic and biotic interactions between the two systems as well as observe and review carbon, nitrogen, and water cycles. ● Saving Water –Students will calculate the impact of installing low-flow shower heads and toilets that use less water to consider the amount of water conserved and the economic benefits of conserving water.	

Windham School District Curriculum

AP Environmental Science: Population

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:
Science is a process.
• Science is a method of learning more about the world.
• Science constantly changes the way we understand the world.
Energy conversions underlie all ecological processes.
• Energy cannot be created; it must come from somewhere.
• As energy flows through systems, at each step more of it becomes unusable.
The Earth itself is one interconnected system.
• Natural systems change over time and space.
• Biogeochemical systems vary in ability to recover from disturbances.
Humans alter natural systems.
• Humans have had an impact on the environment for millions of years.
• Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
Explain that humans have had an impact on the environment for millions of years.
Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Population Biology Concepts
Human Population
Population size
Impacts of population growth
Mining (Mineral formation; extraction; global reserves; relevant laws and treaties)
Fishing</td><td>ESSENTIAL QUESTIONS
Describe the factors that determine the species richness of a community.
Explain factors that may potentially limit the carrying capacity of humans on Earth.explain.
Explain the dynamics that occur in metapopulations.
Discuss species interactions that cause neutral or positive effects on both species.</td></tr>
</table>

<table>
<tr><td rowspan="3">

- *Environmental problems have a cultural and social context.*
  • Understanding the role of cultural, social, and economic factors is vital to the development of solutions.
- *Human survival depends on developing practices that will achieve sustainable systems.*
  • A suitable combination of conservation and develop

</td><td></td><td></td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>

Students will know…

- Historical population sizes; distribution; fertility rates; growth rates and doubling times; demographic transition; age-structure diagrams
- Population ecology; carrying capacity; reproductive strategies; survivorship
- Explain the advantages and disadvantages of energy from hydrogen.
- Discuss the environmental and economic options we must assess in planning our energy future.
- Consider the challenges of a renewable energy strategy.
- Discuss the three major problems caused by wastewater pollution.
- Explain the modern technologies used to treat wastewater.
- Discuss the factors that cause unequal heating of Earth.

</td><td>

Students will be skilled at…

- Strategies for sustainability; case studies; national policies
- Defining causes of Hunger; disease; economic effects;
- Cost/Benefit analysis of resource use; habitat destruction
- Explaining fishing techniques; overfishing; aquaculture; relevant laws and treaties of shared waters
- Global Economics Globalization; World Bank; Tragedy of the Commons; relevant laws and treaties
- Describe how Earth's tilt affects seasonal differences in temperatures.
- Explain how the properties of air affect the way it moves in the atmosphere.
- Identify the factors that drive atmospheric convection currents.
- Describe how Earth's rotation affects the movement of air currents

</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">

not applicable

</td><td>

- Collaboration
- Communication
- Critical Thinking
- Analyzing
- Creativity

</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Exam- AP Format Multiple Choice Free-Response Question
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: AP Environmental Science - Land and Water Use

Unit Name	What	How	Why
Land and Water Use **Topics in which this unit appears:** ● Water Resources ● Water Pollution	**IV. Land and Water Use** ● Agriculture -. Feeding a growing population (Human nutritional requirements; types of agriculture; Green Revolution; genetic engineering and crop production; deforestation; irrigation; sustainable agriculture) ● Controlling pests (Types of pesticides; costs and benefits of pesticide use; integrated pest management; relevant laws) ● Forestry (Tree plantations; old growth forests; forest fires; forest management; national forests) ● Rangelands (Overgrazing; deforestation; desertification; rangeland	**Global Population Trend Statistics Lab** ● Students will compare population statistics among developed and undeveloped countries around the world. Students correlate population trends to resource availability and resource use. **Virtual Cemetery –** ● Students will visit several “virtual cemeteries” to collect data on human life span demographics from various generations. Students will plot data and examine life expectancy values from the gathered information. **The Costs of Commuting –** ● Students will use online calculators to determine the monetary and environmental impact of commuting to-and-from	**To answer the questions:** ● Explain the exponential growth model of populations, which produces a J-shaped curve. ● Describe how the logistic growth model incorporates a carrying capacity and produces an S-shaped curve. ● Compare the reproductive strategies and survivorship curves of different species. ● Explain the role of keystone species. ● Explain the process of primary succession. ● Explain the process of secondary succession. ● Explain the process of aquatic succession. ● How energy is harnessed from water. ● List the different forms of solar energy and their application. ● Describe how wind energy is harnessed and its contemporary uses.explain how relationships among population size, economic development, explain how energy is harnessed from water. ● List the different forms of solar energy and their application. ●

	management; federal rangelands) ● Other Land Use 1. Urban land development (Planned development; suburban sprawl; urbanization) ● Transportation infrastructure (Federal highway system; canals and channels; roadless areas; ecosystem impacts) ● Public and federal lands (Management; wilderness areas; national parks; wildlife refuges; forests; wetlands) ● Land conservation options (Preservation; remediation; mitigation; restoration) ● Sustainable land-use strategies	work, school, and recreational activities by foot, car, and public transportation methods. **Soil Quality Lab** – ● Students will collect experimental data on soil samples taken from on-campus test sites. The data will include soil type, color, percent moisture, percolation rate, organic matter content, temperature, and chemistry. Students will compare samples from various test sites and analyze soil composition in relation to surrounding environment. Data will be compiled in google classroom drive to be used for yearly analysis.	● describe how wind energy is harnessed and its contemporary uses. ● Discuss the methods of harnessing the internal energy from Earth. ● Explain the advantages and disadvantages of energy from hydrogen. ● Discuss the factors that cause unequal heating of Earth. ● Describe how Earth's tilt affects seasonal differences in temperatures. ● Explain how the properties of air affect the way it moves in the atmosphere. Identify the factors that drive atmospheric convection currents. ● Describe how Earth's rotation affects the movement of air currents

Windham School District Curriculum

AP Environmental Science: Land and Water Use

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">ESTABLISHED GOALS:
Science is a process.
Energy conversions underlie all ecological processes.
• Energy cannot be created; it must come from somewhere.
• As energy flows through systems, at each step more of it becomes unusable.
The Earth itself is one interconnected system.
• Natural systems change over time and space.
• Biogeochemical systems vary in ability to recover from disturbances.
Humans alter natural systems.
• Humans have had an impact on the environment for millions of years.
Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.
Environmental problems have a cultural and social context.
Human survival depends on developing practices that will achieve sustainable systems.</td><td colspan="2">Transfer: Performance Expectations

Students will be able to:
Land and Water Use
Human survival depends on developing practices that will achieve sustainable systems.
A suitable combination of conservation and develop</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Agriculture
Controlling pest
Forestry
Rangelands
Other Land Use
Urban land development
Transportation infrastructure
Public and federal lands
Land conservation options
Sustainable land-use strategies</td><td>ESSENTIAL QUESTIONS
What are sustainable land-use strategies
How do we manage public and federal lands
How an we develop transportation infrastructure</td></tr>
</table>

- *A suitable combination of conservation and develop*		
	Acquisition: DCI/SEP	
	Students will know… - Energy forms; power; units; conversions; Laws of Thermodynamics - Industrial Revolution; exponential growth; energy crisis - Formation of coal, oil, and natural gas; extraction/purification methods; world reserves and global demand; synfuels; environmental advantages/ disadvantages of sources - Nuclear fission process; nuclear fuel; electricity production; nuclear reactor types; environmental advantages/disadvantages; safety issues; radiation and human health; radioactive wastes; nuclear fusion	**Students will be skilled at…** - Energy efficiency; CAFE standards; hybrid electric vehicles; mass transit - Solar energy; solar electricity; hydrogen fuel cells; biomass; wind energy; small-scale hydroelectric; ocean waves and tidal energy; geothermal; environmental advantages/disadvantages - Dams; flood control; salmon; silting; other impacts - Explain the sources of heavy metals and their effect on organisms. - Discuss the sources and effects of acid deposition and acid mine drainage. - Explain how synthetic organic compounds can affect aquatic organisms. - Identify the major sources of oil pollution. - Explain some of the current methods to remediate oil pollution. - Identify the major sources of solid waste pollution.
Used in Content Area Standards		***21st Century Skills***
not applicable		- Collaboration - Communication - Critical Thinking - Analyzing - Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Exam- AP Format Multiple Choice Free-Response Question
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: AP Environmental Science - Energy Resources and Consumption

Unit Name	What	How	Why
Energy Resources and Consumption **Topics in which this unit appears:** ● Nonrenewable Energy Resources ● Achieving Energy Sustainability ● Conservation of Biodiversity ● Sustainability, Economics, and Equity	**V. Energy Resources and Consumption** Energy Concepts (Energy forms; power; units; conversions; Laws of Thermodynamics) ● Energy Consumption - History (Industrial Revolution; exponential growth; energy crisis) - Present global energy use - Future energy needs ● Fossil Fuel Resources and Use (Formation of coal, oil, and natural gas; extraction/purification methods; world reserves and global demand; synfuels; environmental advantages/ disadvantages of sources) ● Nuclear Energy (Nuclear fission process; nuclear fuel; electricity production; nuclear	**Who's Got the Power? –** ● Students will explore the relationship between work and power. They will first learn to differentiate between the two, and then will calculate how much work is required to use up the energy in a snack. **Forest Management Plan –** ● Students will conduct a detailed analysis on a parcel of forest. Included in the analysis will be species composition and abundances, average tree age, harvestable timber, firewood timber, wildlife value, historic land use, and current land use. Students will prepare a report to a homeowner recommending a management plan for the forest that includes harvesting timber, increasing wildlife diversity, and maintaining	**To answer the questions:** ● Explain the sources of heavy metals and their effect on organisms. ● Discuss the sources and effects of acid deposition and acid mine drainage. ● Explain how synthetic organic compounds can affect aquatic organisms. ● Identify the major sources of oil pollution. ● Explain some of the current methods to remediate oil pollution. ● Identify the major sources of solid waste pollution. ● Distinguish among the trophic levels that exist in food chains and food webs. ● Quantify ecosystem productivity. ● Explain energy transfer efficiency and trophic pyramids. ● Describe how water cycles within ecosystems. ● Explain how carbon cycles within ecosystems.

	reactor types; environmental advantages/disadvantages; safety issues; radiation and human health; radioactive wastes; nuclear fusion) ● Hydroelectric Power (Dams; flood control; salmon; silting; other impacts) ● Energy Conservation (Energy efficiency; CAFE standards; hybrid electric vehicles; mass transit) ● Renewable Energy (Solar energy; solar electricity; hydrogen fuel cells; biomass; wind energy; small-scale hydroelectric; ocean waves and tidal energy; geothermal; environmental advantages/disadvantages	aesthetical value. All data collected will be included in the report as well as included in a class database for future use. **Plan a City –** ● Students will use their knowledge of urban sprawl and smart-growth development to design a city that fosters environmental awareness, community togetherness, and limits urban sprawl. **Ecological Footprint of Food Consumption –** ● Students will examine data on the amount of different foods consumed by a typical person in the United States and the ecological footprint of producing these items. ● Students will then calculate the ecological footprint for the total amount of each food item consumed in the United States and compare this footprint to that of others in the world.	● Describe how nitrogen cycles within ecosystems. ● Explain how phosphorus cycles within ecosystems. ● Discuss the movement of calcium, magnesium, potassium, and sulfur within ecosystems. ● Distinguish between ecosystem resistance and ecosystem resilience.

Windham School District Curriculum

AP Environmental Science: Energy Resources and Consumption

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">ESTABLISHED GOALS:
Science is a process.
• Science is a method of learning more about the world.
• Science constantly changes the way we understand the world.
Energy conversions underlie all ecological processes.
• Energy cannot be created; it must come from somewhere.
• As energy flows through systems, at each step more of it becomes unusable.
The Earth itself is one interconnected system.
• Natural systems change over time and space.
• Biogeochemical systems vary in ability to recover from disturbances.
Humans alter natural systems.
• Humans have had an impact on the environment for millions of years.
• Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.</td><td colspan="2">Transfer: Performance Expectations
Students will be able to:
Energy Resources and Consumption
Energy cannot be created; it must come from somewhere.
As energy flows through systems, at each step more of it becomes unusable.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Energy Concepts
Energy Consumption
Present global energy use
Future energy needs
Fossil Fuel Resources and Use
. Nuclear Energy
Hydroelectric Power
. Energy Conservation
Renewable Energy</td><td>ESSENTIAL QUESTIONS
Discuss the environmental and economic options we must assess in planning our energy future.
Consider the challenges of a renewable energy strategy.
Discuss the three major problems caused by wastewater pollution.
Explain the modern technologies used to treat wastewater</td></tr>
</table>

● *Environmental problems have a cultural and social context.* *• Understanding the role of cultural, social, and economic factors is vital to the development of solutions.* ● *Human survival depends on developing practices that will achieve sustainable systems.* *• A suitable combination of conservation and develop*		
	Acquisition: DCI/SEP	
	Students will know… ● Energy forms; power; units; conversions; Laws of Thermodynamics ● Industrial Revolution; exponential growth; energy crisis ● Formation of coal, oil, and natural gas; extraction/purification methods; world reserves and global demand; synfuels; environmental advantages/ disadvantages of sources ● Nuclear fission process; nuclear fuel; electricity production; nuclear reactor types; environmental advantages/disadvantages; safety issues; radiation and human health; radioactive wastes; nuclear fusion	**Students will be skilled at…** ● Energy efficiency; CAFE standards; hybrid electric vehicles; mass transit ● Solar energy; solar electricity; hydrogen fuel cells; biomass; wind energy; small-scale hydroelectric; ocean waves and tidal energy; geothermal; environmental advantages/disadvantages ● Dams; flood control; salmon; silting; other impacts ● Explain the sources of heavy metals and their effect on organisms. ● Discuss the sources and effects of acid deposition and acid mine drainage. ● Explain how synthetic organic compounds can affect aquatic organisms. ● Identify the major sources of oil pollution. ● Explain some of the current methods to remediate oil pollution. ● Identify the major sources of solid waste pollution.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical Thinking ● Analyzing ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Exam- AP format Multiple Choice Free-Response Question
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: AP Environmental Science - Pollution

Unit Name	What	How	Why
Pollution **Topics in which this unit appears:** • Air Pollution and Stratospheric Ozone Depletion • Waste Generation and Waste Disposal • Human Health and Environmental Risks	**VI. Pollution** • Pollution Types - Air pollution (Sources — primary and secondary; major air pollutants; measurement units; smog; acid deposition — causes and effects; heat islands and temperature inversions; indoor air pollution; remediation and reduction strategies; Clean Air Act and other relevant laws) • Noise pollution (Sources; effects; control measures) • Water pollution (Types; sources, causes, and effects; cultural eutrophication; groundwater pollution; maintaining water quality; water purification; sewage treatment/septic systems;	**Home Energy Audit** • Students will analyze the ways electricity is used in their household and determine the amount of energy used by their families. They will be responsible for describing ways to reduce their energy use and conservation strategies. • Students will collect data on amount of appliances and lights, hours used by electrical appliances, and electrical energy used to operate the individual appliances. **Coal Investigations –** • Students will measure and calculate the percentage of water found in the four different types of coal.	**To answer the questions** • Explain the harmful effects of sediment pollution. • Discuss the sources and consequences of thermal pollution. • Understand the causes of noise pollution. • Explain how the Clean Water Act protects against water pollution. • Discuss the goals of the Safe Drinking Water Act. • Understand how water pollution legislation is changing in developing countries. • Identify and describe the major air pollutants. • Describe the sources of air pollution. • Explain how photochemical smog forms and why it is still a problem in the United States. • Identify the nine terrestrial biomes. • Identify the major freshwater biomes. • Identify the major marine biomes. • Understand how we estimate the number of species living on Earth. • Quantify biodiversity.

	Clean Water Act and other relevant laws) (Types; disposal; reduction) ● Impacts on the Environment and Human Health -Hazards to human health (Environmental risk analysis; acute and chronic effects; dose-response relationships; air pollutants; smoking and other risks) -Hazardous chemicals in the environment (Types of hazardous waste; treatment/disposal of hazardous waste; cleanup of contaminated sites; biomagnification; relevant laws) - Economic Impacts (Cost-benefit analysis; externalities; marginal costs; sustainability)	**Choosing a Car: Conventional or Hybrid? –** ● Students will determine the pros and cons of choosing a hybrid or a conventional vehicle. ● Solar Energy – Students will experiment with solar cells and compare energy output with different variables in order to learn how passive solar systems work.	● Describe patterns of relatedness among species using a phylogeny. ● Identify the processes that cause genetic diversity. ● Explain how evolution can occur through artificial selection. ● Explain how evolution can occur through natural selection. ● Explain how evolution can occur through random processes.

Windham School District Curriculum

AP Environmental Science: Pollution

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

● Science is a process.
• Science is a method of learning more about the world.
• Science constantly changes the way we understand the world.
● Energy conversions underlie all ecological processes.
• Energy cannot be created; it must come from somewhere.
• As energy flows through systems, at each step more of it becomes unusable.
● The Earth itself is one interconnected system.
• Natural systems change over time and space.
• Biogeochemical systems vary in ability to recover from disturbances.
● Humans alter natural systems.
• Humans have had an impact on the environment for millions of years.
• Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.
● Environmental problems have a cultural and social context.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Pollution
● Determine a suitable combination of conservation and development
● Air, water, terrestrial</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Pollution Types
● Impacts on the Environment and Human Health
● Economic Impacts</td><td>ESSENTIAL QUESTIONS

● Explain the harmful effects of sediment pollution.
● Discuss the sources and consequences of thermal pollution.
● Understand the causes of noise pollution.
● Explain how the Clean Water Act protects against water pollution.</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● Sources — primary and secondary; major air pollutants; measurement units; smog; acid deposition — causes and effects; heat islands and temperature inversions; indoor air pollution; remediation and reduction strategies; Clean Air Act and other relevant laws</td><td>Students will be skilled at…

● Types; disposal; reduction
● Environmental risk analysis; acute and chronic effects; dose-response relationships; air pollutants; smoking and other risks
● Formation of stratospheric ozone; ultraviolet radiation; causes of ozone</td></tr>
</table>

• *Understanding the role of cultural, social, and economic factors is vital to the development of solutions.* ● *Human survival depends on developing practices that will achieve sustainable systems.* • *A suitable combination of conservation and develop*	● Sources; effects; control measures ● Sources, causes, and effects; cultural eutrophication; groundwater pollution; maintaining water quality; water purification; sewage treatment/septic systems; Clean Water Act and other relevant laws ● understand how water pollution legislation is changing in developing countries. ● identify and describe the major air pollutants. ● describe the sources of air pollution. ● explain how photochemical smog forms and why it is still a problem in the United States. ● discuss the goals of the Safe Drinking Water Act. ● explain how evolution can occur through random processes	depletion; effects of ozone depletion; strategies for reducing ozone depletion; relevant laws and treaties ● Types of hazardous waste; treatment/disposal of hazardous waste; cleanup of contaminated sites; biomagnification; relevant laws ● Cost-benefit analysis; externalities; marginal costs; sustainability
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical Thinking ● Analyzing ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Exam- AP format Multiple Choice Free-Response Question
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: AP Environmental Science - Global Change

Unit Name	What	How	Why
Global Change **Topics in which this unit appears:** • Global Change • Global Climates and Biomes	VII. **Global Change:** • Stratospheric Ozone (Formation of stratospheric ozone; ultraviolet radiation; causes of ozone depletion; effects of ozone depletion; strategies for reducing ozone depletion; relevant laws and treaties) • Global Warming (Greenhouse gases and the greenhouse effect; impacts and consequences of global warming; reducing climate change; relevant laws and treaties) • Loss of Biodiversity 1. Habitat loss; overuse; pollution; introduced species; endangered and extinct species 2. Maintenance through	**Solar Oven –** • Students will research, design, and build working solar ovens made from recyclable materials. **Indoor Air Quality Survey/Lab –** • Students will conduct a school wide survey on Indoor Air Quality. They will survey faculty and students, compile data, and create a PowerPoint presentation to be presented to the school administration. Including in their research will be information on indoor air samples collected throughout the school. **Litter Lab/Campus Survey –** • Students will develop a survey that will examine the composition and amount of litter found on their school's campus.	**To answer the questions:** • Describe how acid deposition forms and why it has improved in the United States and become worse elsewhere. • Explain strategies and techniques for controlling sulfur dioxide, nitrogen oxides, and particulate matter. • Describe innovative pollution control measures. • Explain the benefits of stratospheric ozone and how it forms. • Describe the depletion of stratospheric ozone. • Explain efforts to reduce ozone depletion. • Explain how indoor air pollution differs in developing and developed countries. • Describe the major indoor air pollutants and the risks associated with them. • Explain why we generate waste and describe recent waste disposal trends. • Describe the content of the solid waste stream in the United States. • Describe the three Rs.

	conservation 3. Relevant laws and treaties)	- Students will analyze percentages of liter type and abundance and offer explanations of their findings. Following the survey, students will develop a plan to implement a Recycling Program in their school and further enhance recycling awareness in their community. Campus Cleanup – - Students will organize a campus cleanup and school wide Environmental Awareness Day.	- Understand the process and benefits of composting. - Describe the goals and function of a solid waste landfill. - Explain the design and purpose of a solid waste incinerator

Windham School District Curriculum

AP Environmental Science: Global Change

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

1. Science is a process.
• Science is a method of learning more about the world.
• Science constantly changes the way we understand the world.

