Windham School District

Grades 9-12

Science & Engineering Curriculum

Approved by the Windham School Board on 2/21/2023

Windham School District Curriculum

Conceptual Physics and Chemistry: Structure & Properties of Matter

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

● HS-PS1-1: 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.
● HS-PS1-8: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Use the periodic table to describe the structure of elements at the atomic level.
● Use the periodic table to broadly classify elements.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Elements possess definitive characteristics like mass, size and subatomic make-up that determine where it is placed on the periodic table.
● All things are made of matter and energy is the ability to do work.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How can one explain the structure and properties of matter?</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 similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.
● The identity of an element is determined by the number of protons in the nucleus.
● The total amount of matter in a closed system is conserved.</td><td>Students will be skilled at…

● Identifying information about elements from the periodic table.
● Showing matter is conserved in laboratory experiments by accurately and precisely measuring chemicals before and after chemical reactions.
● Making predictions about possible reactions using the periodic table.</td></tr>
</table>

	• Chemical reactions are a visual model for what is observed when compounds are mixed and atoms are rearranged among the compounds; this may release or absorb energy.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Conceptual Physics and Chemistry: Chemical Reactions

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

● HS-PS1-2: 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.
● HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Use chemical equations 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…

● When energy is introduced into a system some bonds will be broken and new bonds will be made. This creates new substances and is defined as a chemical reaction.
● Chemical changes produce new substances while mechanical changes of a substance may alter the appearance or size but the chemical nature of substance remains the same before and after the change.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do substances combine or change (react) to make new substances?
● How are chemical and mechanical changes different?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● The conservation of energy states that matter cannot be created or destroyed however it can change forms.
● In a chemical reaction chemical bonds are broken and new chemical bonds are made this is what allows for the change in matter.
● A chemical equation is used to demonstrate how matter is conserved even though it changes form.</td><td>Students will be skilled at…

● Balancing chemical equations.
● Solving equations to determine the numbers of each, specific type of atom.</td></tr>
</table>

	● The chemical reaction for photosynthesis is the opposite reaction as cell respiration. ● States of matter change when energy is added or removed from a system. ● A change in the state of matter is an example of a mechanical change.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
Conceptual Physics and Chemistry: Chemistry Of Water

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

● HS-PS1-3: 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.
● HS-PS2-6: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● The emergent properties of water and how it interacts with the world are a product of its chemical makeup.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Water is a polar molecule which allows it to be attracted to itself. This attraction is referred to as a hydrogen bond and gives it many of the chemical properties that are unique to water.
● The properties of water impact how it interacts with the world around it.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are the properties of water?
● How have the chemical properties of water influenced life on Earth?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Adhesion and cohesion are properties of water that allow for surface tension to form on still water.
● Water’s attraction to itself allows it to hold a great amount of heat which is referred to as its high specific heat capacity.
● It takes energy for water to evaporate which creates a cooling effect and is the process used in sweating.
● Ice floats on liquid water because the hydrogen bonds allow for a crystalline structure to form.</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.
● 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>

	This causes the solid form of water to be less dense than the liquid form. ● Ice floating on water has allowed for life to form in the ocean without it being destroyed every time the Earth cooled.	

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

Windham School District Curriculum
Conceptual Physics and Chemistry: Forces and Interactions

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

● HS-PS2-1: 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.
● HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
● HS-PS2-4: Use mathematical representations of Newton’s Law of Gravitation to describe and predict the gravitational and electrostatic forces between objects.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Identify the forces that are enacted upon an object and predict what will happen when these forces are altered.
● Apply Newton’s three laws of motion to solve engineering problems.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● In Newton’s first law, an object will not change its motion unless a force acts on it. In the second law, the force on an object is equal to its mass times its acceleration. In the third law, when two objects interact, they apply forces to each other of equal magnitude and opposite direction.
● Acceleration is caused by the change in force being applied to an object.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are Newton’s three laws of motion?
● What causes the motion of an object?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● There are six types of forces in physics and they are the gravitational, natural, spring, tension, applied, frictional and air resistance.
● A free-body diagram is used to describe the forces enacted upon an object.
● Velocity is the movement of an object over a specific distance per unit of time.</td><td>Students will be skilled at…

● Drawing free-body diagrams to identify the forces being acted upon an object.
● Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.
● Interpreting and applying Newton's three laws of motion.</td></tr>
</table>

	• When there is a change in velocity this is characterized as acceleration. • Acceleration can be a positive or negative change in velocity.	
Used in Content Area Standards		***21st Century Skills***
		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Conceptual Physics and Chemistry: Energy

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Content Standards:

- **HS-PS3-1:** 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.
- **HS-PS3-2:** 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).
- **HS-PS3-3:** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Transfer

Students will be able to independently use their learning to…

- Apply Newton's Laws of Motion to solve One and Two Dimensional Force Problems.
- Apply Newton's Laws of Motion to solve connected objects Force problems .

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system.
- Energy is the ability to do work and work is the amount of energy that is transferred over a distance.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What is energy and how does it interact with matter?
- How are work and power related to everyday activities?

Acquisition

Students will know…

- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
- Force = Mass x Acceleration.
- Force is measured with different units and joule's is one of them.
- Work =(Mass x Acceleration) / Distance
- Work is measured in the unit of joules/ distance.

Students will be skilled at…

- Differentiating among the various forms of energy and recognizing that they can be transformed from one form to others.
- Understanding the equations that are used as definitions in physics.

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

Windham School District Curriculum
Conceptual Physics and Chemistry: Engineering & Design

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

● HS-PS2-1: 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.
● HS-ETS1-1: Analyze a challenge to specify qualitative and quantitative criteria and constraints for solutions
● HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● The scientific process requires exact repetition of an experiment to ensure the same result will occur when a variable is tested.
● The engineering process requires the engineer to make changes in the design to determine if the change is valuable.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is the engineering process and how is it different from the scientific process?
● What do I need to change to make this work?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Qualitative data includes observations made that cannot be described by units or numbers i.e., color.
● Quantitative data includes observations made that can be described by using numbers and units.
● Criteria may need to be broken down into simpler ones that can be approached systematically , and decisions about the</td><td>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.
● Applying scientific ideas to solve a design problem, taking into account possible unanticipated effects
● Working collaboratively with a partner to solve a problem and engineer a solution.</td></tr>
</table>

	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. ● 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***
		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
Physical Earth-Space Science - Earth's Geological History

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards
HS-ESS1-5: 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.
HS-ESS1-6: 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.
HS-ESS2-1: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Create a Claim about how and why the continental plates drift and provide evidence and reasoning to this claim.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
The movement of continental and oceanic crust and the theory of plate tectonics is supported by evidence and can explain the age of crustal rocks.
Earth's formation and early history is constructed from evidence of ancient Earth materials, meteorites, and other planetary surfaces.
Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
How does evidence support the theory of plate tectonics?
How did Earth form and what is the evidence to support the theory?
What are the processes internally and on the surface?
that form continental and ocean-floor features?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Continental rock is generally much older than rocks of the ocean floor.
Objects in the solar system such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects provides information about Earth's formation and early history.</td><td>Students will be skilled at…
Evaluating evidence of the past and current movements of continental and oceanic crust.
Applying scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces.
Developing a model to illustrate Earth's internal and surface processes.</td></tr>
</table>

<table>
<tr><td></td><td>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 geologic history.
Plate tectonics are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth’s crust.
Spontaneous radioactive decay follows a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.</td><td></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>

Windham School District Curriculum
Physical Earth-Space Science - Weather and Climate

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

● HS-ESS2-2: Analyze geoscience data to make the claim that one change to earth's surface can create feedback that causes changes to other earth systems.
● HS-ESS2-4: Use a model to describe how variations in the flow of energy into and out of earth's systems result in changes in climate.
● HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
● HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
● HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Students will be able to forecast weather using given variables like temperature, air pressure and processes like the jet stream.
● Students will be able to determine a given biome using flora, fauna and wide-spread, long-term weather patterns.</td></tr>
<tr><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Weather is caused by an interplay of many factors.
● Weather describes the short-term changes in the atmosphere while climate describes the long-term weather patterns in a specific area.
● Storms are caused by interacting cold and warm air masses and pressure fronts.
● Ocean currents play a large role in impacting the climate in an area.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What regulates weather and climate?
● How are weather and climate different?
● What factors cause storms in the atmosphere?
● What role do ocean currents play in the weather?</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>Students will know…