2. Energy conversions underlie all ecological processes.
• Energy cannot be created; it must come from somewhere.
• As energy flows through systems, at each step more of it becomes unusable.

3. The Earth itself is one interconnected system.
• Natural systems change over time and space.
• Biogeochemical systems vary in ability to recover from disturbances.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Global Change
● Science constantly changes the way we understand the world.
● Understanding the role of cultural, social, and economic factors is vital to the development of solutions.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Stratospheric Ozone
● Global Warming
● Loss of Biodiversity</td><td>ESSENTIAL QUESTIONS

● Explain strategies and techniques for controlling sulfur dioxide, nitrogen oxides, and particulate matter and greenhouse gasses.
● Explain efforts to reduce ozone depletion.
● Explain how indoor air pollution differs in developing and developed countries.
● Describe the major indoor air pollutants and the risks associated with them.</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
</table>

	Students will know…	Students will be skilled at…
4. Humans alter natural systems. *• Humans have had an impact on the environment for millions of years.* *• Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.* *5. Environmental problems have a cultural and social context.* *• Understanding the role of cultural, social, and economic factors is vital to the development of solutions.* ● *Human survival depends on developing practices that will achieve sustainable systems.* *• A suitable combination of conservation and develop*	● Formation of stratospheric ozone; ultraviolet radiation; causes of ozone depletion; ● Greenhouse gases and the greenhouse effect; impacts and consequences of global warming; ● Habitat loss; overuse; pollution; introduced species; endangered and extinct species describe innovative pollution control measures. ● Explain the benefits of stratospheric ozone and how it forms. ● Describe the depletion of stratospheric ozone.	● Effects of ozone depletion; strategies for reducing ozone depletion; relevant laws and treaties ● Reducing climate change; relevant laws and treaties ● Maintenance through conservation 3. Relevant laws and treaties ● Explain why we generate waste and describe recent waste disposal trends. ● Describe the content of the solid waste stream in the United States ● Understand the process and benefits of composting. ● Describe the goals and function of a solid waste landfill. ● Explain the design and purpose of a solid waste incinerator

Used in Content Area Standards	***21st Century Skills***
not applicable	● Collaboration ● Communication ● Critical Thinking ● Analyzing ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT:

	● Exam- AP- Format Multiple Choice 60% Free-Response Question 40%
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **AP Physics 1 - Kinematics**

Unit Name	What	How	Why
Kinematics	Students will learn… ● Convert Units and conduct a dimensional analysis ● Solve One Dimensional Motion Problems – (Position, Velocity, Acceleration) ● Resolve Vectors using Algebra ● Solve Relative Velocity and Acceleration problems ● Predict Projectile Motion landing site	● Express the motion of an object using narrative, mathematical, and graphical representations. ● Design an experimental investigation of the motion of an object. ● Analyze experimental data describing the motion of an object in two dimensions and is able to express the results of the analysis using narrative, mathematical, and graphical representations.	● To find the position, velocity, acceleration of an object moving in order to predict its position at a point in time.

Windham School District Curriculum

AP Physics 1: Kinematics - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
• HS-PS2-1
• HS-PS2-2
• HS-PS2-3
• HS-PS2-4
• HS-PS2-5
• HS-ETS1-1
• HS-ETS1-2
• HS-ETS1-3</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
● Convert Units and conduct a dimensional analysis
● Solve One Dimensional Motion Problems – (Position, Velocity, Acceleration)
● Resolve Vectors using Algebra
● Solve Relative Velocity and Acceleration problems
● Predict Projectile Motion landing site</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● All forces share certain common characteristics when considered by observers in inertial reference frames.
● The acceleration of the center of mass of a system is related to the net force exerted on the system,</td><td>ESSENTIAL QUESTIONS
● What is displacement?
● What is velocity and how is it different than speed?
● What is acceleration?
● How do we find the position, velocity, acceleration of an object moving in one dimension?
● How do we find the range, hang time and velocity of a projectile?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
● Units, conversions, dimensional analysis
● One Dimensional Motion – (Position, Velocity, Acceleration) Students should understand the general relationships among position, velocity, and acceleration</td><td>Students will be skilled at…
● How to express the motion of an object using narrative, mathematical, and graphical representations.
● How to design an experimental investigation of the motion of an object.</td></tr>
</table>

	for the motion of a particle along a straight line. ● Students should understand the special case of motion with constant acceleration ● Students should know how to deal with situations in which acceleration is a specified function of velocity and time so they can write an appropriate differential equation and solve it for *u* by separation of variables, incorporating correctly a given initial value of *u*. ● Vectors - Students should be able to add, subtract, and resolve displacement and velocity vectors, so they can: ● Determine components of a vector along two specified, mutually perpendicular axes. ● Determine the net displacement of a particle or the location of a particle relative to another. ● Determine the change in velocity of a particle or the velocity of one particle relative to another. ● Relative Velocity and Acceleration ● Projectile Motion	● How to analyze experimental data describing the motion of an object in two dimensions and is able to express the results of the analysis using narrative, mathematical, and graphical representations.

Used in Content Area Standard	***21st Century Skills***
	● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments predicting interactions between objects ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **AP Physics 1 - Newton's Laws of Motion**

Unit Name	What	How	Why
Newton's Laws of Motion	Students will learn... ● Apply Newton's Laws of Motion to solve One Dimensional Force Problems ● Apply Newton's Laws of Motion to solve connected objects Force problems ● Apply Newton's Laws of Motion to solve Two Dimensional Force Problems (including Inclined Planes)	● Students will with the coefficient of friction in motion problems. ● Students will be able to solve problems in which application of Newton's laws leads to two or three simultaneous linear equations involving unknown forces or accelerations.	● To determine what happens when more than one force acts on an object ● To determine the results of unbalanced forces

Windham School District Curriculum Template

AP Physics 1: Newton's Laws of Motion - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-PS3-1
HS-PS3-2
HS-PS3-3
HS-PS3-4
HS-PS3-5
HS-ETS1-1
HS-ETS1-2
HS-ETS1-3</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Apply Newton's Laws of Motion to solve One Dimensional Force Problems
Apply Newton's Laws of Motion to solve connected objects Force problems
Apply Newton's Laws of Motion to solve Two Dimensional Force Problems (including Inclined Planes)</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Weight and Mass are different
Newton's Laws of Motion
How to solve One Dimensional Force Problems
Connected objects Force problems
Two Dimensional Force Problems (including Inclined Planes)
Friction</td><td>ESSENTIAL QUESTIONS
What is the difference between weight and Mass?
What is a Force?
What happens when more than one force acts on an object?
What are the results of unbalanced forces?
How do objects move at constant speed?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Weight / Mass
Newton's Laws
One Dimensional Force Problems</td><td>Students will be skilled at…
Students should understand the significance of the coefficient of friction
Students should understand Newton's Third Law so that, for a given system, they can identify the force pairs and the objects</td></tr>
</table>

	● Connected objects. ● Two Dimensional Force Problems (including Inclined Planes) ● Friction	on which they act, and state the magnitude and direction of each force. ● Students should be able to solve problems in which application of Newton's laws leads to two or three simultaneous linear equations involving unknown forces or accelerations.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: AP Physics 1 - Work, Energy, Power and Conservation Laws

Unit Name	What	How	Why
Work, Energy. Power and Conservation Laws	Students will learn... ● Predict and calculate the energy transfer to an object or system from information about a force exerted on the object or system through a distance. ● Relate mass, velocity, and linear momentum for a moving object. ● State and apply the relations between linear momentum and center-of-mass motion for a system of particles.	● Apply linear momentum conservation to one-dimensional elastic and inelastic collisions and two-dimensional completely inelastic collisions. ● Apply conservation of energy in analyzing the motion of objects that move under the influence of springs. ● Calculate the power required to maintain the motion of an object with constant acceleration	● To determine how energy is transformed to other objects

Windham School District Curriculum

AP Physics 1: Work, Energy. Power and Conservation Laws - Grade 11-12

Stage 1 Desired Results		
ESTABLISHED GOALS: *Competencies (Standards):* *Content Standards:* • HS-PS4-1 • HS-PS4-2 • HS-PS4-3 • HS-PS4-4 • HS-PS4-5	***Transfer*** *Students will be able to* ● Calculate the kinetic energy of an object in one and two dimensional motion ● Predict and calculate the energy transfer to (i.e., the work done on) an object or system from information about a force exerted on the object or system through a distance. ● Relate mass, velocity, and linear momentum for a moving object, and calculate the total linear momentum of a system of objects. ● State and apply the relations between linear momentum and center-of-mass motion for a system of particles. ● Apply linear momentum conservation to two-dimensional elastic and inelastic collisions.	
	Meaning	
	ENDURING UNDERSTANDINGS *Students will understand that…* ● Momentum, ● Energy ● Work and Power ● Collisions ● Conservation	ESSENTIAL QUESTIONS ● What is Energy? ● What are the types of Energy? ● How is energy transformed to other objects? ● What is momentum? ● What is conservation ● What is a collision?
	Acquisition	
	Students will know… ● Impulse and Momentum ● Linear Momentum ● Conservation of Linear Momentum in an elastic and inelastic collision	*Students will be skilled at…* **Impulse and Momentum** ● Students should understand impulse and linear momentum, so they can:

	- Analyze situations in which two or more objects are pushed apart by a spring or other agency, and calculate how much energy is released in such a process - How to identify situations in which mechanical energy is converted to other forms of energy. **Conservation of energy** - How to analyze situations in which an object's mechanical energy is changed by friction or by a specified externally applied force. - How to identify situations in which mechanical energy is or is not conserved. - How to apply conservation of energy in analyzing the motion of objects that move under the influence of springs. - How to apply conservation of energy in analyzing the motion of objects that move under the influence of other non-constant one-dimensional forces. **Power**	- Relate impulse to the change in linear momentum and the average force acting on an object. - Calculate the area under a force versus time graph and relate it to the change in momentum of an object. **Conservation of linear momentum, collisions** - Students should understand linear momentum conservation, so they can: - Identify situations in which linear momentum, or a component of the linear momentum vector, is conserved. - Apply linear momentum conservation to one-dimensional elastic and inelastic collisions and two-dimensional completely inelastic collisions. **Conservation of energy** - Students should understand the concepts of mechanical energy and of total energy, so they can: - Apply conservation of energy in analyzing the motion of systems of connected objects, such as an Atwood's machine. - Apply conservation of energy in analyzing the motion of objects that move under the influence of springs. **Power** - Students should understand the definition of power, so they can:

		○ Calculate the power required to maintain the motion of an object with constant acceleration ○ Calculate the work performed by a force that supplies constant power, or the average power supplied by a force that performs a specified amount of work.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: AP Physics 1 - Gravitation and Circular Motion

Unit Name	What	How	Why
Gravitation and Circular Motion	• Apply Fm= g to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems • Use Newton's law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving orbital motion • Make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time.	• Relate the radius of the circle and the speed or rate of revolution of the particle to the magnitude of the centripetal acceleration. • Analyze situations in which an object moves with specified acceleration under the influence of one or more forces so they can determine the magnitude and direction of the net force. • Determine the force that one spherically symmetrical mass exerts on another. • Describe the gravitational force inside and outside a uniform sphere, and calculate how the field at the surface depends on the radius and density of the sphere.	• Understand the motion of circling objects. • Understand the factors that determine the force of gravity between two objects

Windham School District Curriculum

AP Physics 1: Gravitation and Circular Motion- Grade 11-12

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

- HS-PS4-1
- HS-PS4-2
- HS-PS4-3
- HS-PS4-4
- HS-PS4-5

Transfer

Students will be able to

- Apply Fm= g to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems
- Use Newton’s law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving orbital motion
- Make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time.

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- When the gravitational force is the dominant force and when the electromagnetic, weak, and strong forces can be ignored
- Newton’s law of gravitation is used to calculate the gravitational force the two objects exert on each other and use that force in contexts other than orbital motion.
- they can make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time.

ESSENTIAL QUESTIONS

- What is the cause of Circular Motion?
- What is acceleration?
- Are circling objects accelerating?
- What is the cause of gravity?
- What factors determine the force of gravity between two objects?
- How do satellites orbit a planet or star?

	Acquisition	
	Students will know… How to describe the following concepts in both a qualitative and quantitative manner. ● Circular Motion -Describe the direction of the particle's velocity and acceleration at any instant during the motion. ● Centripetal Acceleration ● Angular Velocity ● Angular Displacement ● Gravitational Force between objects	*Students will be skilled at…* **Circular motion and rotation** **Uniform circular motion** ● Students should understand the uniform circular motion of a particle, so they can: ○ Relate the radius of the circle and the speed or rate of revolution of the particle to the magnitude of the centripetal acceleration. ○ Determine the components of the velocity and acceleration vectors at any instant, and sketch or identify graphs of these quantities. ○ Analyze situations in which an object moves with specified acceleration under the influence of one or more forces so they can determine the magnitude and direction of the net force, or of one of the forces that makes up the net force, in situations such as the following: **Newton's law of gravity** ○ Determine the force that one spherically symmetrical mass exerts on another. ○ Determine the strength of the gravitational field at a specified point outside a spherically symmetrical mass. ○ Describe the gravitational force inside and outside a uniform sphere, and

		calculate how the field at the surface depends on the radius and density of the sphere.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **AP Physics 1 - Simple Harmonic Motion, Waves and Sound**

Unit Name	What	How	Why
Simple Harmonic Motion, Waves and Sound	• Describe representations of transverse and longitudinal waves • Describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples • Evaluate evidence of the interaction of two or more traveling waves in one or two dimensions	• Analyze data to identify qualitative or quantitative relationships between given values and variables • Construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force. • Describe representations of transverse and longitudinal waves. • Describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples. • How to construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force.	• What properties determine the motion of an object in simple harmonic motion? • What are the relationships between velocity, wavelength, and frequency of a wave? • How do the relative motions of source and observer determine our perceptions of waves?

Windham School District Curriculum

AP Physics 1: Simple Harmonic Motion, Waves, and Sound - Grade 11-12

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

- HS-PS4-1
- HS-PS4-2
- HS-PS4-3
- HS-PS4-4
- HS-PS4-5

Transfer

Students will be able to

- Describe representations of transverse and longitudinal waves
- Describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples
- Evaluate evidence of the interaction of two or more traveling waves in one or two dimensions

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- The energy carried by a wave relates to the amplitude of the wave.
- Waves can be represented graphically
- Data can be used to identify qualitative or quantitative relationships between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion to determine the value of an unknown.

ESSENTIAL QUESTIONS

- What properties determine the motion of an object in simple harmonic motion?
- What are the relationships between velocity, wavelength, and frequency of a wave?
- How do the relative motions of source and observer determine our perceptions of waves?

Acquisition

Students will know…

- Analyze data to identify qualitative or quantitative relationships between given values and variables

Students will be skilled at…

- Determining the spring constant of a spring in two different ways:
- Predicting which properties determine the motion of a simple harmonic oscillator and

	• Construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force. • Describe representations of transverse and longitudinal waves. • Describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples. • How to predict properties of standing waves that result from the addition of incident and reflected waves that are confined to a region and have nodes and antinodes. • How to construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force.	what the dependence of the motion is on those properties • Using a graphical representation of a periodic mechanical wave (position versus time) to determine the period and frequency of the wave and describe how a change in the frequency would modify features of the representation. • Using representations of individual pulses and construct representations to model the interaction of two wave pulses to analyze the superposition of two pulses. • Calculating wavelengths and frequencies (if given wave speed) of standing waves based on boundary conditions and length of region within which the wave is confined, and calculate numerical values of wavelengths and frequencies
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: **AP Physics 1 - Electrostatics and Simple Electric Circuits**

Unit Name	What	How	Why
Electrostatics and Simple Electric Circuits	• Connect the concepts of gravitational force and electric force to compare similarities and differences between the forces • Use Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges • Use a description or schematic diagram of an electrical circuit to calculate unknown values of current in various segments or branches of the circuit.	• Make predictions about the interaction between two electric point charges using Coulomb's Law. • Using a description or schematic diagram of an electrical circuit to calculate unknown values of current in various segments or branches of the circuit. • Determining the resistance of an unknown object in a simple circuit.	• Gravitational force is similar to electrical force. • Voltage, current, and resistance are predictably related in both series and parallel circuits.