● Weather is caused by an interplay between temperature, air pressure, humidity, dew points and fog.
● Changes in the atmospheric temperature causes changes in the atmospheric pressure and vice versa.
● Relative humidity measures the amount of water vapor in the atmosphere relative to the saturation point when it rains.</td><td>Students will be skilled at…

● Planning and conducting an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design.
● Analyzing 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.
● Designing or refining a solution to a complex real-world problem, based on scientific knowledge.</td></tr>
</table>

	- Climate can be used to describe the weather patterns for large areas which can be categorized as biomes. Biomes are depicted by weather patterns, types of flora and fauna present and the amount of precipitation. - There are a number of different types of storms with varying degrees of wind and precipitation. - Storms are caused by the interaction of cold air fronts dropping below warm air fronts. The drop in temperature causes a decrease in the amount of water vapor that the atmosphere can hold. - Thermohaline circulation causes the world's oceans to turn and brings warm water to cold parts of the world and vice versa. Changes in the thermohaline circulation would cause fluctuations in the world's climates.	

Used in Content Area Standards	***21st Century Skills***
not applicable	- Critical thinking - Communication skills - Creativity - Problem solving

Windham School District Curriculum
Physical Earth-Space Science - Earth's Interior

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

● **HS-ESS2-1:** Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales for continental and ocean-floor features.
● **HS-ESS2-3:** Develop a model based on evidence on Earth's interior to describe the cycling of matter by thermal convection.
● **HS-ESS2-7:** Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.</td><td colspan="2">***Transfer: Performance Expectations***</td></tr>
<tr><td colspan="2">***Students will be able to independently use their learning to…***

● Make a claim about how energy is transferred through Earth's interior and provide evidence and reasoning to support this claim.</td></tr>
<tr><td colspan="2">***Meaning***</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● A change to Earth's surface can create feedback that causes changes to other Earth systems.
● Matter is cycled in Earth's interior by thermal convection.
● Life on Earth coevolved with Earth's systems; as one changed so did the other.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What geoscience data supports the claim that a change in Earth's surface causes changes to other Earth systems?
● How is matter cycled in Earth's interior?
● How has life coevolved as Earth has changed?</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>***Students will know…***

● The Earth is composed of compositionally distinct layers which increase in temperature the closer they are to the center.
● Pressure from the mass of the Earth, combined with radioactive decay cause the increasing temperature of the Earth towards the center.
● Convection currents in the Earth's mantle cause the lithospheric plates to move around the globe.
● All of the Earth's continents were driven by convection towards one another and combined to create a supercontinent called Pangea.
● Modifications of the Earth's surface have influenced how life changed over time.</td><td>***Students will be skilled at…***

● Analyzing geoscience data to describe how a change in one of Earth's systems can create feedback and cause changes in other Earth systems.
● Developing a model to describe how matter is cycled in Earth's interior.
● Using evidence to develop an argument about how life has coevolved as Earth has changed.</td></tr>
</table>

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

Windham School District Curriculum

Physical Earth-Space Science - Properties of Water & the Water Cycle

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

● HS-PS1-3: 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.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Make predictions about how water will interact with the world by describing the emergent properties that are intrinsic to the substance.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Some properties of matter are based on the forces that exist between particles.
● Solubility is based upon the structure of the molecule.
● States of matter are based upon movement of individual particles in a substance.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Why do some substances dissolve in others and some do not?
● How do substances change as they change states of matter?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● The mathematical and diagrammatic difference between states of matter at the molecular level.
● The shape and composition of a molecule can be used to predict what it can dissolve or be dissolved in.
● Liquids that are polar are soluble in other polar liquids. Liquids that are nonpolar are soluble in nonpolar liquids. Polar liquid and nonpolar liquids are not soluble.</td><td>Students will be skilled at…

● Identifying types of solutions and solubility.
● Predicting acidity based on pH and the concentration of hydronium ions.
● Modeling solids, liquids, and gasses at the molecular level.
● Identifying the six phase changes.
● Modeling how forces between particles define the properties of a substance.</td></tr>
</table>

	• Water is a polar substance and is a tetrahedron. • Hydrogen bonding exists between polar molecules and therefore, liquids with hydrogen bonding exhibit different properties than those without. • Solutions are defined by their composition and concentration.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Creativity • Collaboration • Communication

Windham School District Curriculum
Physical Earth-Space Science - Astronomy and Light

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

● HS-ESS1-1: 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.
● HS-ESS1-2: 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.
● HS-ESS1-3: Communicate scientific ideas about the way stars, over their life cycles, produce elements.
● HS-ESS1-4: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Predict changes in the sky based on patterns caused by Earth's movement in the solar system.
● Predict the chemical makeup of a planet based on evidence gathered by a spectrometer.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● The matter of our world formed during the Big Bang and within the cores of stars.
● The sun has a life span and nuclear fusion in the sun's core releases energy that reaches Earth in the form of radiation.
● The motion of orbiting objects can be predicted.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is the role of nuclear fusion in a star and how does it play a role in a star's life cycle?
● What is the evidence for the big bang theory and how does it support the theory?
● Where do elements come from?
● How can the motion of orbiting objects be predicted?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● The composition and life cycles of stars.
● A star's composition, movement, and distance from Earth can be determined using the star's light spectra and brightness.
● The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gasses, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.</td><td>Students will be skilled at…

● Developing a model based on evidence to illustrate the life span of the sun and role of nuclear fusion in the sun's core.
● Constructing an explanation of the Big Bang theory.
● Communicating scientific ideas about the way stars produce elements.
● Using mathematical and computational representations to predict the motion of orbiting objects.</td></tr>
</table>

	• 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.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Communication skills • Creativity • Problem solving

Windham School District Curriculum
Astronomy: How Do We Measure Space?

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

● HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● HS-PS4-2: Evaluate questions about the advantages of using digital transmission and storage of information.
● HS-PS4-3: 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.
● HS-ESS1-4: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Explain how cultures through the ages have used celestial observations in structuring their lives.
● Use parallax to determine the distance to objects around them.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Phases, eclipses, and astronomical objects are used to structure our lives.
● Light travels in paths so that it can be detected.
● The small angle equation and the parallax equation are used to estimate distance to objects.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How does light travel so that humans can detect objects?
● How have phases, eclipses, and astronomical objects impacted human culture?
● How can the small angle equation and the parallax equation be used to estimate distances to objects?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● The phases of the moon, eclipses, and different astronomical objects.
● Light travels in straight paths and can only be detected if it enters our eye directly or reflects off of something.
● The definition of angular size and how to approximate the size of objects around them.
● The coordinate system used to identify the location of objects in the sky.</td><td>Students will be skilled at…

● Applying dimensional analysis for the appropriate unit conversion.
● Approximating the angular size of objects around them using hands and fingers.
● Collecting data and using the small angle approximation in determining distance.
● Using reference objects and plate scale to determine the sizes of astronomical objects in images.
● Using parallax to determine distances to objects.
● Using image processing software (SalsaJ, JS9) to determine size and distances from images with a reference object.</td></tr>
</table>

	• The relationship between distance, size, and angle. • Parallax is a perceived change in position.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Astronomy: How Do We Know About Objects and Events in Space?

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards
HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
HS-PS4-2: Evaluate questions about the advantages of using digital transmission and storage of information.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Explain light in terms of electromagnetic radiation and its properties.
Explain how we gather and measure different properties of light.
Explain how we use light to learn about objects.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Light is part of the electromagnetic spectrum and is defined by the range of frequencies, wavelengths, and photon energies.
Light can be modeled as photons; light comes from sources, it interacts with matter, and it can be detected using eyes, telescopes, and cameras.
Light can be used to learn about emission and reflection nebulae and other astronomical systems.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
How is the electromagnetic spectrum used to study astronomical events?
How do we detect objects in terms of sources of light, interactions of light with matter, and detectors of light?
How can light be used to learn about objects in the universe?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…
The definition of the electromagnetic spectrum as the range of frequencies of electromagnetic radiation and their respective wavelengths and photon energies.
The properties of light.</td><td>Students will be skilled at…
Identifying regions of the electromagnetic spectrum used to study astronomical events.
Using a model of light to explain brightness, diffraction, and atomic spectra.
Employing light curves and radial velocity to investigate binary stars and discover exoplanets.</td></tr>
</table>

	● Light can be modeled as a photon to explain how we detect objects in terms of sources, interactions, and detection. ● A moving wave source (Doppler) is used to explain red and blue shifts. ● How light is used to explain images of astronomical objects.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
Astronomy: How Did Space Begin and Will it End?