Windham School District Curriculum

AP Physics 1: Electrostatics and Simple Electric Circuits- Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
• HS-PS4-1
• HS-PS4-2
• HS-PS4-3
• HS-PS4-4
• HS-PS4-5</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
● Use Coulomb’s law qualitatively and quantitatively to make predictions about the interaction between two electric point charges
● Use a description or schematic diagram of an electrical circuit to calculate unknown values of current in various segments or branches of the circuit.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● electric charge is conserved in simple circuits
● Coulomb’s Law can be used to predict forces in an electrical field
● electrical values can be predicted in an electrical circuit using Kirchoff’s Junction Rule</td><td>ESSENTIAL QUESTIONS
● What are the fundamental carriers of electrical charge, and how may they be used to charge objects?
● How is gravitational force similar to electrical force, and in what ways are these forces very different?
● How are voltage, current, and resistance related in a series circuit?
● How are voltage, current, and resistance related in a simple parallel circuit?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
● Connect the concepts of gravitational force and electric force to compare similarities and differences between the forces</td><td>Students will be skilled at…
● Using Coulomb’s law qualitatively and quantitatively to make predictions about the interaction between two electric point charges</td></tr>
</table>

	- How to apply conservation of energy concepts to the design of an experiment that will demonstrate the validity of Kirchhoff's loop rule ($\Sigma\Delta V = 0$) in a circuit - How to apply conservation of electric charge (Kirchhoff's junction rule) to the comparison of electric current in various segments of an electrical circuit with a single battery and resistors in series and in, at most, one parallel branch and predict how those values would change if configurations of the circuit are changed.	- Using a description or schematic diagram of an electrical circuit to calculate unknown values of current in various segments or branches of the circuit. - Determining the resistance of an unknown object in a simple circuit.
Used in Content Area Standards		***21st Century Skills***
not applicable		- one to one technology - collaboration - communication - critical thinking - creativity

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: - Unit and summative assessments - Unit specific research labs, research papers and projects
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **AP Physics C: Mechanics - Kinematics**

Unit Name	What	How	Why
Kinematics	Students will learn… • Convert Units and conduct a dimensional analysis • Solve One Dimensional Motion Problems – (Position, Velocity, Acceleration) • Resolve Vectors using Algebra • Solve Relative Velocity and Acceleration problems • Predict Projectile Motion landing site	• Express the motion of an object using narrative, mathematical, and graphical representations. • Design an experimental investigation of the motion of an object. • Analyze experimental data describing the motion of an object in two dimensions and is able to express the results of the analysis using narrative, mathematical, and graphical representations.	• To find the position, velocity, acceleration of an object moving in order to predict its position at a point in time.

Windham School District Curriculum

AP Physics C: Mechanics - Kinematics - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Convert Units and conduct a dimensional analysis
Solve One Dimensional Motion Problems – (Position, Velocity, Acceleration)
Resolve Vectors using Algebra
Solve Relative Velocity and Acceleration problems
Predict Projectile Motion landing site</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
All forces share certain common characteristics when considered by observers in inertial reference frames.
The acceleration of the center of mass of a system is related to the net force exerted on the system,</td><td>ESSENTIAL QUESTIONS
What is displacement?
What is velocity and how is it different than speed?
What is acceleration?
How do we find the position, velocity, acceleration of an object moving in one dimension?
How do we find the range, hang time and velocity of a projectile?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Units, conversions, dimensional analysis
One Dimensional Motion – (Position, Velocity, Acceleration) Students should understand the general relationships among position, velocity, and acceleration</td><td>Students will be skilled at…
How to express the motion of an object using narrative, mathematical, and graphical representations.
How to design an experimental investigation of the motion of an object.</td></tr>
</table>

	for the motion of a particle along a straight line. ● Students should understand the special case of motion with constant acceleration ● Students should know how to deal with situations in which acceleration is a specified function of velocity and time so they can write an appropriate differential equation and solve it for *u* by separation of variables, incorporating correctly a given initial value of *u*. ● Vectors - Students should be able to add, subtract, and resolve displacement and velocity vectors, so they can: ○ Determine components of a vector along two specified, mutually perpendicular axes. ○ Determine the net displacement of a particle or the location of a particle relative to another. ○ Determine the change in velocity of a particle or the velocity of one particle relative to another. ● Relative Velocity and Acceleration ● Projectile Motion	● how to analyze experimental data describing the motion of an object in two dimensions and is able to express the results of the analysis using narrative, mathematical, and graphical representations.
Used in Content Area Standard		***21st Century Skills***
		● one to one technology ● collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments predicting interactions between objects ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **AP Physics C: Mechanics - Newton's Laws of Motion**

Unit Name	What	How	Why
Newton's Laws of Motion	Students will learn... ● Apply Newton's Laws of Motion to solve One Dimensional Force Problems ● Apply Newton's Laws of Motion to solve connected objects Force problems ● Apply Newton's Laws of Motion to solve Two Dimensional Force Problems (including Inclined Planes)	● Students will with the coefficient of friction in motion problems. ● Students will be able to solve problems in which application of Newton's laws leads to two or three simultaneous linear equations involving unknown forces or accelerations.	● To determine what happens when more than one force acts on an object ● To determine the results of unbalanced forces

Windham School District Curriculum Template

AP Physics C: Mechanics - Newton's Laws of Motion - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to

● Apply Newton's Laws of Motion to solve One Dimensional Force Problems
● Apply Newton's Laws of Motion to solve connected objects Force problems
● Apply Newton's Laws of Motion to solve Two Dimensional Force Problems (including Inclined Planes)</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
● Students will understand that…
● Weight and Mass are different
● Newton's Laws of Motion
● How to solve One Dimensional Force Problems
● Connected objects Force problems
● Two Dimensional Force Problems (including Inclined Planes)
● Friction</td><td>ESSENTIAL QUESTIONS
● What is the difference between weight and Mass?
● What is a Force?
● What happens when more than one force acts on an object?
● What are the results of unbalanced forces?
● How do objects move at constant speed?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

● Weight / Mass
● Newton's Laws
● One Dimensional Force Problems
● Connected objects.</td><td>Students will be skilled at…
● Students should understand the significance of the coefficient of friction
● Students should understand Newton's Third Law so that, for a given system, they can identify the force pairs and the objects</td></tr>
</table>

	● Two Dimensional Force Problems (including Inclined Planes) ● Friction	on which they act, and state the magnitude and direction of each force. ● Students should be able to solve problems in which application of Newton's laws leads to two or three simultaneous linear equations involving unknown forces or accelerations.
Used in Content Area Standards		***21st Century Skills***
not applicable		● one to one technology ● collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **AP Physics C: Mechanics - Work, Energy, Power and Conservation Laws**

Unit Name	What	How	Why
Work, Energy,. Power and Conservation Laws	Students will learn... • Predict and calculate the energy transfer to an object or system from information about a force exerted on the object or system through a distance. • Relate mass, velocity, and linear momentum for a moving object. • State and apply the relations between linear momentum and center-of-mass motion for a system of particles.	• Apply linear momentum conservation to one-dimensional elastic and inelastic collisions and two-dimensional completely inelastic collisions. • Apply conservation of energy in analyzing the motion of objects that move under the influence of springs. • Calculate the power required to maintain the motion of an object with constant acceleration	• To determine how energy is transformed to other objects

Windham School District Curriculum

AP Physics C: Mechanics - Work, Energy, Power - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
Calculate the kinetic energy of an object in one and two dimensional motion
Predict and calculate the energy transfer to (i.e., the work done on) an object or system from information about a force exerted on the object or system through a distance.
Relate mass, velocity, and linear momentum for a moving object, and calculate the total linear momentum of a system of objects.
State and apply the relations between linear momentum and center-of-mass motion for a system of particles.
Apply linear momentum conservation to two-dimensional elastic and inelastic collisions.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Momentum,
Energy
Work and Power
Collisions
Conservation</td><td>ESSENTIAL QUESTIONS
What is Energy?
What are the types of Energy?
How is energy transformed to other objects?
What is momentum?
What is conservation
What is a collision?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td></td><td>Students will know…
Weight / Mass
Newton’s Laws
One Dimensional Force Problems
Connected objects.</td><td>Students will be skilled at…
Students should understand the significance of the coefficient of friction
Students should understand Newton’s Third Law so that, for a given system, they</td></tr>
</table>

	● Two Dimensional Force Problems (including Inclined Planes) ● Friction	can identify the force pairs and the objects on which they act, and state the magnitude and direction of each force. ● Students should be able to solve problems in which application of Newton's laws leads to two or three simultaneous linear equations involving unknown forces or accelerations.
Used in Content Area Standards		***21st Century Skills***
not applicable		● one to one technology ● collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: AP Physics C: Mechanics - Gravitation and Circular Motion

Unit Name	What	How	Why
Gravitation and Circular Motion	• Apply Fm= g to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems • Use Newton's law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving orbital motion • Make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time.	• Relate the radius of the circle and the speed or rate of revolution of the particle to the magnitude of the centripetal acceleration. • Analyze situations in which an object moves with specified acceleration under the influence of one or more forces so they can determine the magnitude and direction of the net force. • Determine the force that one spherically symmetrical mass exerts on another. • Describe the gravitational force inside and outside a uniform sphere, and calculate how the field at the surface depends on the radius and density of the sphere.	• Understand the motion of circling objects. • Understand the factors that determine the force of gravity between two objects

Windham School District Curriculum

AP Physics C: Mechanics - Gravitation and Circular Motion- Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Apply Fm= g to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems
Use Newton’s law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving orbital motion
Make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
When the gravitational force is the dominant force and when the electromagnetic, weak, and strong forces can be ignored
Newton’s law of gravitation is used to calculate the gravitational force the two objects exert on each other and use that force in contexts other than orbital motion.
they can make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time.</td><td>ESSENTIAL QUESTIONS
What is the cause of Circular Motion?
What is acceleration?
Are circling objects accelerating?
What is the cause of gravity?
What factors determine the force of gravity between two objects?
How do satellites orbit a planet or star?</td></tr>
</table>

	Acquisition	
	Students will know… How to describe the following concepts in both a qualitative and quantitative manner. ● Circular Motion -Describe the direction of the particle's velocity and acceleration at any instant during the motion. ● Centripetal Acceleration ● Angular Velocity ● Angular Displacement ● Gravitational Force between objects	*Students will be skilled at…* **Circular motion and rotation** ● **Uniform circular motion** ● Students should understand the uniform circular motion of a particle, so they can: ○ Relate the radius of the circle and the speed or rate of revolution of the particle to the magnitude of the centripetal acceleration. ○ Determine the components of the velocity and acceleration vectors at any instant, and sketch or identify graphs of these quantities. ○ Analyze situations in which an object moves with specified acceleration under the influence of one or more forces so they can determine the magnitude and direction of the net force, or of one of the forces that makes up the net force, in situations such as the following: ● **Newton's law of gravity** ○ Determine the force that one spherically symmetrical mass exerts on another. ○ Determine the strength of the gravitational field at a specified point outside a spherically symmetrical mass. ○ Describe the gravitational force inside and outside a uniform sphere, and calculate how the field at the surface depends on the radius and density of the sphere.

Used in Content Area Standards	*21st Century Skills*
not applicable	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence	
Evaluative Criteria	*Assessment Evidence*
	ASSESSMENT: • Unit and summative assessments • Unit specific research labs, research papers and projects
	OTHER EVIDENCE: • Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: AP Physics C: Mechanics - Simple Harmonic Motion, Waves and Sound

Unit Name	What	How	Why
Simple Harmonic Motion, Waves and Sound	• Describe representations of transverse and longitudinal waves • Describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples • Evaluate evidence of the interaction of two or more traveling waves in one or two dimensions	• Analyze data to identify qualitative or quantitative relationships between given values and variables • Construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force. • Describe representations of transverse and longitudinal waves. • Describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples. • How to construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force.	• What properties determine the motion of an object in simple harmonic motion? • What are the relationships between velocity, wavelength, and frequency of a wave? • How do the relative motions of source and observer determine our perceptions of waves?

Windham School District Curriculum

AP Physics C: Mechanics - Simple Harmonic Motion and Waves - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Describe representations of transverse and longitudinal waves
Describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples
Evaluate evidence of the interaction of two or more traveling waves in one or two dimensions</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
The energy carried by a wave relates to the amplitude of the wave.
Waves can be represented graphically
Data can be used to identify qualitative or quantitative relationships between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion to determine the value of an unknown.</td><td>ESSENTIAL QUESTIONS
What properties determine the motion of an object in simple harmonic motion?
What are the relationships between velocity, wavelength, and frequency of a wave?
How do the relative motions of source and observer determine our perceptions of waves?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Analyze data to identify qualitative or quantitative relationships between given values and variables
Construct a qualitative and/or a quantitative explanation of oscillatory</td><td>Students will be skilled at…
Determining the spring constant of a spring in two different ways:
Predicting which properties determine the motion of a simple harmonic oscillator and what the dependence of the motion is on those properties</td></tr>
</table>

	behavior given evidence of a restoring force. ● Describe representations of transverse and longitudinal waves. ● Describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples. ● How to predict properties of standing waves that result from the addition of incident and reflected waves that are confined to a region and have nodes and antinodes. ● How to construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force.	● Using a graphical representation of a periodic mechanical wave (position versus time) to determine the period and frequency of the wave and describe how a change in the frequency would modify features of the representation. ● Using representations of individual pulses and construct representations to model the interaction of two wave pulses to analyze the superposition of two pulses. ● Calculating wavelengths and frequencies (if given wave speed) of standing waves based on boundary conditions and length of region within which the wave is confined, and calculate numerical values of wavelengths and frequencies
Used in Content Area Standards		***21st Century Skills***
not applicable		● one to one technology ● collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: AP Physics C: Electricity and Magnetism - Electrostatics

Unit Name	What	How	Why
Electrostatics ● Electric Field and Electric Potential ● Gauss's Law ● Fields and potential of other charge distributions	● Describe the types of charge, attraction and repulsion of charges ● Connect the concepts of gravitational force and electric force to compare similarities and differences between the forces ● Use Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges ● Define an electric field in terms of the force on a test charge ● Describe the electric field of a single point charge ● Interpret an electric field diagram ● Determine the electric potential in the vicinity of one or more point charges ● Use integration to determine electric potential difference between two points on a line, given electric field strength as a function of position along that line.	● Make predictions about the interaction between two electric point charges using Coulomb's Law. ● Analyze the motion of a particle of specified charge under an electrostatic force ● Calculate the electrical work done on a charge ● Determine the speed of a charge that moves through a specified potential difference ● Determine the direction and approximate magnitude of the electric field at various positions given a sketch of equipotentials. ● Calculate the potential difference between two points in a uniform electric field, and state which point has a higher potential. ● Calculate how much work is required to move a test charge from one location to another in the field of fixed point charges	● How is gravitational force is similar to electrical force?

	- State the general relationship between field and potential. - Understand the relationship between electric field and electric flux. - Apply the relationship between flux and lines of force - State Gauss's law in integral form and apply it qualitatively to relate flux and electric charge of a specified surface. - Apply the law to determine the charge density or total charge on a surface in terms of the electric field near the surface. - Identify situation in which the direction of the electric field produced by a chag distribution can be deduced from symmetry considerations - Describe qualitatively the patterns and variation with distance of the electric field of oppositely charged parallel plates and a uniformly charged wire .	- Calculate the electrostatic potential energy of a system of two or more point charges, and calculate how much work is required to establish the charge system. - Use integration to determine electric potential difference between two points on a line - Calculate the flux of an electric field over a Gaussian surface and perpendicular to it. - Calculate the flux of electric field through a rectangle when the field is perpendicular to the rectangle and a function of one coordinate only. - Use the principle of superposition to calculate by integration the electric field of a straight, uniformly charged wire - Calculate the electric potential on the axis of a uniformly charged disk. - Derive expression for electric potential as a function of position	

Windham School District Curriculum

AP Physics C: Electricity and Magnetism - Electrostatics - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Use Coulomb’s law qualitatively and quantitatively to make predictions about the interaction between two electric point charges
Connect the concepts of gravitational force and electric force to compare similarities and differences between the forces</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Coulomb’s Law can be used to predict forces in an electrical field
Understand the relationship between electric field and electric flux.</td><td>ESSENTIAL QUESTIONS
How is gravitational force similar to electrical force, and in what ways are these forces very different?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Describe the types of charge, attraction and repulsion of charges
Connect the concepts of gravitational force and electric force to compare similarities and differences between the forces
Use Coulomb’s law qualitatively and quantitatively to make predictions about</td><td>Students will be skilled at…
Make predictions about the interaction between two electric point charges using Coulomb’s Law.
Analyze the motion of a particle of specified charge under an electrostatic force</td></tr>
</table>

	the interaction between two electric point charges ● Define an electric field in terms of the force on a test charge ● Describe the electric field of a single point charge ● Interpret an electric field diagram ● Determine the electric potential in the vicinity of one or more point charges ● Use integration to determine electric potential difference between two points on a line, given electric field strength as a function of position along that line. ● State the general relationship between field and potential. ● Understand the relationship between electric field and electric flux. ● Apply the relationship between flux and lines of force ● State Gauss's law in integral form and apply it qualitatively to relate flux and electric charge of a specified surface. ● Apply the law to determine the charge density or total charge on a surface in terms of the electric field near the surface. ● Identify situation in which the direction of the electric field produced by a chag distribution can be deduced from symmetry considerations ● Describe qualitatively the patterns and variation with distance of the electric field of oppositely charged parallel plates and a uniformly charged wire	● Calculate the electrical work done on a charge ● Determine the speed of a charge that moves through a specified potential difference ● Determine the direction and approximate magnitude of the electric field at various positions given a sketch of equipotentials. ● Calculate the potential difference between two points in a uniform electric field, and state which point has a higher potential. ● Calculate how much work is required to move a test charge from one location to another in the field of fixed point charges ● Calculate the electrostatic potential energy of a system of two or more point charges, and calculate how much work is required to establish the charge system. ● Use integration to determine electric potential difference between two points on a line ● Calculate the flux of an electric field over a Gaussian surface and perpendicular to it. ● Calculate the flux of electric field through a rectangle when the field is perpendicular to the rectangle and a function of one coordinate only. ● Use the principle of superposition to calculate by integration the electric field of a straight, uniformly charged wire ● Calculate the electric potential on the axis of a uniformly charged disk. ● Derive expression for electric potential as a function of position

Used in Content Area Standards	*21st Century Skills*
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence

Evaluative Criteria	*Assessment Evidence*
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects ● AP style summative assessment
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: **AP Physics C: Electricity and Magnetism - Conductors, Capacitors and Dielectrics**

Unit Name	What	How	Why
Conductors, Capacitors and Dielectrics	**Electrostatics with conductor** ● Students should understand the nature of electric fields in and around conductors, so they can: ● Explain the mechanics responsible for the absence of electric field inside a conductor, and know that all excess charge must reside on the surface of the conductor . ● Explain why a conductor must be an equipotential, and apply this principle in analyzing what happens when conductors are connected by wires . ● Students should understand induced charge and electrostatic shielding, so they can: ● Describe the process of charging by induction . ● Explain why a neutral conductor is attracted to a charged object ● Explain why there can be no electric field in a charge-free region completely surrounded by a single conductor, and	**Electrostatics with conductors** ● Show that all excess charge on a conductor must reside on its surface and that the field outside the conductor must be perpendicular to the surface . ● Students should be able to describe and sketch a graph of the electric field and potential inside and outside a charged conducting sphere . **Capacitors** ● Relate the electric field to the density of the charge on the plates ● Derive an expression for the capacitance of a parallel-plate capacitor 4) Determine how changes in dimension will affect the value of the capacitance . ● Derive and apply expressions for the energy stored in a parallel-plate capacitor and for the energy density in the field between the plates .	● How do the functions of conductors, capacitors and Dielectrics allow them to be used to control electrical charges? ● How can electric fields be changed to serve different purposes?

	recognize consequences of this result . ● Explain why the electric field outside a closed conducting surface cannot depend on the precise location of charge in the space enclosed by the conductor, and identify consequences of this result . **Capacitors** ● Students should understand the definition and function of capacitance, so they can: ● Relate stored charge and voltage for a capacitor . ● Relate voltage, charge and stored energy for a capacitor . ● Recognize situations in which energy stored in a capacitor is converted to other forms . ● Students should understand the physics of the parallel-plate capacitor, so they can: -Describe the electric field inside the capacitor, and relate the strength of this field to the potential difference between the plates and the plate separation . ● Students should understand cylindrical and spherical capacitors, so they can:	● Analyze situations in which capacitor plates are moved apart or moved closer together, or in which a conducting slab is inserted between capacitor plates, either with a battery connected between the plates or with the charge on the plates held fixed . ● Students should understand cylindrical and spherical capacitors, so they can: ● Derive an expression for the capacitance of each . **Dielectrics** ● Analyze situations in which a dielectric slab is inserted between the plates of a capacitor .	