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

● HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● HS-PS4-2: Evaluate questions about the advantages of using digital transmission and storage of information.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Describe the life cycle of stars using the Hertzsprung-Russell diagram from protostar to main sequence to death.
● Explain the evolution of structure of the universe.
● Describe evidence for the expanding universe.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Stars have a predictable life cycle based upon a star's mass and density.
● A star's mass and density will determine the type of supernova that will occur and its outcome.
● There is a time-space continuum to describe how the universe is structured.
● There is evidence for an expanding universe.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do stars change over time?
● How does the universe change over time?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● Stars</td><td>Students will be skilled at…

● Employing light curves to investigate variable stars and supernovae.
● Stars have a life cycle starting with protostars, to the main sequence, to death.
● The mechanism of star death includes the role of mass and density and how they determine the type of supernova that</td></tr>
</table>

		will occur and whether it leads to a black hole, neutron star, or white dwarf. ● The evolution of structure in the universe. ● The evidence of the expanding universe including cosmic background radiation, galaxy motion, cepheid variables, and supernovae.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
MythBusters: Scientific Inquiry

Stage 1 Desired Results

<table>
<tr><td rowspan="5">ESTABLISHED GOALS:
NGSS Science Standards

● HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
● HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● How is the scientific method used to solve problems?
● What are the essential requirements for performing scientific inquiry?</td></tr>
<tr><td>Acquisition
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.
● Share your results.</td><td>Students will be skilled at…

● Formulating a hypothesis.
● Determining a procedure.
● Conducting an experiment.
● Identifying control and constants.
● 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.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
MythBusters: Biological Myths

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **HS-ETS1-3:** 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.

Transfer

Students will be able to independently use their learning to…

- Use sterile techniques to collect bacterial samples.
- Analyze bacterial growth as an estimate of bacterial populations.
- Use the scientific method to answer questions about human perception including vision, balance, hearing and direction.

Meaning

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.

ESSENTIAL QUESTIONS
Students will be able to answer…

- Is the 5-second rule valid?
- What is the dirtiest place in the school?
- Do instant hand sanitizers work as well as they claim?

Acquisition

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).

Students will be skilled at…

- Using the scientific method to determine and conduct appropriate tests.
- Quantitatively and qualitatively describe outcomes of tests
- Practicing safety in the science laboratory.
- Following experimental procedures.
- Recording observations.
- Planning and carrying out investigations.
- Analyzing and interpreting data.

	• 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.	• Constructing explanations (for science) and designing solutions (for engineering).
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
MythBusters: Forces in Solids and Fluids

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

● HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
● HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Constructing a Vortex cannon.
● Use the scientific method to construct a toroidal vortex.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Air masses can move in patterns that are unusual
● rotating fluids can maintain a form.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● 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?</td></tr>
<tr><td>Acquisition
Students will know…

● 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.
● Basic research skills</td><td>
Students will be skilled at…

● Using the scientific method to determine and conduct appropriate tests.
● Quantitatively and qualitatively describe outcomes of tests.
● Practicing safety in the science laboratory.
● Following experimental procedures.
● Recording observations.
● Planning and carrying out investigations.
● Analyzing and interpreting data.
● Constructing explanations (for science) and designing solutions (for engineering).</td></tr>
</table>

	• How to draw and utilize effective blueprint designs.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
MythBusters: Death Ray

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards
HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3: 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><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…
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…
Using the scientific method to determine and conduct appropriate tests.
Quantitatively and qualitatively describe outcomes of tests.
Practicing safety in the science laboratory.
Following experimental procedures.
Recording observations.
Planning and carrying out investigations.
Analyzing and interpreting data.
Constructing explanations (for science) and designing solutions (for engineering).</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
MythBusters: Build Challenge

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

● HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
● HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Build a structure (ex. duct-tape boat, paper airplane, spaghetti bridge, egg drop container)within the given constraints of the challenge.
● Follow the 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
Students will be able to answer…

● 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…

● 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.</td><td>Students will be skilled at…

● 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 a bridge using provided materials.
● Assess the strength of a bridge through testable means.</td></tr>
</table>

	• How to analyze flight path to determine where improvements can be made.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
AP Environmental Science: The Living World: Ecosystems

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** ENERGY TRANSFER (ENG) 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.
- **BIG IDEA 2:** INTERACTIONS BETWEEN EARTH SYSTEMS (ERT) The Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in ability to recover from disturbances.
- **BIG IDEA 3:** INTERACTIONS BETWEEN DIFFERENT SPECIES AND THE ENVIRONMENT (EIN) Humans alter natural systems and 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.
- **BIG IDEA 4:** SUSTAINABILITY (STB) Human survival depends on

Transfer: Performance Expectations

Students will be able to independently use their learning to…

- The ability to describe environmental processes and relationships within an environment is central to this unit.