	-Describe the electric field inside each **Dielectrics** ● Students should understand the behavior of dielectrics, so they can: ● Describe how the insertion of a dielectric between the plates of a charged parallel-plate capacitor affects its capacitance and the field strength and voltage between the plates .		

Windham School District Curriculum

AP Physics C: Electricity and Magnetism - Conductors, Capacitors and Dielectrics - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Describe the electric field produced in the various configurations of wires, capacitors and dielectrics
● Describe the process of induction</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● electric fields exert forces and the fields change with the configurations of the conductor
● charges can be stored in a capacitor</td><td>ESSENTIAL QUESTIONS
● How can electric fields be changed to serve different purposes?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Electrostatics with conductors
● Students should understand the nature of electric fields in and around conductors, so they can:
● Explain the mechanics responsible for the absence of electric field inside a conductor, and know that all excess charge must reside on the surface of the conductor .
● Explain why a conductor must be an equipotential, and apply this principle in</td><td>Students will be skilled at…
Electrostatics with conductors
● Show that all excess charge on a conductor must reside on its surface and that the field outside the conductor must be perpendicular to the surface .
● Students should be able to describe and sketch a graph of the electric field and potential inside and outside a charged conducting sphere .
Capacitors</td></tr>
</table>

	analyzing what happens when conductors are connected by wires . Students should understand induced charge and electrostatic shielding, so they can: ● Describe the process of charging by induction. ● Explain why a neutral conductor is attracted to a charged object ● Explain why there can be no electric field in a charge-free region completely surrounded by a single conductor, and recognize consequences of this result . ● Explain why the electric field outside a closed conducting surface cannot depend on the precise location of charge in the space enclosed by the conductor, and identify consequences of this result . **Capacitors** Students should understand the definition and function of capacitance, so they can: ● Relate stored charge and voltage for a capacitor . ● Relate voltage, charge and stored energy for a capacitor . ● Recognize situations in which energy stored in a capacitor is converted to other forms . Students should understand the physics of the parallel-plate capacitor, so they can: ● Describe the electric field inside the capacitor, and relate the strength of this field to the potential difference between the plates and the plate separation . Students should understand cylindrical and spherical capacitors, so they can:	● Relate the electric field to the density of the charge on the plates ● Derive an expression for the capacitance of a parallel-plate capacitor 4) Determine how changes in dimension will affect the value of the capacitance . ● Derive and apply expressions for the energy stored in a parallel-plate capacitor and for the energy density in the field between the plates . ● Analyze situations in which capacitor plates are moved apart or moved closer together, or in which a conducting slab is inserted between capacitor plates, either with a battery connected between the plates or with the charge on the plates held fixed . Students should understand cylindrical and spherical capacitors, so they can: ● Derive an expression for the capacitance of each . **Dielectrics** ● Analyze situations in which a dielectric slab is inserted between the plates of a capacitor .

	● Describe the electric field inside each **Dielectrics** Students should understand the behavior of dielectrics, so they can: ● Describe how the insertion of a dielectric between the plates of a charged parallel-plate capacitor affects its capacitance and the field strength and voltage between the plates .	
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects ● AP style summative assessment
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **AP Physics C: Electricity and Magnetism - Electric Circuits**

Unit Name	What	How	Why
Electric Circuits	**Current, resistance, power** ● Students should understand the definition of electric current, so they can relate the magnitude and direction of the current to the rate of flow of positive and negative charge ● Students should understand conductivity, resistivity and resistance, so they can: ● Write the relationship between electric field strength and current density in a conductor, and describe, in terms of the drift velocity of electrons, why such a relationship is plausible . ● Describe how the resistance of a resistor depends upon its length and cross-sectional area, and apply this result in comparing current flow in resistors of different material ● Students should understand the behavior of series and parallel combinations of resistors, so they can:	● Relate current and voltage for a resistor ● Derive an expression for the resistance of a resistor of uniform cross- section in terms of its dimensions and the resistivity of the material from which it is constructed ● Derive expressions that relate the current, voltage and resistance to the rate at which heat is produced when current passes through a resistor . ● Apply the relationships for the rate of heat production in a resistor ● Identify on a circuit diagram whether resistors are in series or in parallel ● Determine the ratio of the voltages across resistors connected in series or the ratio of the currents through resistors connected in parallel ● Calculate the equivalent resistance of a network of	● How are voltage, current, and resistance related in a series circuit? ● How are voltage, current, and resistance related in a simple parallel circuit?

	• Students should be able to apply Ohm's law and Kirchhoff's rules to direct- current circuits, in order to: • Set up and solve simultaneous equations to determine two unknown currents . • Students should understand the properties of voltmeters and ammeters, so they can: • State whether the resistance of each is high or low . • Identify or show correct methods of connecting meters into circuits in order to measure voltage or current . • Assess qualitatively the effect of finite meter resistance on a circuit into which these meters are connected . **Capacitors in circuits** • Students should understand the *t* = 0 and steady-state behavior of capacitors connected in series or in parallel, so they can: • Describe how stored charge is divided between capacitors connected in parallel • Determine the ratio of voltages for capacitors connected in series .	resistors that can be broken down into series and parallel combinations . • Calculate the voltage, current and power dissipation for any resistor in such a network of resistors connected to a single power supply . • Design a simple series-parallel circuit that produces a given current through and potential difference across one specified component, and draw a diagram for the circuit using conventional symbols • Calculate the terminal voltage of a battery of specified emf and internal resistance from which a known current is flowing • Calculate the rate at which a battery is supplying energy to a circuit or is being charged up by a circuit • Determine a single unknown current, voltage or resistance • Calculate the equivalent capacitance of a series or parallel combination • Calculate the voltage or stored charge, under steady-state conditions, for a capacitor connected to a	

	• Students should understand the discharging or charging of a capacitor through a resistor, so they can: • Write expressions to describe the time dependence of the stored charge or voltage for the capacitor, or of the current or voltage for the resistor .	circuit consisting of a battery and resistors . • Calculate and interpret the time constant of the circuit • Sketch or identify graphs of stored charge or voltage for the capacitor, or of current or voltage for the resistor, and indicate on the graph the significance of the time constant . • Analyze the behavior of circuits containing several capacitors and resistors, including analyzing or sketching graphs that correctly indicate how voltages and currents vary with time	

Windham School District Curriculum

AP Physics C: Electricity and Magnetism - Electric Circuits- Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Calculate voltage, resistance and current for a variety of arrangements and magnetic fields
● Use a description or schematic diagram of an electrical circuit to calculate unknown values of current in various segments or branches of the circuit.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Ohm’s law allows them to determine an unknown in a circuit
● electrical values can be predicted in an electrical circuit using Kirchoff’s Junction Rule</td><td>ESSENTIAL QUESTIONS

● How are voltage, current, and resistance related in a series circuit?
● How are voltage, current, and resistance related in a simple parallel circuit?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● Students should understand the definition of electric current, so they can relate the magnitude and direction of the current to the rate of flow of positive and negative charge
● Students should understand conductivity, resistivity and resistance, so they can:
● Write the relationship between electric field strength and current density in a conductor, and describe, in terms of the</td><td>Students will be skilled at…

● Relate current and voltage for a resistor
● Derive an expression for the resistance of a resistor of uniform cross- section in terms of its dimensions and the resistivity of the material from which it is constructed
● Derive expressions that relate the current, voltage and resistance to the rate at which</td></tr>
</table>

	drift velocity of electrons, why such a relationship is plausible . ● Describe how the resistance of a resistor depends upon its length and cross-sectional area, and apply this result in comparing current flow in resistors of different material ● Students should be able to apply Ohm's law and Kirchhoff's rules to direct- current circuits, in order to: ● Set up and solve simultaneous equations to determine two unknown currents . ● Students should understand the properties of voltmeters and ammeters, so they can: ● State whether the resistance of each is high or low . ● Identify or show correct methods of connecting meters into circuits in order to measure voltage or current . ● Assess qualitatively the effect of finite meter resistance on a circuit into which these meters are connected . ● Students should understand the t = 0 and steady-state behavior of capacitors connected in series or in parallel, so they can: ● Describe how stored charge is divided between capacitors connected in parallel . ● Determine the ratio of voltages for capacitors connected in series . ● Students should understand the discharging or charging of a capacitor through a resistor, so they can:	heat is produced when current passes through a resistor . ● Apply the relationships for the rate of heat production in a resistor ● Identify on a circuit diagram whether resistors are in series or in parallel ● Determine the ratio of the voltages across resistors connected in series or the ratio of the currents through resistors connected in parallel ● Calculate the equivalent resistance of a network of resistors that can be broken down into series and parallel combination ● Calculate the voltage, current and power dissipation for any resistor in such a network of resistors connected to a single power supply . ● Design a simple series-parallel circuit that produces a given current through and potential difference across one specified component, and draw a diagram for the circuit using conventional symbols ● Calculate the terminal voltage of a battery of specified emf and internal resistance from which a known current is flowing ● Calculate the rate at which a battery is supplying energy to a circuit or is being charged up by a circuit ● Determine a single unknown current, voltage or resistance ● Calculate the equivalent capacitance of a series or parallel combination

	● Write expressions to describe the time dependence of the stored charge or voltage for the capacitor, or of the current or voltage for the resistor	● Calculate the voltage or stored charge, under steady-state conditions, for a capacitor connected to a circuit consisting of a battery and resistors . ● Calculate and interpret the time constant of the circuit ● Sketch or identify graphs of stored charge or voltage for the capacitor, or of current or voltage for the resistor, and indicate on the graph the significance of the time constant . ● Analyze the behavior of circuits containing several capacitors and resistors, including analyzing or sketching graphs that correctly indicate how voltages and currents vary with time
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **AP Physics C: Electricity and Magnetism - Magnetic Fields**

Unit Name	What	How	Why
Magnetic Fields	**Forces on moving charges in magnetic fields** ● Students should understand the force experienced by a charged particle in a magnetic field, so they can: ● Deduce the direction of a magnetic field from information about the forces experienced by charged particles moving through that field . ● Describe the paths of charged particles moving in uniform magnetic fields . ● Describe under what conditions particles will move with constant velocity through crossed electric and magnetic fields **Forces on current-carrying wires in magnetic fields** ● Students should understand the force exerted on a current-carrying wire in a magnetic field, so they can: ● Indicate the direction of magnetic forces on a current-carrying loop of wire in a	● Derive and apply the formula for the radius of the circular path of a charge that moves perpendicular to a uniform magnetic field . ● Calculate the magnitude and direction of the force on a straight segment of current-carrying wire in a uniform magnetic field . ● Calculate the magnitude and direction of the torque experienced by a rectangular loop of wire carrying a current in a magnetic field . ● Calculate the magnitude and direction of the field at a point in the vicinity of such a wire ● Use superposition to determine the magnetic field produced by two long wires ● Calculate the magnitude and direction of the force in terms of *q*, *v*, and *B*, and explain	● Gravitational force is similar to electrical force. ● Voltage, current, and resistance are predictably related in both series and parallel circuits.

	magnetic field, and determine how the loop will tend to rotate as a consequence of these forces . **Biot-Savart law and Ampere's law** ● Students should understand the Biot-Savart law, so they can: ● Deduce the magnitude and direction of the contribution to the magnetic field made by a short straight segment of current-carrying wire . ● Students should understand the statement and application of Ampere's law in integral form, so they can: ● State the law precisely ● Students should be able to apply the superposition principle so they can determine the magnetic field produced by combinations of the configurations listed above .	why the magnetic force can perform no work . ● Calculate the force of attraction or repulsion between two long current-carrying wires ● Derive and apply the expression for the magnitude of B on the axis of a circular loop of current ● Use Ampere's law, plus symmetry arguments and the right-hand rule, to relate magnetic field strength to current for planar or cylindrical symmetries	

Windham School District Curriculum

AP Physics C: Electricity and Magnetism - Magnetic Fields- Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Deduce the direction of a magnetic field in various configurations using the Biot-Savart Law, Ampere’s Law and superposition
State Ampere’s Law in integral form</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Describe the paths of charged particles moving in uniform magnetic fields
Indicate the direction of magnetic forces on a current-carrying loop of wire in a magnetic field, and determine how the loop will tend to rotate as a consequence of these forces .</td><td>ESSENTIAL QUESTIONS
What are the fundamental carriers of electrical charge, and how may they be used to charge objects?
How is gravitational force similar to electrical force, and in what ways are these forces very different?
How are voltage, current, and resistance related in a series circuit?
How are voltage, current, and resistance related in a simple parallel circuit?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Forces on moving charges in magnetic fields
Students should understand the force experienced by a charged particle in a magnetic field, so they can:
Deduce the direction of a magnetic field from information about the forces</td><td>Students will be skilled at…
Derive and apply the formula for the radius of the circular path of a charge that moves perpendicular to a uniform magnetic field .</td></tr>
</table>

	experienced by charged particles moving through that field . ● Describe the paths of charged particles moving in uniform magnetic fields . ● Describe under what conditions particles will move with constant velocity through crossed electric and magnetic fields **Forces on current-carrying wires in magnetic fields** ● Students should understand the force exerted on a current-carrying wire in a magnetic field, so they can: ● Indicate the direction of magnetic forces on a current-carrying loop of wire in a magnetic field, and determine how the loop will tend to rotate as a consequence of these forces . **Biot-Savart law and Ampere's law** ● Students should understand the Biot-Savart law, so they can: ● Deduce the magnitude and direction of the contribution to the magnetic field made by a short straight segment of current-carrying wire . ● Students should understand the statement and application of Ampere's law in integral form, so they can: ● State the law precisely . ● Students should be able to apply the superposition principle so they can determine the magnetic field produced by combinations of the configurations listed above.	● Calculate the magnitude and direction of the force on a straight segment of current-carrying wire in a uniform magnetic field . ● Calculate the magnitude and direction of the torque experienced by a rectangular loop of wire carrying a current in a magnetic field . ● Calculate the magnitude and direction of the field at a point in the vicinity of such a wire ● Use superposition to determine the magnetic field produced by two long wires ● Calculate the magnitude and direction of the force in terms of q, v, and B, and explain why the magnetic force can perform no work . ● Calculate the force of attraction or repulsion between two long current-carrying wires ● Derive and apply the expression for the magnitude of B on the axis of a circular loop of current ● Use Ampere's law, plus symmetry arguments and the right-hand rule, to relate magnetic field strength to current for planar or cylindrical symmetries

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs, research papers and projects ● AP style summative assessment
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **AP Physics C: Electricity and Magnetism - Electromagnetism**

Unit Name	What	How	Why
Electromagnetism	**Electromagnetic induction (including Faraday's law and Lenz's law)** ● Students should understand Faraday's law and Lenz's law, so they can: ● Recognize situations in which changing flux through a loop will cause an induced emf or current in the loop . ● Students should be able to analyze the forces that act on induced currents so they can determine the mechanical consequences of those forces **Inductance (including LR and LC circuits)** ● Students should understand the concept of inductance, so they can: ● Students should understand the transient and steady state behavior of DC circuits containing resistors and inductors, so they can: ● Apply Kirchhoff's rules to a simple *LR* series circuit to obtain a differential equation	● Calculate the flux of a uniform magnetic field through a loop of arbitrary orientation ● Use integration to calculate the flux of a non-uniform magnetic field, whose magnitude is a function of one coordinate, through a rectangular loop perpendicular to the field ● Calculate the magnitude and direction of the induced emf and current in a loop of wire or a conducting bar under the following conditions: ● The magnitude of a related quantity such as magnetic field or area of the loop is changing at a constant rate . ● The magnitude of a related quantity such as magnetic field or area of the loop is a specified non-linear function of time ● Calculate the magnitude and sense of the emf in an inductor through which a	● How can the forces of a changing magnetic field be predicted or calculated?

	for the current as a function of time . **Maxwell's equations** ● Students should be familiar with Maxwell's equations so they can associate each equation with its implications .	specified changing current is flowing ● Derive and apply the expression for the self-inductance of a long solenoid ● Solve the differential equation obtained in (1) for the current as a function of time through the battery, using separation of variables ● Calculate the initial transient currents and final steady state currents through any part of a simple series and parallel circuit containing an inductor and one or more resistors ● Sketch graphs of the current through or voltage across the resistors or inductor in a simple series and parallel circuit ● Calculate the rate of change of current in the inductor as a function of time ● Calculate the energy stored in an inductor that has a steady current flowing through it	

Windham School District Curriculum

AP Physics C: Electricity and Magnetism - Electromagnetism - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Calculate the flux of a uniform magnetic field through a loop
Recognize situations in which changing flux will cause an induced emf or current in the loop</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Magnetic fields can induce current and current can induce magnetic fields
induced currents can be calculated</td><td>ESSENTIAL QUESTIONS
How can the forces of a changing magnetic field be predicted or calculated?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Electromagnetic induction (including Faraday’s law and Lenz’s law)
Students should understand Faraday’s law and Lenz’s law, so they can:
Recognize situations in which changing flux through a loop will cause an induced emf or current in the loop .
Students should be able to analyze the forces that act on induced currents so they</td><td>Students will be skilled at…
Calculate the flux of a uniform magnetic field through a loop of arbitrary orientation
Use integration to calculate the flux of a non-uniform magnetic field, whose magnitude is a function of one coordinate, through a rectangular loop perpendicular to the field
Calculate the magnitude and direction of the induced emf and current in a loop of</td></tr>
</table>

	can determine the mechanical consequences of those forces **Inductance (including LR and LC circuits)** ● Students should understand the concept of inductance, so they can: ● Students should understand the transient and steady state behavior of DC circuits containing resistors and inductors, so they can: ● Apply Kirchhoff's rules to a simple *LR* series circuit to obtain a differential equation for the current as a function of time **.** **Maxwell's equations** ● Students should be familiar with Maxwell's equations so they can associate each equation with its implications **.**	wire or a conducting bar under the following conditions: ● The magnitude of a related quantity such as magnetic field or area of the loop is changing at a constant rate . ● The magnitude of a related quantity such as magnetic field or area of the loop is a specified non-linear function of time ● Calculate the magnitude and sense of the emf in an inductor through which a specified changing current is flowing ● Derive and apply the expression for the self-inductance of a long solenoid ● Solve the differential equation obtained in (1) for the current as a function of time through the battery, using separation of variables ● Calculate the initial transient currents and final steady state currents through any part of a simple series and parallel circuit containing an inductor and one or more resistors ● Sketch graphs of the current through or voltage across the resistors or inductor in a simple series and parallel circuit ● Calculate the rate of change of current in the inductor as a function of time ● Calculate the energy stored in an inductor that has a steady current flowing through it
Used in Content Area Standards		***21st Century Skills***

not applicable	- One to one technology - Collaboration - Communication - Critical thinking - Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: - Unit and summative assessments - Unit specific research labs, research papers and projects - AP style summative assessment
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Honors Engineering Capstone - Skills Development - Grade 12**

Unit Name	What	How	Why
Skills Development	● Practice and further develop the necessary technical skills needed to build a prototype project.	● Creating an engineering drawing ● Creating a CAD drawing ● Printing a 3D object ● Soldering wires/connectors ● Drawing and reading electrical schematics, wiring diagrams and Prototyping ● Programming an arduino computer ● Troubleshooting electrical circuits	**To answer the question:** ● Can I use/develop the skills needed to solve a technical problem?

Windham School District Curriculum

Honors Engineering Capstone - Skills Development - Grades 12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Use learned technical skills to produce a prototype of their project</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Engineering drawings and notebooks are required communication elements
● How to manage the timeline and development of a project</td><td>ESSENTIAL QUESTIONS
● Can I use/develop the skills needed to solve a technical problem?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…
● Practice and further develop the necessary technical skills needed to build a prototype project.</td><td>Students will be skilled at…

● Creating an engineering drawing
● Creating a CAD drawing
● Printing a 3D object
● Soldering wires/connectors
● Drawing and reading electrical schematics, wiring diagrams and Prototyping
● Programming an arduino computer
● Troubleshooting electrical circuits</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">not applicable</td><td>● One to one technology</td></tr>
</table>

	● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Practice projects will be graded according to rubrics
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Honors Engineering Capstone - Idea Development and Public Speaking - Grades 12**

Unit Name	What	How	Why
Idea Development and Public Speaking	• Define a problem to solve • Prepare a preliminary design of a solution • Meet with industry mentor and receive technical feedback	• Researching the aspects of a problem • presenting preliminary ideas to industry mentor • Revising ideas to improve them • Preparing a formal presentation to "Shark Tank"	**To answer the question:** • What makes a problem worth solving? • What constitutes a good solution to a problem? • How can I best communicate my idea in a short time to possible investors?

Windham School District Curriculum

Honors Engineering Capstone - Idea Development and Public Speaking - Grades 12

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:

Transfer: Performance Expectations

Students will be able to:
- *Define a problem*
- *Propose a preliminary solution*

Meaning: Crosscutting

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Students will understand that… ● Not all problems are worth the effort to solve ● Solutions take multiple iterations and usually involve input from many people	● What makes a problem worth solving? ● What constitutes a good solution to a problem? ● How can I best communicate my idea in a short time to possible investors?

Acquisition: DCI/SEP

Students will know…	Students will be skilled at…
● Define a problem to solve ● Prepare a preliminary design of a solution ● Meet with industry mentor and receive technical feedback	● Researching the aspects of a problem ● Presenting preliminary ideas to industry mentor ● Revising ideas to improve them ● Preparing a formal presentation to “Shark Tank”

Used in Content Area Standards	*21st Century Skills*
not applicable	● One to one technology ● Employing 21st century skills of collaboration ● Communication

	● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Practice Presentations in class ● Shark Tank event
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

__Title of Curriculum:__ **Honors Engineering Capstone - Prototype Construction - Grades 12**

Unit Name	What	How	Why
Prototype Construction	• Create a Team Milestones Document of 5 SMART goals for the project • Create a Bill of Materials in order to build the prototype • Present four team progress reports during the construction period • Create a logo and a social media presence to share progress	• Creating a proposed budget and practicing an ordering process • Using Twitter to promote the project work and share updates of progress • Presenting goal progress updates to practice presentation skills • Practice interviewing skills with industry recruiters which are recorded for analysis • Final showcase presentation to mentors and VIP's • Produce a Project Highlights Video of their work	**To answer the question:** • How can I find a technical solution to this problem?

Windham School District Curriculum

Honors Engineering Capstone - Prototype Construction - Grades 12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Write SMART goals and manage a project to meet those goals
● Present their project or progress of their project in person and digitally</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● That technical skills/knowledge is not enough to be a successful inventor
● Presentation/communication skills are an important element to career success
● Solutions require input from many people and many iterations</td><td>ESSENTIAL QUESTIONS
● How can I find a technical solution to this problem?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
</table>

	Students will know… ● Create a Team Milestones Document of 5 SMART goals for the project ● Create a Bill of Materials in order to build the prototype ● Present four team progress reports during the construction period ● Create a logo and a social media presence to share progress	**Students will be skilled at…** ● Creating a proposed budget and practicing an ordering process ● Using Twitter to promote the project work and share updates of progress ● Presenting goal progress updates to practice presentation skills ● Practice interviewing skills with industry recruiters which are recorded for analysis ● Final showcase presentation to mentors and VIP's ● Produce a Project Highlights Video of their work
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Research ● Construction benchmarks ● Industry Presentations
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum:</u> Introduction to Python - Representing Data Digitally

Unit Name	What	How	Why
Representing Data Digitally	● How digital data is represented ● Encoding data ● Converting and using different number systems - Binary - Hexadecimal ● Manipulating images at the pixel level	● Encoding data - Create your own encoding scheme - Encode images using binary ● Using different number systems - Convert numbers between decimal, binary, and hexadecimal ● Manipulating Images - Make different colors by changing the amount of red, green, and blue present - Create image filters - Create images pixel by pixel	**To answer questions related to:** ● How can data be represented and used by a computer?

Windham School District

Introduction to Python - Representing Data Digitally

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Explain how digital data is represented on a screen
● Convert base 10 numbers and text to a binary and Hexadecimal format</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● How digital data is represented
● Encoding data
● Converting and using different number systems
○ Binary
○ Hexadecimal
○ Manipulating images at the pixel level</td><td>ESSENTIAL QUESTIONS
● How can data be represented and used by a computer?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
</table>

<table>
<tr><td></td><td>Students will know…

Encoding data
Using different number systems

Convert numbers between decimal, binary, and hexadecimal
Example Activity:
Earn a high score playing the decimal to binary game or decimal to hexadecimal game. Click on the digits to change their values and make the binary or hexadecimal number match the target decimal value.

Manipulating Images

Make different colors by changing the amount of red, green, and blue present
Create image filters
Create images pixel by pixel
Example Activity:
Create a pixel rainbow by typing out the hexadecimal color encoding for each pixel

</td><td>Students will be skilled at…

Encoding data by writing a message in binary using ASCII codes.
Encode images using binary
Program pixels to create an image
</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">not applicable</td><td>
One to one technology
Employing 21st century skills of collaboration
Communication
Critical thinking
Creativity
</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Formative script writing ● Clear, concise comments written with scripts ● Write programs ● Debug/analyze programs
	OTHER EVIDENCE: ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Introduction to Python - Introduction to Programming**

Unit Name	What	How	Why
Introduction to Programming	• How data is represented in Python - string, integer, float, value, • Define - script, print, run output, variable, mutability storing, assignment, input, comments	• Write a simple script in the IDE to print some value and collect user input • Apply knowledge of inputs/outputs to write a madlib game.	**To answer questions related to:** • How can coding produce an output • How can user input be used within a script

Windham School District

Introduction to Python - Introduction to Programming

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:
Students will be introduced to the basic principles of programming using Python programming.

Content Standards:</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Write simple programs that can use conditions
● Write comments and structure their code to make it understandable to humans</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Computer programs have language/syntax requirements
● Programs can be structured to respond to logical condition statements</td><td>ESSENTIAL QUESTIONS
● How are computer programs structured so that they give different outputs?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
</table>

	Students will know… ● What is a Command? ● How data is represented in Python - string, integer, float, value, ● Python programming vocabulary - script, print, run output, variable, mutability storing, assignment, input, comments ● Top Down Design - creating "readable" programs ● How to enter variables program for variable inputs	**Students will be skilled at…** ● Write a simple script in the IDE to print some value and collect user input ● Apply knowledge of inputs/outputs to write a madlib game. ● Top Down Design ○ Breaking down large problems into smaller, more manageable problems Loops and Conditionals ○ Random inputs Write a program that uses a function to identify and respond to random inputs
Used in Content Area Standards		***21st Century Skills***
not applicable		● one to one technology ● employing 21st century skills of collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Research reports ● Write programs ● Debug/analyze programs
	OTHER EVIDENCE: ● Unit specific labs, and collaborative projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Introduction to Python - Logic Controls**

Unit Name	What	How	Why
Logic Controls	● Define and identify how numerical data is stored/represented. ● Define and use logic statements - Boolean, expression, composition, tru, false ● Define and use conditional statements - if, else, elif, flow of control ● Identify best way to store data - list, index, integer, item. ● Identify best ways to access the data - slice, append, pop, remove ● Define a while loop ● and other materials.	● Write small scripts using boolean logic - Can I or can't I ● Create a game show script using conditional logic ● Create a college chooser script using stored data. ● Create a tic-tac-toe game using while loops	**To answer questions related to:** ● How can computers interact with humans using logical controls in a script?

Windham School District

Introduction to Python - Logic Controls

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Describe a computer as an input/output machine
● Use logical control commands to allow computers to interact with humans</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● What a computer is
● Computers can use logic controls to change outputs as humans enter inputs</td><td>ESSENTIAL QUESTIONS
● What does a computer do?
● How can computers interact with humans using logical controls in a script?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…
● Define and identify how numerical data is stored/represented.
● Define and use logic statements - Boolean, expression, composition, true, false
● Define and use conditional statements - if, else, elif, flow of control
● Identify best way to store data - list, index, integer, item.
● Identify best ways to access the data - slice, append, pop, remove
● Define a while loop</td><td>Students will be skilled at…
● Writing small scripts using boolean logic - Can I or can't I
● Create a game show script using conditional logic
● Create a college chooser script using stored data.
● Create a tic-tac-toe game using while loops</td></tr>
</table>

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Formative script writing ● Clear, concise comments written with scripts ● Write programs ● Debug/analyze program
	OTHER EVIDENCE: ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum:</u> Introduction to Python - Creating and Calling Functions

Unit Name	What	How	Why
Creating and Calling Functions	• Creating Functions to use variables. • Utilize/modify code others have written • Create arguments to use call functions • Define difference between return, none, void • Understand the scope of functions and how to debug them.	• Create a "magic 8 ball" game using and calling a function • Create a "War" card game • Begin collaborating on a longer programming challenge in small teams	**To answer questions related to:** • How can functions and arguments be used in a program script?

Windham School District

Introduction to Python - Creating and Calling Functions

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Identify and create a function in Python
● Write code to call the function</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Functions make coding easier to read and modify
● Comments are necessary to explain intent of the code</td><td>ESSENTIAL QUESTIONS
● How are functions best used in a program?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…
● How to look for abstractions in a process
● How to write a function for that abstraction
● Creating Functions to use variables.
● Utilize/modify code others have written
● Create arguments to use call functions
● Define difference between return, none, void
● Understand the scope of functions and how to debug them.</td><td>Students will be skilled at…
● Writing functions and calling functions in a script using variables, logic and/or user input.
● Creating a “magic 8 ball” game using and calling a function
● Create a “War” card game
● Begin collaborating on a longer programming challenge in small teams that utilizes all previously learned concepts.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Formative script writing ● Clear, concise comments written with scripts ● Solve a challenge problem using coding concepts ● Debug/analyze programs
	OTHER EVIDENCE: ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum:</u> Introduction to Python - Loops and Lists

Unit Name	What	How	Why
Loops and Lists	• Define and identify - for loops, iteration, item, scope and range • Understand how to use nested loops via a function and a for loop • Use a stack trace to understand and demonstrate the flow of nested loops.	• Use the range and len function to update lists via for loops. • Write a loop to traverse through items in a list. • Use nested for loops to traverse through nested lists • Use project planning skills to complete a larger project utilizing lists, loops, and nested loops/lists ex. tic-tac-toe game	**To answer questions related to:** • How can a repeated process be written into a small amount of code?

Windham School District

Introduction to Python - Loops and Lists

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Identify repeatable processes that can be programmed using loops.
● Use loops to traverse items in a list
● Nest both loops and lists in a script</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● loops allow repeated processes to be easily programmed</td><td>ESSENTIAL QUESTIONS
● How can lists and loops be used to create many different outcomes using the same process?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…
● Define and identify - for loops, iteration, item, scope and range
● Understand how to use nested loops via a function and a for loop
● Use a stack trace to understand and demonstrate the flow of nested loops.</td><td>Students will be skilled at…
● Use the range and len function to update lists via for loops.
● Write a loop to traverse through items in a list.
● Use nested for loops to traverse through nested lists
● Use project planning skills to complete a larger project utilizing lists, loops, and nested loops/lists ex. tic-tac-toe game</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Formative script writing ● Clear, concise comments written with scripts ● Solve a challenge problem using coding concepts ● Debug/analyze programs
	OTHER EVIDENCE: ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum:</u> Introduction to Python - "Classy" Programming

Unit Name	What	How	Why
"Classy" Programming	● Define and identify - class, instance, object and attributes. ● Define and identify -self, Init., method, str, add, and operator overloading ● Structure script to show inheritance, a parent class and a child class.	● Write a script that manipulates instances and attributes using a function ● Create a class with the init method. ● Write a script that uses the self argument ● Create a class that inherits from another class	**To answer questions related to:** ● How can we best structure code so that it is most flexible and understandable?

Windham School District

Introduction to Python - “Classy” Programming

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
Construct a script that utilizes classes
Structure a script to use both parent and child classes</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Creating classes provides great flexibility and functionality for a program
Classes and comments make modifying code easier</td><td>ESSENTIAL QUESTIONS
How can we best structure code so that it is most flexible and understandable?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…
Define and identify - class, instance, object and attributes.
Define and identify -self, Init., method, str, add, and operator overloading
Structure script to show inheritance, a parent class and a child class.</td><td>Students will be skilled at…
Writing a script that manipulates instances and attributes using a function
Create a class with the init method.
Write a script that uses the self argument
Create a class that inherits from another class</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
</table>

not applicable	- one to one technology - employing 21st century skills of collaboration - communication - critical thinking - creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: - Formative script writing - Clear, concise comments written with scripts - Solve a challenge problem using coding concepts - Debug/analyze programs
	OTHER EVIDENCE: - Unit specific research labs, research papers and projects - Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Mobile App Development - Getting Started

Unit Name	What	Why	How
UNIT 1: Getting Started with App Development	Students will learn… • The basics of data, operators, and control flow in Swift, as well as documentation, debugging, Xcode, building and running an app, and Interface Builder. • This knowledge is applied to the guided project, Light, in which they create a simple flashlight app that lets the user tap the screen to toggle its color between black and white.	• This first unit introduces students to the fundamentals of Swift, building modern mobile apps, iOS, Xcode, and other tools in the Xcode development environment. Students will also learn about Interface Builder, a visual tool for crafting user interfaces. • After completing this unit, students will be familiar with everything they need to develop their first app.	Swift Lessons • Introduction to Swift and Playgrounds • Constants, Variables, and Data Types • Operators • Control Flow • SDK Lessons Xcode Lessons • Building, Running, and Debugging • Documentation • Interface Builder Basics

Windham School District Curriculum
Mobile App Development Unit 1: Getting Started

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">CSTA Standards
3A-A-2-1
● Design and develop a software artifact working in a team.
● Framework Concept: Algorithms and Programming
● Framework Practice: Collaborating
3A-A-4-8
● Deconstruct a complex problem into simpler parts using predefined constructs.
● Framework Concept: Algorithms and Programming
● Framework Practice: Developing and Using Abstractions
3A-A-4-9
● Demonstrate the value of abstraction for managing problem complexity.
● Framework Concept: Algorithms and Programming
● Framework Practice: Developing and Using Abstractions
3A-A-3-10
● Design algorithms using sequence, selection, and iteration.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to:
Describe the basics of data, operators, and control flow in Swift, accessing documentation, debugging, Xcode, building and running an app, and Interface Builder. This knowledge is applied to the guided project, Light, in which they create a simple flashlight app.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand …
● How to use Xcode to build and run an app
● How to access and use documentation,
● The basics of Interface Builder.</td><td>ESSENTIAL QUESTIONS
● What purpose do operators have in computer programming?
● Why is debugging an essential skill in Computer Science?
● How can the documentation library help resolve problems?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● The basics of data and operators
● Control flow in Swift
● How to debug
● How to design an Interface</td><td>Students will be skilled at demonstrating …
● How to use playgrounds to run Swift code
● How to declare variables and constants
● How to specify the type for a variable or constant
● How to format integers and float values</td></tr>
</table>

● Framework Concept: Algorithms and Programming ● Framework Practice: Recognizing and Defining Computational Problems		
Used in Content Area Standards		***21st Century Skills***
		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Mobile App Development - Introduction to UI Kit**

Unit Name	What	Why	How
UNIT 2: Introduction to UI Kit	Students will learn... • About Swift strings, functions, structures, collections, and loops. • About UIKit—the system views and controls that make up a user interface—and how to display data using Auto Layout and stack views. • This knowledge is applied in the guided project, Apple Pie, where they build a word-guessing game app.	• Unit 2 introduces structures, collections, loops, and different ways to work with information that makes up an app. • Students build an ambitious project and begin to experience the challenges, need for perseverance, and rewards every coder faces.	Swift Lessons • Strings • Functions • Structures • Classes and Inheritance • Collections • Loops SDK Lessons • Introduction to UIKit • Displaying Data • Controls in Action • Auto Layout and Stack Views

Windham School District Curriculum
Mobile App Development Unit 2: Introduction to UI Kit

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">CSTA Standards
3A-A-2-1:
Design and develop a software artifact working in a team.
Framework Concept: Algorithms and Programming
Framework Practice: Collaborating
3A-A-4-8:
Deconstruct a complex problem into simpler parts using predefined constructs.
Framework Concept: Algorithms and Programming
Framework Practice: Developing and Using Abstractions
3A-A-4-9:
Demonstrate the value of abstraction for managing problem complexity.
Framework Concept: Algorithms and Programming
Framework Practice: Developing and Using Abstractions
3A-A-3-10:
Design algorithms using sequence, selection, and iteration.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to :
Work with Swift strings, functions, structures, collections, and loops.
Navigate UIKit—the system views and controls that make up a user interface—and how to display data using Auto Layout and stack views.
Put this knowledge to practice in the guided project, Apple Pie, a word-guessing game app .</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand …
The role UIKit plays in app development
How to use developer documentation to find out more
How to use the Auto Layout system for constraining views</td><td>ESSENTIAL QUESTIONS
What are the key factors to consider when designing a User Interface?
Why are naming conventions important to follow in computer programming?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
How to configure views using Interface Builder
How to set the content mode for image view
How to use a button to execute a code block
How to add constraints to a view
How to use a stack view to help manage constraints</td><td>Students will be skilled at ensuring …
The project compiles with no errors or warnings.
The project meets all the specifications outlined in the project guide.
The code follows recommended naming conventions and consistent style.</td></tr>
</table>

- Framework Concept: Algorithms and Programming - Framework Practice: Recognizing and Defining Computational Problems		

Used in Content Area Standards	***21st Century Skills***
not applicable	- One to one technology - Collaboration - Communication - Critical thinking - Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: - Unit and summative assessments - Performance assessments - Unit specific labs, research papers and projects
	OTHER EVIDENCE: Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Mobile App Development - Navigation and Workflows**

Unit Name	What	Why	How
UNIT 3: Navigation and Workflows	Students will learn… ● How to build simple workflows and navigation hierarchies using navigation controllers, tab bar controllers, and segues. ● About optionals and enumerations, two powerful tools in Swift. ● This knowledge is applied to the guided project, Personality Quiz, a personalized survey that reveals a fun response to the user.	● Students apply new knowledge of workflows and navigation hierarchies ● Learn to improve the functionality of their apps to include more advanced features.	Swift Lessons ● Optionals ● Type Casting and Inspection ● Guard ● Constant and Variable Scope ● Enumerations SDK Lessons ● Segues and Navigation Controllers ● Tab Bar Controllers ● View Controller Life Cycle ● Building Simple Workflows

Windham School District Curriculum
Mobile App Development Unit 3: Navigation and Workflows

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">CSTA Standards
3A-A-2-1:
Design and develop a software artifact working in a team.
Framework Concept: Algorithms and Programming
Framework Practice: Collaborating
3A-A-4-8:
Deconstruct a complex problem into simpler parts using predefined constructs.
Framework Concept: Algorithms and Programming
Framework Practice: Developing and Using Abstractions
3A-A-4-9:
Demonstrate the value of abstraction for managing problem complexity.
Framework Concept: Algorithms and Programming
Framework Practice: Developing and Using Abstractions</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
Build simple workflows and navigation hierarchies using navigation controllers, tab bar controllers, and segues
Apply optionals and enumerations in a guided project called Personality Quiz, which produces a personalized survey that reveals a fun response to the user.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand …
How to use Swift optionals,
How to use Swift guard statements to write safer code and reduce excessive logic.
How to write nicely structured code that's easy to read
How to use basic iOS navigation paradigms to create a simple workflow</td><td>ESSENTIAL QUESTIONS
Why does writing efficient, effectively structured code important in computer programming?
How can knowledge of methodical programming workflows help to streamline the development process?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
How to create variables and constants</td><td>Students will be skilled at…
How to create safe, clean code</td></tr>
</table>

3A-A-3-10: ● Design algorithms using sequence, selection, and iteration. ● Framework Concept: Algorithms and Programming ● Framework Practice: Recognizing and Defining Computational Problems	● How to assign values to variables and constants	● How to create functions and initializers that return optionals
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Mobile App Development - Tables and Persistence

Unit Name	What	Why	How
UNIT 4:Tables and Persistence	Students will learn... ● Three important sets of techniques in app development, which—taken together—will enable them to build more much complex apps. ● Master-detail design pattern ● Organization of files, structures, and classes in your apps, ● Approaches for saving data to the device .	● Students use current knowledge of Xcode, Swift, and UIKit to begin envisioning many different types of apps. ● By the end of this unit, they will be comfortable building many useful apps that display all kinds of information that allow users to enter, edit, and save in-app information.	Swift Lessons ● Protocols SDK Lessons ● App Life Cycle ● Model View Controller ● Scroll Views ● Table Views ● Intermediate Table Views ● System View Controllers ● Saving Data ● Building Complex Input Screens

Windham School District Curriculum

Mobile App Development Unit 4:Tables and Persistence

<table>
<tr><td rowspan="6">

CSTA Standards

3A-A-2-1:

- Design and develop a software artifact working in a team.
- Framework Concept: Algorithms and Programming
- Framework Practice: Collaborating

3A-A-5-4:

- Design, develop, and implement a computing artifact that responds to an event.
- Framework Concept: Algorithms and Programming
- Framework Practice: Creating Computational Artifact

3A-A-4-8:

- Deconstruct a complex problem into simpler parts using predefined constructs.
- Framework Concept: Algorithms and Programming
- Framework Practice: Developing and Using Abstractions

3A-A-4-9:

- Demonstrate the value of abstraction for managing problem complexity.