Meaning: Crosscutting

ENDURING UNDERSTANDINGS
Students will understand that…

- Ecosystems are the result of biotic and abiotic interactions.
- Energy can be converted from one form to another.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How does energy change forms?
- How old is the water you drink?

Acquisition: DCI/SEP

Students will know…

- In a predator-prey relationship, the predator is an organism that eats another organism.
- A biome contains characteristic communities of plants and animals that result from, and are adapted to, its climate.
- Freshwater biomes include streams, rivers, ponds, and lakes. These freshwater biomes are a vital resource for drinking water.
- The carbon cycle is the movement of atoms and molecules containing the element carbon between sources and sinks.
- The nitrogen cycle is the movement of atoms and molecules containing the element nitrogen between sources and sinks.
- The phosphorus cycle is the movement of atoms and molecules containing the element phosphorus between sources and sinks.

Students will be skilled at…

- Explaining relationships between different characteristics of environmental concepts, processes, or models represented visually: § In theoretical contexts § In applied contexts.
- Calculating an accurate numeric answer with appropriate units.
- Describing characteristics of an environmental concept, process, or model represented visually.

developing practices that will achieve sustainable systems. A suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.	• The hydrologic cycle, which is powered by the sun, is the movement of water in its various solid, liquid, and gaseous phases between sources and sinks. • Primary productivity is the rate at which solar energy (sunlight) is converted into organic compounds via photosynthesis over a unit of time. • All ecosystems depend on a continuous inflow of high-quality energy in order to maintain their structure and function of transferring matter between the environment and organisms via biogeochemical cycles. • The 10% rule approximates that in the transfer of energy from one trophic level to the next, only about 10% of the energy is passed on. • A food web is a model of an interlocking pattern of food chains that depicts the flow of energy and nutrients in two or more food chains.	• Describing environmental concepts and processes.

Used in Content Area Standards	***21^{st} Century Skills***
not applicable	• Collaboration • Communication • Critical Thinking • Analyzing • Creativity

Windham School District Curriculum
AP Environmental Science: The Living World: Biodiversity

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

● BIG IDEA 1: ENERGY TRANSFER (ENG) 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.
● BIG IDEA 2: INTERACTIONS BETWEEN EARTH SYSTEMS (ERT) The Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in ability to recover from disturbances.
● BIG IDEA 3: INTERACTIONS BETWEEN DIFFERENT SPECIES AND THE ENVIRONMENT (EIN) Humans alter natural systems and 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.
● BIG IDEA 4: SUSTAINABILITY (STB) Human survival depends on developing practices that will achieve sustainable systems. A suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and</td>
<th colspan="2">Transfer: Performance Expectations</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Biodiversity, which includes genetic, species, and habitat diversity, is critically important to ecosystems.
● Biodiversity in ecosystems is a key component to sustaining life within the living world.</td></tr>
<tr><th colspan="2">Meaning: Crosscutting</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Ecosystems have structure and diversity that change over time</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Can an invasive species be considered a native species if it occupies a place for a long time?</td></tr>
<tr><th colspan="2">Acquisition: DCI/SEP</th></tr>
<tr><td>Students will know…

● Biodiversity in an ecosystem includes genetic, species, and habitat diversity
● There are four categories of ecosystem services: provisioning, regulating, cultural, and supporting.
● Island biogeography is the study of the ecological relationships and distribution of organisms on islands, and of these organisms’ community structures.
● Ecological tolerance refers to the range of conditions, such as temperature, salinity, flow rate, and sunlight that an organism can endure before injury or death results.
● Natural disruptions to ecosystems have environmental consequences that may, for a given occurrence, be as great as, or greater than, many human-made disruptions.</td><td>Students will be skilled at…