</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">

Students will be able to

- Apply knowledge of scroll views, table views, and building complex input screens to build a task-tracking app that allows the user to add, edit, and delete items in a familiar table-based interface.
- Customize the app to keep track of any type of information, such as a collection, tasks, or playlists.

</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>

ENDURING UNDERSTANDINGS

Students will understand …

- The purpose of protocols
- The Model-View-Controller design pattern
- The proper use cases for displaying data in table views

</td><td>

ESSENTIAL QUESTIONS

- How do Swift protocols provide a common set of functionalities across multiple classes?
- What is each segment's function in the Model-View-Controller design pattern?

</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>

Students will know…

- How to debug a project until it compiles with no errors or warnings.
- How to create new items that are displayed in the table view.
- How to ensure their code follows proper MVC conventions.

</td><td>

Students will be skilled at…

- Ensuring projects meet all specifications outlined in the project guide.
- Structuring code that follows recommended naming conventions and consistent style.

</td></tr>
</table>

● Framework Concept: Algorithms and Programming ● Framework Practice: Developing and Using Abstractions **3A-A-3-10:** ● Design algorithms using sequence, selection, and iteration. ● Framework Concept: Algorithms and Programming ● Framework Practice: Recognizing and Defining Computational Problems		

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Mobile App Development - Working with the Web

Unit Name	What	Why	How
UNIT 5: Working with the Web	Students will learn… ● About app personality, animations, concurrency, and working with the web. ● How to apply their knowledge into practice in the guided project, Restaurant, a customizable menu app that displays the available dishes from a restaurant and allows the user to submit an order. ● This app uses a web service that allows students to set up the menu with their own menu items and photos.	● Most apps connect to web services to fetch or send information that is used in the app. Students will learn how to create and send network requests to send and receive data. ● The Unit's three lessons explain how the web works, how to request information from a web service, and how to turn that information into structures or classes that can be used within an app.	Swift Lessons ● Closures ● Extensions SDK Lessons ● Practical Animation ● Working with the Web: HTTP and URL Session ● Working with the Web: JSON ● Working with the Web: Concurrency

Windham School District Curriculum

Mobile App Development Unit 5: Working with the Web

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">CSTA Standards:
3A-A-2-1:
Design and develop a software artifact working in a team.
Framework Concept: Algorithms and Programming
Framework Practice: Collaborating
3A-A-5-4:
Design, develop, and implement a computing artifact that responds to an event.
Framework Concept: Algorithms and Programming
Framework Practice: Creating Computational Artifact
3A-A-4-8:
Deconstruct a complex problem into simpler parts using predefined constructs.
Framework Concept: Algorithms and Programming
Framework Practice: Developing and Using Abstractions
3A-A-4-9:</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
List at least three ways to use extensions (computed properties, new methods, new initializers)
Demonstrate how to perform basic UIView animations
Describe the basics of the HTTP networking protocol, including commonly used methods, response types, and response codes
Describe JSON (JavaScript Object Notation) and the role JSON plays in working with network services</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand …
Best practices for architecting networking code in an application
The appropriate role of custom animations in an app
The concurrency model of an iOS app</td><td>ESSENTIAL QUESTIONS
How does the HTTP networking protocol enhance app functionality?
How do web services fetch or send information that is used in the app?
How can we use closures to work with collections and create animations in an app?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
How to define a closure
How to add an initializer to a predefined type
The basics of the HTTP networking protocol, including commonly used</td><td>Students will be skilled at…
Developing apps that utilize web services to fetch and send data
Perform simple view animations to direct user attention, orient the user, and</td></tr>
</table>

• Demonstrate the value of abstraction for managing problem complexity. • Framework Concept: Algorithms and Programming • Framework Practice: Developing and Using Abstractions **3A-A-3-10:** • Design algorithms using sequence, selection, and iteration. • Framework Concept: Algorithms and Programming • Framework Practice: Recognizing and Defining Computational Problems	methods, response types, and response codes	connect user behaviors to improve the experience of using an app.

Used in Content Area Standards	***21st Century Skills***
not applicable	• One to one technology • Collaboration

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Unit and summative assessments • Performance assessments • Unit specific labs, research papers • Engineering mitigation project
	OTHER EVIDENCE: • Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Mobile App Development - Prototyping and Project Planning**

Unit Name	What	Why	How
UNIT 6: Prototyping and Project Planning	Students will learn... ● How to begin work on an app idea that's all theirs, starting with learning what key design principles influence the app's success and how to add personality to their app. ● They will brainstorm app ideas and work through an iterative cycle of planning, prototyping, and soliciting feedback on their prototypes. ● Finally, they will end up with a concrete, workable development plan that they can use to build their very own iOS app.	● Students need to complement their new technical skills with the ability to design, prototype, and plan their approach to an entire project.	● Students learn about designing, prototyping, and architecting a project of their own design. Given enough time, they should be able to build this project independently.

Windham School District Curriculum

Mobile App Development Unit 6: Prototyping and Project Planning

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">CSTA Standards:
3A-A-2-1:
Design and develop a software artifact working in a team.
Framework Concept: Algorithms and Programming
Framework Practice: Collaborating
3A-A-5-4:
Design, develop, and implement a computing artifact that responds to an event.
Framework Concept: Algorithms and Programming
Framework Practice: Creating Computational Artifact
3A-A-4-8:
Deconstruct a complex problem into simpler parts using predefined constructs.
Framework Concept: Algorithms and Programming
Framework Practice: Developing and Using Abstractions
3A-A-4-9:
Demonstrate the value of abstraction for managing problem complexity.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to ;
Leverage color and iconography to tailor their app and create a consistent, branded user experience.
Apply best practices for prototyping: brainstorming ideas, putting together a list of core features, identifying target audience, and seeking (and incorporating) feedback from potential users.
Apply best practices for turning their feature sets and prototypes into a tangible application architecture.
Develop strategies for planning and starting a new project from scratch.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand …
The human interface guidelines and how to implement the them in   app design
The role of branding in creating a unique in-app experience
The three best practices for good app icon design</td><td>ESSENTIAL QUESTIONS
Why is it important to clearly define the problem and brainstorm ideas before starting a project?
How should we conduct a user interview to gather feedback on a prototype?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
The role of user personas in design decisions
How to add an app icon to an Xcode project</td><td>Students will be skilled at…
Turning a list of features into an app workflow</td></tr>
</table>

• Framework Concept: Algorithms and Programming Framework Practice: Developing and Using Abstractions **3A-A-3-10:** Design algorithms using sequence, selection, and iteration. Framework Concept: Algorithms and Programming Framework Practice: Recognizing and Defining Computational Problems	• The role of the launch screen and best practices for customizing it • How to define the features for a minimum viable product	• Planning an interface and implementing scenes and views

Used in Content Area Standards	***21st Century Skills***
not applicable	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Unit and summative assessments • Performance assessments • Unit specific labs, research papers • Engineering mitigation project
	OTHER EVIDENCE: • Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Conceptual Chemistry: Structure and Properties of Matter - Grade 11**

Unit Name	What	Why	How
Structure and Properties of Matter	Students will learn... • Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. • Molecular models of classes of substances and phases of matter. • How matter and its interactions can be analyzed quantitatively • Basic quantitative problem solving strategies for dealing with matter.	• By understanding the structure and properties of matter, students gain the necessary background to study chemistry. The properties and concepts learned in this unit are frequently referenced and used in future topics to explain how bulk scale observations relate to the atomic scale structure. • Chemistry, as a science, relies on quantitative data, therefore a basic understanding of how to process quantitative data is important for success in the subject.	• Formative assessments such as: homework, quizzes, mini-labs and lab investigations • Summative assessments such as: unit or sub-unit tests, and projects

Windham School District Curriculum

Conceptual Chemistry: Structure and Properties of Matter - Grade 11

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:

- HS-PS1-1
- HS-PS1-8

Transfer

Students will be able to

- *Explain the structure and properties of matter using the particulate nature of matter as a basis.*
- *Use the periodic table to describe the structure of elements at the atomic level.*
- *Use the periodic table to broadly classify elements.*

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

ESSENTIAL QUESTIONS

- How can one explain the structure and properties of matter?

Acquisition

Students will know…

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.

Students will be skilled at…

- Use a model to predict the relationships between systems or between components of a system.
- Develop a model based on evidence to illustrate the relationships between systems or between components of a system.

Used in Content Area Standards	*21st Century Skills*
not applicable	● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Use the periodic table as a model to predict the relative properties of elements ● Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. ● Summative Assessments: Unit or sub-unit tests,
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: **Conceptual Chemistry: Chemical Reactions - Grade 11**

Unit Name	What	Why	How
Chemical Reactions	Students will learn... • The reactivity of everyday chemicals can be understood in terms of their composition. • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. • Almost all chemical processes are accompanied with changes in energy for their systems.	• Students in this unit will learn how chemical reactions take place and how to predict their material and energetic outcomes. Students will apply concepts that they learned in prior units in order to predict common reaction patterns.	• Formative assessments such as: homework, quizzes, mini-labs and lab investigations • Summative assessments such as: unit or sub-unit tests, and projects

Windham School District Curriculum

Conceptual Chemistry: Chemical Reactions - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-PS1-2
HS-PS1-7</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
Construct and revise an explanation for the outcome with outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
The total amount of energy and matter in closed systems is conserved.
Science assumes the universe is a vast single system in which basic laws are consistent.</td><td>ESSENTIAL QUESTIONS
How do substances combine or change (react) to make new substances?
How does one characterize and explain these reactions and make predictions about them?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
</table>

	- The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. - The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. - The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, and peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. - Use mathematical representations of phenomena to support claims.
Used in Content Area Standards		***21st Century Skills***
not applicable		Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Construct and revise an explanation for the outcome of a simple chemical reaction. ● Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. ● Summative Assessments: Unit or sub-unit tests ● Performance lab assessment
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Conceptual Chemistry: Chemistry of Water - Grade 11

Unit Name	What	Why	How
Chemistry of Water	Students will learn... ● The structure of water affects its properties. ● How water acts as a solvent. ● Polar/non-polar bonds and their interactions with each other. ● How intermolecular forces cause bulk scale properties.	● By making use of their understanding of atoms, students will continue by learning about the structure of compounds and how that causes them to interact differently with the molecules around them. ● By focusing on water, students will be able to explore concepts of polarity, intermolecular forces, and molecular shape and how those interact to create the bulk properties that students observe.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, and projects

Windham School District Curriculum

Conceptual Chemistry: Chemistry Of Water - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-PS1-3
HS-PS2-6.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
● Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● The molecular structure of materials directly impacts how they behave and interact with other chemicals.</td><td>ESSENTIAL QUESTIONS
● How does the atomic scale influence what we observe?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● How to determine the molecular shape of simple molecules.
● How to determine a molecule's polarity
● The different forms of intermolecular forces, and how they relate to a substance's bulk properties.
● How to explain how the observed properties of materials (soap, paper, water, salts, etc.) relate to the atomic structure.</td><td>Students will be skilled at…

● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, and peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</td></tr>
</table>

		● Use a model to predict the relationships between systems or between components of a system. ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Summative Assessments: Unit or sub-unit tests ● Lab data analysis
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

Title of Curriculum: **Conceptual Chemistry: Chemistry of Air - Grade 11**

Unit Name	What	Why	How
Chemistry of Air	Students will learn... ● The properties of gases and how they relate to each other. ● How the properties of gases work to create weather phenomena. ● The composition of the atmosphere and the chemistry involved with it.	● By focusing on the atmosphere and the air within it, students will be able to access concepts about how gases behave and their properties. They will connect these ideas to observable weather events and will learn how atmospheric chemistry functions.	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests,and projects

Windham School District Curriculum

Conceptual Chemistry: Chemistry Of Air - Grade 11

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-PS3-2</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Explain the properties of gases and how they relate to each other.
● Model how the properties of gases work to create simple weather phenomena.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● The behavior of gases are determined by their pressure, temperature, volume, and number of particles.
● The properties of gases work to produce certain weather phenomena.
● The atmosphere’s composition determines how it behaves.</td><td>ESSENTIAL QUESTIONS
● How do the gases of the atmosphere lead to observable weather events?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● How pressure, volume, temperature, and number of particles are related.
● The gases typically found in the atmosphere.
● The processes in which carbon dioxide and oxygen are produced and consumed.</td><td>Students will be skilled at…

● Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, and peer review) and the assumption that theories and laws that describe the natural world operate</td></tr>
</table>

	● How the gas properties relate to weather phenomena such as areas of high and low pressure, wind, and storms.	today as they did in the past and will continue to do so in the future. ● Use a model to predict the relationships between systems or between components of a system. ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Projects, lab work, and assessments will engage students in critical thinking skills, problem solving, technology integration, and provide opportunities for collaboration with peers.

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Summative Assessments: Unit or sub-unit tests ● Lab data analysis
	OTHER EVIDENCE: ● Daily homework, quizzes, mini-labs and lab investigations

<u>Title of Curriculum</u>: Applied Physics - Forces and Interactions

Unit Name	What	How	Why
Forces and Interactions	Students will learn… ● How to use initial conditions and knowledge of Newton's Laws to predict and describe an object's motion	● Formative and summative assessments ● Performance assessments predicting interactions between objects ● Unit specific labs and projects	● We can predict and describe an object's motion prior to the event that would change its motion

Windham School District Curriculum

Applied Physics: Forces and Interactions - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards?):

NGSS Content Standards:
HS-PS2-1
HS-PS2-2
HS-PS2-3
HS-PS2-4
HS-PS2-5
HS-ETS1-1
HS-ETS1-2
HS-ETS1-3</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability and aesthetics, as well as possible social, cultural and environmental impacts</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena
Systems can be designed to cause a desired effect.
When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.</td><td>ESSENTIAL QUESTIONS
What causes the motion of an object?
How and why can we use initial conditions and knowledge of Newton’s Laws to predict and describe an object’s motion?
How are free-body diagrams (FBD) used to explain outcomes of force interactions?
How do we use Newton’s Laws of Motion to solve problems involving force?
How is work related to force, displacement and changes in energy?</td></tr>
</table>

		● How does safety equipment in cars and sports protect us?
	Acquisition	
	Students will know… ● Students will know what force is, be able to apply Newton's Laws of Motion to cases involving mass, acceleration, and inertia, and understand weight, friction and normal force. ● Newton's second law accurately predicts changes in the motion of macroscopic objects ● Forces at a distance are explained by fields (gravitational and electric) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.	Students will be skilled at… ● Designing, building, and refining a device that works within given constraints to convert one form of energy into another form of energy. ● Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. ● Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. ● Interpreting and applying Newton's three laws of motion
Used in Content Area Standards		***21st Century Skills***
		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific labs and projects ● Design challenges
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Applied Physics - Energy

Unit Name	What	How	Why
Energy	Students will learn... • That there is a single quantity called energy. It is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.	• Formative and summative assessments • Performance assessments • Unit specific labs and projects	• Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.

Windham School District Curriculum

Applied Physics: Energy - Grade 11-12

Stage 1 Desired Results	
ESTABLISHED GOALS: *Competencies (Standards?):* *NGSS Content Standards:* • HS-PS3-1 • HS-PS3-2 • HS-PS3-3 • HS-PS3-4 • HS-PS3-5 • HS-ETS1-1 • HS-ETS1-2 • HS-ETS1-3	***Transfer*** *Students will be able to* ● *Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.* ● *Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).* ● *Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.* ● *Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).* ● *Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.* ● *Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants* ● *Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering* ● *Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability and aesthetics, as well as possible social, cultural and environmental impacts*

	Meaning	
	ENDURING UNDERSTANDINGS *S*tudents will understand that… ● The transformation and utilization of energy plays a critical role in maintaining modern civilization. ● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. ● When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. ● Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. ● Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. ● Modern civilization depends on major technological systems. Engineers continuously modify these technological	ESSENTIAL QUESTIONS ● What is energy and how does it interact with matter? ● How are work and power related to everyday activities? ● How does our understanding of Conservation of Energy allow us to better experience the world around us? ● Why is the transformation of energy so important to modern society? ● How do charged objects interact and move from one place to another? ● How is electricity generated and distributed and what are its environmental and economic costs? ● How do we solve problems involving the application of energy? ● How is energy transformed in open and closed systems? ● How do electrical circuits distribute charge in useful ways?

	systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks ● New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology	
	Acquisition	
	Students will know… ● The basic properties of electric current and solve problems relating current, charge, and time. ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. ● Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. ● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. ● Differentiation among conductors, semiconductors, and insulators	*Students will be skilled at…* ● Differentiating among the various forms of energy and recognize that they can be transformed from one form to others. ● Investigating and explaining the relationships among current, voltage, resistance, and power ● Interpret and construct circuit diagrams ● Analyzing and designing basic circuits ● Testing and evaluating circuits using multimeters ● Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

		● Design, evaluate and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. ● Analyze complex real-world problems by specifying criteria and constraints for successful solutions
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Unit specific research labs and projects ● Design challenges
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Applied Physics - Engineering and Design

Unit Name	What	How	Why
Engineering and Design	Students will learn… • qualitative criteria relating to potential specific solutions. • how to differentiate large complex real-world problems into simpler manageable components. • realistic constraints associated with real world problems. • Prioritization of a project includes a variety of constraints which include, cost safety, reliability, and aesthetics, as well as possible social, cultural and environmental impacts.	• Prototype benchmarks • Performance assessments • Unit specific labs and projects	• How are conclusions drawn based on evidence? • How do the principles of physics govern your daily life? • How can one explain and predict interactions between objects and energy exchanges within systems? • What are the mathematical models governing physics?

Windham School District Curriculum

Applied Physics: Engineering & Design - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

NGSS Content Standards:
HS-PS2-1
HS-PS2-2
HS-PS2-3
HS-PS2-4
HS-PS2-5
HS-ETS1-1
HS-ETS1-2
HS-ETS1-3</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Recognize current global challenges.
● design models that represent potential solutions to global challenges.
● break down problems into manageable parts.
● analyze and draw conclusions from their models or simulations.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● humanity faces major challenges today, such as supplies, which can be addressed through engineering.
● both physical models and computers can be used in various ways to aid in the engineering design process.
● design must be done within a range of constraints.
● evaluation must be made considering constraints such as cost, material, and feasibility.</td><td>ESSENTIAL QUESTIONS
● How are conclusions drawn based on evidence?
● How do the principles of physics govern your daily life?
● How can one explain and predict interactions between objects and energy exchanges within systems?
● What are the mathematical models governing physics?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● qualitative criteria relating to potential specific solutions.</td><td>Students will be skilled at…
● Designing, building, and refining a device that works within given constraints to</td></tr>
</table>

	• how to differentiate large complex real-world problems into simpler manageable components. • realistic constraints associated with real world problems. • Prioritization of a project includes a variety of constraints which include, cost safety, reliability, and aesthetics, as well as possible social, cultural and environmental impacts.	convert one form of energy into another form of energy. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data, and refine the design accordingly. • Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects
Used in Content Area Standards		***21st Century Skills***
		• one to one technology • collaboration • communication • critical thinking • creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Unit and summative assessments • Unit specific labs and projects • Design challenges
	OTHER EVIDENCE: • Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Issues in Environmental Science - Impact of Perceptions**

Unit Name	What	Why	How
Impact of Perceptions	Students will learn… ● The 3 main standards for environmental ethics are anthropocentrism, biocentrism, and ecocentrism. ● An ecological footprint model represents the environmental impact of populations and/or individuals	● Personal perspectives such as age, economics, living conditions, education, and values impact environmental issues.	● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers and projects

Windham School District Curriculum

Issues in Environmental Science: Impact of Perceptions - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards: NGSS

● HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
● HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
● HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

● Relate, giving specific examples, how varying perceptions/attitudes based on age, economics, living conditions, education, and values impact environmental issues.
● From given data, calculate an ecological footprint and assess the impact on the environment.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Personal perspectives such as age, economics, living conditions, education, and values impact environmental issues.</td><td>ESSENTIAL QUESTIONS

● How does environmental science help us understand the natural world?
● What are current environmental issues?
● Why does a “perspective” have so much to do with environmental issues?
● What are the influences on how environmental perspective and how do they affect the topic?
● How do environmental perspectives impact environmental ethics?
● How can the environmental impact of a population or individual be modeled</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
</table>

	Students will know… • Environmental science studies how the natural world works, how the environment affects humans, and how humans affect the environment. • Personal perspectives such as age, economics, living conditions, education, and values impact environmental issues. • The 3 main standards for environmental ethics are anthropocentrism, biocentrism, and ecocentrism. • An ecological footprint model represents the environmental impact of populations and/or individuals	Students will be skilled at… • Define environmental science. • Compare and contrast anthropocentrism, biocentrism, and ecocentrism. • From given data, calculate an ecological footprint and assess the impact on the environment.
Used in Content Area Standards		***21st Century Skills***
		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Issues in Environmental Science - Environmental History & Policy**

Unit Name	What	Why	How
Environmental History & Policy	Students will learn... • Environmental policy uses science, ethics, economics, and the political process to solve environmental problems. • International organizations create laws and treaties to foster global agreement on environmental issues.	• Many resources stem from the environment, but when their management and that of their wastes is overlooked the environment is negatively impacted.	• Unit and summative assessments • Performance assessments • Unit specific labs, research papers and projects

Windham School District Curriculum

Issues in Environmental Science: Environmental History & Policy - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards: NGSS
HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able t
Conduct a cost-benefit analysis for a given situation. Assess the information and formulate a conclusion/course of action based on the data.
Compare and contrast approaches to global environmental policy (command and control approach, cap & trade, subsidy, green tax) outlining the benefits and drawbacks of each.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Many resources stem from the environment, but when their management and that of their wastes is overlooked the environment is negatively impacted.</td><td>ESSENTIAL QUESTIONS
How is sustainability affected by economics?
How do environmental policies protect the environment?
Can/should environmental policies be global?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Supply and demand and cost-benefit analysis influence economic decisions and may directly/indirectly impact the environment.</td><td>Students will be skilled at…
Distinguish between supply and demand.
Construct a chart to conduct a cost-benefit analysis for a given situation. Assess the information from the chart and formulate</td></tr>
</table>

	● Environmental policy uses science, ethics, economics, and the political process to solve environmental problems. ● Describe the history of environmental policy and the environmental movement in the United States. ● International organizations create laws and treaties to foster global agreement on environmental issues.	a conclusion/course of action based on the data. ● Using an Environmental Impact Statement as an example, explain the purpose of environmental policy. ● Describe the historical trends for environmental policy and the environmental movement in the United States. ● Compare and contrast approaches to global environmental policy (command and control approach, cap & trade, subsidy, green tax) outlining the benefits and drawbacks of each

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Issues in Environmental Science - Ecology

Unit Name	What	Why	How
Ecology	Students will learn... ● Ecosystems include both abiotic (nonliving) and biotic (living factors). ● Both beneficial and harmful interactions occur between species. These include predation, parasitism, commensalism, mutualism, symbiosis, and competition.	● Both beneficial and harmful interactions occur between species. These include predation, parasitism, commensalism, mutualism, symbiosis, and competition. ● Energy flows through food chains and food webs generally from the autotrophs (producers) to the various types of heterotrophs (consumers).	● Formative assessments such as: homework, quizzes, mini-labs and lab investigations ● Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Issues in Environmental Science: Ecology - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="7">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards: NGSS
HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Identify the abiotic and biotic factors in an ecosystem (living example or diagram).
Identify the roles and interactions present in a living community.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Both beneficial and harmful interactions occur between species. These include predation, parasitism, commensalism, mutualism, symbiosis, and competition.
Energy flows through food chains and food webs generally from the autotrophs (producers) to the various types of heterotrophs (consumers).</td><td>ESSENTIAL QUESTIONS
How do ecologists organize and study life?
What are the important characteristics of populations?
What factors determine whether, and how, a population's size changes?
How do species interact in nature?
How do energy and nutrients move through communities?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
</table>

	● Ecologists study life at various levels of organization including populations, communities, ecosystems and the biosphere. ● Ecosystems include both abiotic (nonliving) and biotic (living factors). ● Populations can be analyzed according to density, distribution, age structure, and growth. ● Both beneficial and harmful interactions occur between species. These include predation, parasitism, commensalism, mutualism, symbiosis, and competition. ● Energy flows through food chains and food webs generally from the autotrophs (producers) to the various types of heterotrophs (consumers).	● Describe the differences between each level of organization in an ecosystem. ● Identify the abiotic and biotic factors in an ecosystem (living example or diagram). ● Collect data and analyze a population according to density and distribution. ● Identify the roles and interactions present in a living community. ● Construct a food chain and/or food web from given information. ● Characterize a significant federally protected area or national park by describing the biome to which it belongs and the organisms and associated food chains/webs found within it.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Issues in Environmental Science - Biodiversity & Invasive Species**

Unit Name	What	Why	How
Biodiversity & Invasive Species	Students will learn… • Overtime, communities change due to succession which can be a natural progression or due to a disturbance. • Biodiversity loss can be due to a variety of causes such as habitat change, habitat loss, invasive species, overharvesting, pollution, and climate change.	• Invasive species are non-native organisms that spread widely in a community due to the lack of limiting factors. • In ecosystems, diversity is stability--species variety is an indication of ecosystem health and success.	• Formative assessments such as: homework, quizzes, mini-labs and lab investigations • Summative assessments such as: unit or sub-unit tests, formal lab reports, and projects

Windham School District Curriculum

Issues in Environmental Science: Biodiversity & Invasive Species - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards: NGSS
HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
Describe the impact of one invasive species on an endemic species when given the invasive species role and survival adaptations in the ecosystem.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Invasive species are non-native organisms that spread widely in a community due to the lack of limiting factors.
In ecosystems, diversity is stability--species variety is an indication of ecosystem health and success.</td><td>ESSENTIAL QUESTIONS
How do communities respond to a disturbance?
Why is biodiversity important?
How can biodiversity be protected and preserved?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Overtime, communities change due to succession which can be a natural progression or due to a disturbance.
Invasive species are non-native organisms that spread widely in a community due to the lack of limiting factors.</td><td>Students will be skilled at…
Compare and contrast primary and secondary succession.
Compare and contrast pioneer species and invasive species.</td></tr>
</table>

	• In ecosystems, diversity is stability--species variety is an indication of ecosystem health and success. • To assess biodiversity trends, scientists classify species as endangered, threatened, or extinct. • Biodiversity loss can be due to a variety of causes such as habitat change, habitat loss, invasive species, overharvesting, pollution, and climate change. • Laws such as the Endangered Species Act can help to preserve and protect biodiversity.	• Using a specific example, describe the impact of one invasive species on an endemic species.
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Unit and summative assessments • Performance assessments • Unit specific labs, research papers and projects
	OTHER EVIDENCE: • Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Issues in Environmental Science - Environmental Health and Water**

Unit Name	What	Why	How
Environmental Health and Water	Students will learn... ● Infectious diseases are caused by pathogens, are biological hazards, and are spread through a variety of means. ● The result of biomagnification (bioaccumulation) is the continued build up of toxic substances through each step in a food chain. .	● Environmental health hazards can be biological, social, chemical or physical. ● Epidemiology is the study of disease in a population while toxicology is the study of the impact of poisonous substances on health.	● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers ● Engineering mitigation project

Windham School District Curriculum

Issues in Environmental Science: - Environmental Health and Water - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards: NGSS

● HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
● HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
● HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

● Analyze a current or historical New Hampshire environmental health event in terms of the type of health hazard involved and the nature of the cause and ultimate response. (groundwater, air pollution, soil contamination, etc.)</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Environmental health hazards can be biological, social, chemical or physical.
● Epidemiology is the study of disease in a population while toxicology is the study of the impact of poisonous substances on health.</td><td>ESSENTIAL QUESTIONS

● How does environmental health impact society?
● How do biological and social factors in the environment affect human health?
● How do chemicals in the environment affect human health?
● Where is all of our water?
● How does water pollution affect humans and ecosystems?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Environmental health hazards can be biological, social, chemical or physical.</td><td>Students will be skilled at…

● Describe and distinguish between examples of biological, social, chemical</td></tr>
</table>

	● Epidemiology is the study of disease in a population while toxicology is the study of the impact of poisonous substances on health. ● Infectious diseases are caused by pathogens, are biological hazards, and are spread through a variety of means. ● Emerging diseases are caused by pathogens and are biological hazards that are new or rapidly increasing in the world population. ● The result of biomagnification (bioaccumulation) is the continued buildup of through each step in a food chain.	and physical environmental health hazards. ● Compare and contrast epidemiology and toxicology. ● Analyze a current or historical environmental health event in terms of the type of health hazard involved and the nature of the cause and ultimate response.
Used in Content Area Standards		***21st Century Skills***
not applicable		● one to one technology ● collaboration ● communication ● critical thinking ● creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers ● Engineering mitigation project
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: Issues in Environmental Science - Environmental Health and Waste

Unit Name	What	Why	How
Environmental Health, Waste	Students will learn... • Waste can be classified as solid municipal waste, industrial waste, and hazardous waste. • Traditional methods of solid waste disposal include sanitary landfills and incineration. • Solid waste can be minimized through waste reduction and waste recovery.	• Every organism produces waste. In high population densities, waste needs to be managed in order to maintain environmental health.	• Unit and summative assessments • Performance assessments • Unit specific labs, research papers • Engineering mitigation project

Windham School District Curriculum

Issues in Environmental Science: - Environmental Health and Waste - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards: NGSS

● HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
● HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
● HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

● Identify the waste stream of a particular waste product and propose three possible solutions to better manage the waste.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Every organism produces waste. In high population densities, waste needs to be managed in order to maintain environmental health.</td><td>ESSENTIAL QUESTIONS

● How does our current waste disposal impact our environment?
● What is the best way to manage our solid waste?
● How can we best reduce the impact of hazardous waste?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● Waste can be classified as solid municipal waste, industrial waste, and hazardous waste.
● Traditional methods of solid waste disposal include sanitary landfills and incineration.
● Solid waste can be minimized through waste reduction and waste recovery.</td><td>Students will be skilled at…
● Compare and contrast the benefits and problems associated with the traditional methods of solid waste disposal (landfill versus incineration).
● Compare and contrast the benefits and problems associated with waste reduction and waste recovery.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers ● Engineering mitigation project
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Issues in Environmental Science - Environmental Health and Air**

Unit Name	What	Why	How
Environmental Health and Air	Students will learn… • Acid deposition results from the combination of combustion products and water and oxygen present in the atmosphere. • Rising atmospheric temperatures, precipitation trends, melting ice, warming ocean temperatures and rising sea levels are all evidences of global climate change.	• Natural processes and human activities cause air pollution. • Air pollution can be controlled through a variety of means including legislation, global treaties, mechanical processes, and changes in product design and use.	• Unit and summative assessments • Performance assessments • Unit specific labs, research papers • Engineering mitigation project

Windham School District Curriculum

Issues in Environmental Science: Environmental Health and Air - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards: NGSS

● HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
● HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
● HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

● Explain the negative feedback loop of increased CO_2 levels in the atmosphere.
● Present an argument to support or oppose a proposed solution to climate change mitigation, including a cost/benefit analysis</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Natural processes and human activities cause air pollution.
● Air pollution can be controlled through a variety of means including legislation, global treaties, mechanical processes, and changes in product design and use.</td><td>ESSENTIAL QUESTIONS

● What are sources of air pollution?
● What measures can limit and prevent pollution of the atmosphere?
● What evidence shows that global climate change is occurring, and why is it happening?
● What are the effects of climate change?
● How can we respond to climate changes</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
</table>

	Students will know… ● Natural processes and human activities cause air pollution. ● Air pollutants primarily affect the respiratory system causing or aggravating a variety health problems. ● Temperature inversions prevent the dispersal of air pollutants. ● Acid deposition results from the combination of combustion products and water and oxygen present in the atmosphere. ● Rising atmospheric temperatures, precipitation trends, melting ice, warming ocean temperatures and rising sea levels are all evidences of global climate change.	*Students will be skilled at…* ● Distinguish between primary and secondary air pollutants. ● List health problems associated with air pollution. ● Label a diagram of a temperature inversion. ● Describe the cause and effect of sources of acid deposition. ● Explain the cause and effect on organisms of each of the major contributing factors to global climate change. ● Design or critique a model or piece of legislation that would lead to a decrease in air pollutants or emissions improve the negative effects of global climate change.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance assessments ● Unit specific labs, research papers ● Engineering mitigation project
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Issues in Environmental Science - Renewable Energy**

Unit Name	What	Why	How
Renewable Energy	Students will learn… • The arguments for and against all energy sources and learn to form a scientific argument • There exist a variety of technologies for sharply increasing the energy efficiency. • The transition to a more sustainable energy future requires greatly improving energy efficiency.	• All energy sources have positive and negative reasons for their implementation	• Unit and summative assessments • Performance assessments • Unit specific labs, research papers • Engineering mitigation project

Windham School District Curriculum

Issues in Environmental Science: Renewable Energy - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards: NGSS

● HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
● HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
● HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to

● Construct an argument about the best energy source for a given environment and human population</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● all energy sources have positive and negative reasons for their implementation</td><td>ESSENTIAL QUESTIONS

● How do nonrenewable energy resources affect the environment?
● What are the advantages and disadvantages of energy resources.How can we cut energy waste?
● How can we make the transition to a more sustainable energy future?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● Conventional oil, natural gas and coal are currently abundant, have a high net energy yield, and are relatively inexpensive, but currently have a high environmental impact.
● Nuclear power has a low environmental impact and a very low accident risk, but has a high environmental impact. (long term)</td><td>Students will be skilled at…

● conducting a personal/household energy audit
● researching and presenting an argument regarding the benefits and limitations of energy sources</td></tr>
</table>

	• Passive and active solar heating systems can heat water and buildings effectively, and the costs of using direct sunlight to produce high-temperature heat and electricity are coming down. • Hydropower uses water flowing over dams, tidal flows, and ocean waves to generate electricity, but has a high environmental cost. • Wind power is the least expensive and least polluting way to produce electricity, when you include environmental costs. • Solid biomass is a renewable resource for much of the world's population, but has a high environmental cost. • Geothermal energy has great potential for supplying many areas with heat and electricity, and it has a generally low environmental impact, but the sites where it can be used economically are limited. • There exist a variety of technologies for sharply increasing the energy efficiency of industrial operations, motor vehicles, appliances, and buildings. • The transition to a more sustainable energy future requires greatly improving energy efficiency, using a mix of renewable energy resources, and including the environmental costs of energy resources in their market prices.	• identifying the most efficient energy resources for Windham and New Hampshire.
Used in Content Area Standards		***21st Century Skills***

not applicable	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Unit and summative assessments • Performance assessments • Unit specific labs, research papers • Engineering mitigation project
	OTHER EVIDENCE: • Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **MythBusters - Scientific Inquiry**

Unit Name	What	How	Why
Scientific Inquiry	• Ask a testable question • Construct a hypothesis • Design and conduct an experiment • Collect data • Analyze the data • Draw a conclusion	Students will be skilled at • Formulating a hypothesis • Determining a procedure • Conducting an experiment • Identifying control and constants	Enduring understandings • Claims can be proven true or false through rigorous experimentation

Windham School District Curriculum

MythBusters: Scientific Inquiry - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-ETS1-1
HS-ETS1-2
HS-ETS1-3

NGSS: Crosscutting Concepts
● Patterns-Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
● Cause and effect-Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
● Scale, proportion, and quantity-In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Identify different types of evidence
● Use proper procedures in collecting evidence
● Use the scientific method as a problem-solving tool to answer testable questions.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Claims can be proven true or false through rigorous experimentation</td><td>ESSENTIAL QUESTIONS

● How is the scientific method used to solve problems?
● What are the essential requirements for performing scientific inquiry?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

How to...
● Ask a testable question
● Do background research on scientific principles
● Construct a hypothesis
● Design and conduct an experiment
● Collect data
● Analyze the data
● Draw a conclusion</td><td>Students will be skilled at…

● Formulating a hypothesis
● Determining a procedure
● Conducting an experiment
● Identifying control and constants