● Describing environmental concepts and processes.
● Identifying the author’s claim.
● Describing patterns or trends in data.
● Describing relationships among variables in data represented.
● Explaining patterns and trends in data to draw conclusions.</td></tr>
</table>

economic factors is vital to the development of solutions.	● Organisms adapt to their environment over time, both in short- and long-term scales, via incremental changes at the genetic level. ● There are two main types of ecological succession: primary and secondary succession.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical Thinking ● Analyzing ● Creativity

Windham School District Curriculum
AP Environmental Science: Introduction to Biodiversity

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** ENERGY TRANSFER (ENG) 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.
- **BIG IDEA 2:** INTERACTIONS BETWEEN EARTH SYSTEMS (ERT) The Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in ability to recover from disturbances.
- **BIG IDEA 3:** INTERACTIONS BETWEEN DIFFERENT SPECIES AND THE ENVIRONMENT (EIN) Humans alter natural systems and 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.
- **BIG IDEA 4:** SUSTAINABILITY (STB) Human survival depends on developing practices that will achieve sustainable systems. A

Transfer: Performance Expectations

Students will be able to independently use their learning to…

- Comparing trends and patterns in data helps to interpret experimental data in order to explain environmental changes that occur over time.
- Predicting short and long-term changes in an environment.

Meaning: Crosscutting

ENDURING UNDERSTANDINGS
Students will understand that…

- Populations change over time in reaction to a variety of factors.
- Human populations change in reaction to a variety of factors, including social and cultural factors.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How do changes in habitats influence changes in species over time?
- How is educational opportunity for women connected to human population changes?

Acquisition: DCI/SEP

Students will know…

- Specialist species tend to be advantaged in habitats that remain constant, while generalist species tend to be advantaged in habitats that are changing.
- K-selected species tend to be large, have few offspring per reproduction event, live in stable environments, expend significant energy for each offspring, mature after many years of extended youth and parental care, have long life spans/life expectancy, and reproduce more than once in their lifetime. Competition for resources in K-selected species' habitats is usually relatively high.
- Many species have reproductive strategies that are not uniquely r-selected or K-selected, or they change in different conditions at different times.

Students will be skilled at…

- Explaining environmental concepts and processes.
- Describing patterns or trends in data.
- Explaining patterns and trends in data to draw conclusions.
- Explain what the data implies or illustrates about environmental issues.
- Applying appropriate mathematical relationships to solve a problem, with work shown (e.g., dimensional analysis).

suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.	● A survivorship curve is a line that displays the relative survival rates of a cohort—a group of individuals of the same age—in a population, from birth to the maximum age reached by any one cohort member. There are Type I, Type II, and Type III curves. ● When a population exceeds its carrying capacity (carrying capacity can be denoted as K), overshoot occurs. There are environmental impacts of population overshoot, including resource depletion. ● Population growth is limited by environmental factors, especially by the available resources and space. ● Population growth rates can be interpreted from age structure diagrams by the shape of the structure. ● Total fertility rate (TFR) is affected by the age at which females have their first child, educational opportunities for females, access to family planning, and government acts and policies. ● Birth rates, infant mortality rates, and overall death rates, access to family planning, access to good nutrition, access to education, and postponement of marriage all affect whether a human population is growing or declining. ● The demographic transition refers to the transition from high to lower birth and death rates in a country or region as development occurs and that country moves from a preindustrial to an industrialized economic system. This transition is typically demonstrated through a four-stage demographic transition model (DTM).	● Explaining patterns and trends in data to draw conclusions.

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

Windham School District Curriculum
AP Environmental Science: Earth Systems and Resources

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

● BIG IDEA 1: ENERGY TRANSFER (ENG) 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.
● BIG IDEA 2: INTERACTIONS BETWEEN EARTH SYSTEMS (ERT) The Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in ability to recover from disturbances.
● BIG IDEA 3: INTERACTIONS BETWEEN DIFFERENT SPECIES AND THE ENVIRONMENT (EIN) Humans alter natural systems and 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.
● BIG IDEA 4: SUSTAINABILITY (STB) Human survival depends on developing practices that will achieve sustainable systems. A suitable combination of</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Students can practice analyzing and interpreting qualitative models and representations of environmental issues.
● Describing global maps and maps of plate boundaries is key to explaining the global changes that occur at plate boundaries.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Earth’s systems interact, resulting in a state of balance over time.
● Most of the Earth’s atmospheric processes are driven by input of energy from the sun.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How does energy from the sun influence the weather?
● How can earthquakes be predicted?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● Convergent boundaries can result in the creation of mountains, island arcs, earthquakes, and volcanoes.
● Soils are formed when parent material is weathered, transported, and deposited.
● Water holding capacity—the total amount of water soil can hold—varies with different soil types. Water retention contributes to land productivity and fertility of soils.
● The atmosphere is made up of major gasses, each with its own relative abundance.
● Global wind patterns primarily result from the most intense solar radiation arriving at the equator, resulting in density differences and the Coriolis effect.</td><td>Students will be skilled at…