PRACTICES:
● Asking questions (for science) and defining problems (for engineering)
● Developing and using models</td></tr>
</table>

● Systems and system models-Defining the system under study provides tools for understanding and testing ideas that are applicable throughout science and engineering.	● Share your results	● Planning and carrying out investigations ● Analyzing and interpreting data ● Using mathematics and computational thinking ● Constructing explanations (for science) and designing solutions (for engineering) ● Engaging in argument from evidence ● Obtaining, evaluating, and communicating information
Used in Content Area Standards		***21st Century Skills***
		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
Science & Engineering Practices	ASSESSMENT: ● Unit and summative assessments ● Performance assessments on experimental design, data collection and data analysis ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **MythBusters - Biological Myths**

Unit Name	What	How	Why
Biological Myths	• Bacteria/germs are necessary for many aspects of our life. • To accurately assess the quantity of germs, we can grow them in colonies using agar plates. • Very specific and careful techniques will be utilized to gather data. • General operating mechanism for each of our five senses • Brain processes and interprets information sent to it from the various senses.	Students will be skilled at • Collecting Bacterial samples • Sterile technique • Practice safety in the science laboratory • Use a compound microscope • Designing an experiment • Record observations • Make conclusions that will help to further students' investigations	Enduring understandings • Germs are everywhere. • Many neurologists argue humans have many more than the five traditional senses. • Some researchers agree that when one sense is blocked/removed the others become heightened to compensate

Windham School District Curriculum

MythBusters: Biological Myths - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-ETS1-1
HS-ETS1-2
HS-ETS1-3

NGSS: Crosscutting Concepts
● Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
● Cause and effect Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
● Scale, proportion, and quantity In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Use sterile techniques to collect bacterial sample
● Analyze bacterial growth as an estimate of bacterial populations
● Design and conduct tests to answer questions about human perception including vision, balance, hearing and direction</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Germs are everywhere.
● Many neurologists argue humans have many more than the five traditional senses.
● Some researchers agree that when one sense is blocked/removed the others become heightened to compensate</td><td>ESSENTIAL QUESTIONS
● Is the 5-second rule valid?
● What is the dirtiest place in the school?
● Do instant hand sanitizers work as well as they claim?
● Does removing/blocking one of our senses allow the others to be heightened?
● Can you walk in a straight line while blindfolded?
● Does repetition of a path allow you to walk it successfully while blindfolded?
● Do we have a sense of direction?
● Do we have a sense of time?
● Do we have a sense of balance?</td></tr>
</table>

<table>
<tr><td rowspan="3">Structure and function The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
Systems and system models Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.</td><td></td><td></td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Bacteria/germs are necessary for many aspects of our life.
To accurately assess the quantity of germs, we can grow them in colonies using agar plates.
Different types of germs have different appearances in their colony (color, size, shape).
Very specific and careful techniques will be utilized to gather data.
General operating mechanism for each of our five senses
Brain processes and interprets information sent to it from the various senses.</td><td>Students will be skilled at…
Collecting Bacterial samples
Sterile technique
Practice safety in the science laboratory
Use a compound microscope
Record observations
Make conclusions that will help to further students’ investigations
NGSS Practices
Planning and carrying out investigations
Analyzing and interpreting data
Constructing explanations (for science) and designing solutions (for engineering</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">not applicable</td><td>one to one technology
collaboration
communication
critical thinking
creativity</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Case Studies ● Performance assessments using sterile techniques ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: MythBusters - Forces in Solids and Fluids

Unit Name	What	How	Why
Forces in Solids and Fluids	• Concepts from research to construct vortex cannon • The differential speed of the vortex causes it to rotate on itself and actually propels itself along. • A vortex is a toroidal ring which is compact and fast moving • A hole must be utilized to form the vortex, and the hole size is important • The basic required components of an effective catapult • How to draw and utilize effective blueprint designs	Students will be skilled at • Utilize the scientific method to determine and conduct appropriate tests • Quantitatively and qualitatively describe outcomes of tests • Gather and interpret measurements. • Interpret graphs. • Practice safety in the science laboratory. • Follow experimental procedures • Record observations	Enduring understandings • Air masses can move in patterns that are unusual • Rotating fluids can maintain a form/structure within that fluid

Windham School District Curriculum

MythBusters: Forces in Solids and Fluids - Grade 11-12

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:

HS-ETS1-1
HS-ETS1-2
HS-ETS1-3

NGSS: Crosscutting Concepts

- Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
- Cause and effect Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
- Scale, proportion, and quantity In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Transfer

Students will be able to

- Build a Vortex cannon
- Explain structure of a vortex
- Hypothesize uses of a toroidal vortex
- Construct a desktop catapult or trebuchet

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- Air masses can move in patterns that are unusual
- rotating fluids can maintain a form

ESSENTIAL QUESTIONS

- Can air be harnessed to extinguish flames at various distances, accurately?
- Can air be harnessed to destroy structures?
- What considerations must be taken into account when constructing the vortex cannon?
  What common household items may be effectively combined into a functioning catapult which will launch small beans?

Acquisition

Students will know…

- Concepts from research to construct vortex cannon

Students will be skilled at…

- Utilize the scientific method to determine and conduct appropriate tests
- Quantitatively and qualitatively describe outcomes of tests
- Gather and interpret measurements.

● Structure and function The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.	● The differential speed of the vortex causes it to rotate on itself and actually propels itself along. ● A vortex is a toroidal ring which is compact and fast moving ● A hole must be utilized to form the vortex, and the hole size is important ● The basic required components of an effective catapult ● Basic research skills ● How to draw and utilize effective blueprint designs.	● Interpret graphs. ● Practice safety in the science laboratory. ● Follow experimental procedures. ● Record observations. NGSS Practices ● Planning and carrying out investigations ● Analyzing and interpreting data ● Constructing explanations (for science) and designing solutions (for engineering)
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance lab assessments ● Case Studies ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: MythBusters - Death Ray

<table>
<tr><th>Unit Name</th><th>What</th><th>How</th><th>Why</th></tr>
<tr>
<td>Death Ray</td>
<td>Archimedes original plan to burn ships at sea using a solar reflector.
Structure of a parabolic curve
Materials most efficient for reflecting light
How to calculate the angle of reflection</td>
<td>Students will be skilled at
Performing tests to identify focal point of light
Practicing safety in the science laboratory
Reading and interpreting tables</td>
<td>Enduring understandings
Solar energy can be concentrated enough to ignite an object
Materials have specific temperatures needed for combustion to occur</td>
</tr>
</table>

Windham School District Curriculum

MythBusters: Death Ray - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-ETS1-1
HS-ETS1-2
HS-ETS1-3

NGSS: Crosscutting Concepts
Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and effect Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
Scale, proportion, and quantity In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to
Build a parabolic solar reflector to focus sunlight until a paper ship ignites
Explain concepts of light reflection and focal point</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Solar energy can be concentrated enough to ignite an object
Materials have specific temperatures needed for combustion to occur</td><td>ESSENTIAL QUESTIONS
How powerful is solar energy?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
Archimedes original plan to burn ships at sea using a solar reflector.
Structure of a parabolic curve
Materials most efficient for reflecting light
How to calculate the angle of reflection</td><td>Students will be skilled at…
Perform tests to identify focal point of light
Practice safety in the science laboratory
Read and interpret tables
NGSS Practices
Asking questions (for science) and defining problems (for engineering)
Developing and using models
Planning and carrying out investigations
Analyzing and interpreting data</td></tr>
</table>

• Structure and function The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. • Stability and change For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.		• Using mathematics and computational thinking • Constructing explanations (for science) and designing solutions (for engineering) • Engaging in argument from evidence • Obtaining, evaluating, and communicating information
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: • Unit and summative assessments • Performance lab assessments • Case Studies • Unit specific research labs, research papers and projects
	OTHER EVIDENCE: • Multiple formative assessments for data collection and curriculum modification

<u>Title of Curriculum</u>: MythBusters - Build Challenge

Unit Name	What	How	Why
Build Challenge	• How to create a blueprint/CAD design for their prototype • The fundamental difference between a boat and a raft • How boats float and the aspects required to track in a straight path • The best design of a paper airplane • How to analyze flight path to determine where improvements can be made	Students will be skilled at • Creating a series of designs and blueprints prior to building • Designing testable procedures for analyzing effectiveness of construction • Construct bridge using provided materials • Assess strength of bridge through testable means • Draw conclusions based on experimental evidence • Practice safety in the science laboratory	Enduring understandings • Problems can be solved by using the engineering/design process and testing prototypes.

Windham School District Curriculum

MythBusters: Build Challenge - Grade 11-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards):

Content Standards:
HS-ETS1-1
HS-ETS1-2
HS-ETS1-3

NGSS: Crosscutting Concepts
● Patterns Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
● Cause and effect Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.
● Scale, proportion, and quantity In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to
● Build a structure (ex. duct-tape boat, paper airplane, spaghetti bridge, egg drop container)within the given constraints of the challenge
● Follow engineering/design process
● Test prototypes and revise models</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● A bridge is any object which allows a gap to be spanned
● There are many types of bridge designs, each with their own strengths and weaknesses.
● Buoyancy and Lift
● Compression, Tension and Torsion</td><td>ESSENTIAL QUESTIONS
● Can a small scale boat be made from duct tape and coffee stirrers that can hold a lot of weight and can travel in a straight path?
● Can the classic paper airplane be improved through the implementation of duct tape?
● Given two pounds of uncooked spaghetti and a short length of duct tape, what is the maximum amount of weight a 14-inch (span) spaghetti bridge can hold?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…</td><td>Students will be skilled at…</td></tr>
</table>

• Structure and function The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. • Stability and change For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.	• How to create a blueprint/CAD design for their prototype • The fundamental difference between a boat and a raft • How boats float and the aspects required to track in a straight path • The best design of a paper airplane • How to analyze flight path to determine where improvements can be made	• Create a series of designs and blueprints prior to building the boat • Design testable procedures for analyzing effectiveness of construction • Research and analyze effective bridge design elements • Construct bridge using provided materials • Assess strength of bridge through testable means • Draw conclusions based on experimental evidence • Practice safety in the science laboratory NGSS Practices • Asking questions (for science) and defining problems (for engineering) • Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Constructing explanations (for science) and designing solutions (for engineering) • Obtaining, evaluating, and communicating information
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Unit and summative assessments ● Performance lab assessments ● Unit specific research labs, research papers and projects
	OTHER EVIDENCE: ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Grades 10-12: Planetary Science - The Course to Space**

Unit Name	What	How	Why
The Course to Space **Topics in which this unit appears:** ● Reading the Night Sky ● Historical Overview of Astronomy ● Electromagnetic Spectrum ● Spectroscopy ● Telescope	● The night sky is broken down into 88 constellations that are used to help navigate the night sky and identify regions, like a map. ● The field of astronomy has evolved over millennia through advances in science and technology, which has broadened our understanding of the greater Universe. ● The seven portions of the electromagnetic spectrum have different properties and all help scientists gain knowledge of the Universe. ● Spectral light signatures tell us the chemical compositions of planetary atmospheres, stars, galaxies, and other astronomical features. ● Telescopes have been used for centuries to gather faint light and make distant objects more visible.	● Student will learn how the night sky is organized and how to read it like a map. ● Students will research the past history of astronomy and analyze how it has changed over the centuries through new scientific and technological advances. ● Students will experiment with the electromagnetic spectrum to observe how different portions of the spectrum provide us with different information, which has fueled our knowledge of the Universe. ● Students will use spectrometers to understand how the chemical composition of objects can be measured visually. ● Students will design telescopes to better understand how they work.	**To answer the question:** ● How can objects be found in the night sky? ● How has our understanding of the night sky changed over our history? ● How can we gather information about the Universe from Earth? ● How do telescopes work?

Windham School District Curriculum

Planetary Science - The Course to Space - Grades 10-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-PS4-1
HS-PS4-2
HS-PS4-3
HS-PS4-4
HS-PS4-5
HS-ESS1-4</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Find constellations in the night sky and read sky charts.
● Read an electromagnetic diagram.
● Be able to distinguish elements from their spectroscopy.
● Build simple telescopes.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Constellations, while stars appear to be groups together, are composed of stars that are very far away from one another.
● Our knowledge of astronomy is evolving as our technology improves.
● Various portions of the electromagnetic spectrum tell us different information about the Universe, and some portions can “see” things other portions can’t.
● Spectroscopy is used to identify what elements and compounds are present on distance stars, clouds, and planets.
● Telescopes gather light, but do not magnify it.</td><td>ESSENTIAL QUESTIONS
● How can objects be found in the night sky?
● How has our understanding of the night sky changed over our history?
● How can we gather information about the Universe from Earth?
● How do telescopes work?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
</table>

	Students will know… ● How to find stars in the night sky. ● The basic course of the history of astronomy and how our knowledge has evolved. ● That various portions of the electromagnetic spectrum are used to gather different types of information and that we can "see" more than just what the visual portion tells us. ● How to read spectroscopy data to interpret what type of elements/compounds are present. ● How telescopes work.	**Students will be skilled at…** ● Finding constellations in the night sky. ● Using data to back up statements. ● Reading the electromagnetic spectrum. ● Reading spectroscopy charts. ● Using telescopes.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Employing 21st century skills of collaboration ● Communication ● Critical thinking ● Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Identify constellations on a sky map. ● Identify elements/compounds by spectroscopy. ● Build and use a simple telescope.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: Grades 10-12: Planetary Science - Formation of the Solar System

Unit Name	What	How	Why
How We Began: The Formation of Our Solar System **Topics in which this unit appears:** ● theories of solar system formation	● One theory of solar system formation is the core-accretion theory in which planets formed through the rapid accretion of gas and icy particles. ● Another theory is the gravitational instability theory in which the giant planets formed from portions of the interstellar cloud collapsing under their own gravity.	● Students will analyze the core-accretion theory and the gravitational instability theory to compare how well these theories explain the observed properties of our solar system. ● Students will observe other solar systems, in different stages of formation, to help understand how scientists know about our solar system's formation and what is common in the Universe.	**To answer the question:** ● How do the two leading theories of solar system formation differ from each other? ● How did scientist develop the core-accretion theory and the gravitational instability theory? ● Are there other solar systems like ours in the Universe? ● Is it common for Earth-like planets to form?

Windham School District Curriculum

Planetary Science - How We Began: The Formation of Our Solar System - Grades 10-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-PS2-1
HS-PS2-2</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Explain the differences between the various theories of solar system formation.
● Analyze the theories based on our understanding of our solar system.
● Argue based on evidence why these theories have merit.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● Our knowledge of how the solar system formed is based on the laws of physics, the current properties of our solar system, and our knowledge of other solar systems.
● Theories of solar system formation have strengths and weaknesses, but none have been disproven.
● Our knowledge of how our solar system formed helps us understand other planetary systems and whether there could be life in those systems.</td><td>ESSENTIAL QUESTIONS
● How do the two leading theories of solar system formation differ from each other?
● How did scientist develop the core-accretion theory and the gravitational instability theory?
● Are there other solar systems like ours in the Universe?
● Is it common for Earth-like planets to form?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
</table>

<table>
<tr><td></td><td>Students will know…
The various theories for the formation of our solar system.
That the physical properties of our solar system are important when astronomers develop the theories of solar system formation; the properties of our solar system must fit the formation model.
The formation theories will be modified, supported, or disproven as new information and technology becomes available.</td><td>Students will be skilled at…
Analyzing the various theories of solar system formation and debating the scientific merit of each.</td></tr>
<tr><td colspan="2">Used in Content Area Standards</td><td>21st Century Skills</td></tr>
<tr><td colspan="2">not applicable</td><td>One to one technology
Employing 21st century skills of collaboration
Communication
Critical thinking
Creativity</td></tr>
</table>

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: ● Analyze the validity of the various theories of solar system formation based on current knowledge.
	OTHER EVIDENCE: ● Unit and Summative Assessments ● Unit specific research labs, research papers and projects ● Multiple formative assessments for data collection and curriculum modification

Title of Curriculum: **Grades 10-12:Planetary Science -What It Takes to Harbor Life**

Unit Name	What	How	Why
What it Takes to Harbor Life - A Look at the Planets **Topics in which this unit appears:** ● planets ● comets, asteroids, and minor planets ● exoplanets ● what makes life possible? ● colonizing other planets	● The inner planets are dense, rocky, and much smaller than the outer, gas giants. ● Comets, asteroids, and minor planets are left over debris from the formation of the solar system. ● Scientists are looking for life on exoplanets, which are planets outside of the solar system.	● Students will look at evidence from space missions and telescope observations to learn distinguishing features of the planets, comets, asteroids, and minor planets. ● Students will engage in discussion based on evidence as to what features are necessary for life and the likelihood that other exoplanets harbor life.	**To answer the question:** ● What are the major differences between the planets of the solar system? ● What can comets, asteroids, and minor planets tell us about our solar system? ● What factors are needed to harbor life on other worlds? ● Are we the only planet with life on it?

Windham School District Curriculum

Planetary Science - What it Takes to Harbor Life - A Look at the Planets - Grades 10-12

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS:

Competencies (Standards?):

Content Standards:
HS-ESS1-6</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to:
● Distinguish between the inner and outer planets of the solar system.
● Convey the importance of comets, asteroids, and minor planets in the formation of our solar system.
● Describe how exoplanets are found and characterized.
● Analyze planetary properties to decide if life could potentially exist on an exoplanet.
● Understand the challenges and complications of colonizing another planet.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
● The inner and outer planets of the solar system are very different from one another due to differences in location in proximity to the Sun and how the solar system formed.
● Comets, asteroids, and minor planets are the remnants of solar system formation and are in many cases in the same state as when the solar system formed 4.5 billions years ago.
● The eight planets of our solar system are not the only planets in the Universe, scientists are finding more and more exoplanets as our technology advances.</td><td>ESSENTIAL QUESTIONS
● What are the major differences between the planets of the solar system?
● What can comets, asteroids, and minor planets tell us about our solar system?
● What factors are needed to harbor life on other worlds?
● Are we the only planet with life on it?</td></tr>
</table>

	• Life on Earth may not be unique in the Universe or solar system. However, life does require certain conditions to exist. • Colonizing other planets is complex and requires much consideration in terms of needed resources, protection from harmful radiation, and human social and emotional requirements.	
	Acquisition: DCI/SEP	
	Students will know… • The inner planets are rocky, dense, and small compared to the outer, giant gaseous planets of our solar system. • Studying comets, asteroids, and minor planets help astronomers understand what the solar system was like at the time of its formation and provide clues as to how it formed. • Exoplanets exist around other stars throughout the Universe. • Many exoplanets discovered thus far do now have the right conditions for life, but some do. • Colonizing other planets takes time and much planning. There are many hurdles that must be crossed to successfully bring humans to another planet to live.	**Students will be skilled at…** • Distinguishing the inner and outer planets of the solar system by their properties. • Identifying the importance of comets, asteroids, and minor planets. • Explaining how exoplanets are found. • Explaining what conditions are necessary for live and analyzing exoplanets to determine if life is possible.
Used in Content Area Standards		***21st Century Skills***

not applicable	- One to one technology - Employing 21st century skills of collaboration - Communication - Critical thinking - Creativity

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	ASSESSMENT: - Compare and contrast the inner and outer planets of the solar system. - Based on evidence, create an argument as to whether an exoplanet is capable of life. - Design a plan to colonize Mars.
	OTHER EVIDENCE: - Unit and Summative Assessments - Unit specific research labs, research papers and projects - Multiple formative assessments for data collection and curriculum modification