● Explain how environmental concepts and processes represented visually relate to broader environmental issues.
● Identify a research method, design, and/or measure used.
● Describe an aspect of a research method, design, and/or measure used.
● Describe characteristics of an environmental concept, process, or model represented visually.</td></tr>
</table>

conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.	● Characteristics of a given watershed include its area, length, slope, soil, vegetation types, and divides with adjoining watersheds. ● Incoming solar radiation (insolation) is the Earth's main source of energy and is dependent on season and latitude. ● Weather and climate are affected not only by the sun's energy but by geologic and geographic factors, such as mountains and ocean temperature. ● El Niño and La Niña are phenomena associated with changing ocean surface temperatures in the Pacific Ocean. These phenomena can cause global changes to rainfall, wind, and ocean circulation patterns.	● Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: § In theoretical contexts § In applied contexts.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical Thinking ● Analyzing ● Creativity

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="6">ESTABLISHED GOALS:
College Board Big Ideas

● BIG IDEA 1: ENERGY TRANSFER (ENG) 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.
● BIG IDEA 2: INTERACTIONS BETWEEN EARTH SYSTEMS (ERT) The Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in ability to recover from disturbances.
● BIG IDEA 3: INTERACTIONS BETWEEN DIFFERENT SPECIES AND THE ENVIRONMENT (EIN) Humans alter natural systems and 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.
● BIG IDEA 4: SUSTAINABILITY (STB) Human survival depends on developing practices that will achieve sustainable systems. A</td>
<td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Identifying environmental problems (e.g., pollution, depletion of the ozone layer, global climate change).
● Thinking critically about the problem, and when evaluating a given solution, articulating its benefits and drawbacks.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● When humans use natural resources, they alter natural systems.
● Humans can mitigate their impact on land and water resources through sustainable use.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How does your use of natural resources impact the world?
● Why are sustainable practices difficult to implement?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● The tragedy of the commons suggests that individuals will use shared resources in their own self-interest rather than in keeping with the common good, thereby depleting the resources.
● Clearcutting can be economically advantageous but leads to soil erosion, increased soil and stream temperatures, and flooding.
● The Green Revolution started a shift to new agricultural strategies and practices in order to increase food production, with both positive and negative results. Some of these strategies and methods are mechanization, genetically</td>
<td>Students will be skilled at…

● Explaining environmental concepts and processes.
● Describe the author’s perspective and assumptions.
● Describing disadvantages, advantages, or unintended consequences for potential solutions.
● Making a claim that proposes a solution to an environmental problem in an applied context.
● Explaining what the data implies or illustrates about environmental issues.
● Describing disadvantages, advantages, or unintended consequences for potential solutions.</td></tr>
</table>

suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.	modified organisms (GMOs), fertilization, irrigation, and the use of pesticides. ● Agricultural practices that can cause environmental damage include tilling, slash and-burn farming, and the use of fertilizers. ● The largest human use of freshwater is for irrigation (70%). ● Spray irrigation involves pumping groundwater into spray nozzles across an agricultural field. This system is more efficient than flood and furrow irrigation, with only 1/4 or less of the water lost to evaporation or runoff. However, spray systems are more expensive than flood and furrow irrigation, and also require energy to run. ● One consequence of using common pest-control methods such as pesticides, herbicides, fungicides, rodenticides, and insecticides is that organisms can become resistant to them through artificial selection. Pest control decreases crop damage by pests and increases crop yields. ● Methods of meat production include concentrated animal feeding operations (CAFOs), also called feedlots, and free-range grazing. ● Overfishing has led to the extreme scarcity of some fish species, which can lessen biodiversity in aquatic systems and harm people who depend on fishing for food and commerce. ● As the more accessible ores are mined to depletion, mining operations are forced to access lower grade ores. Accessing these ores requires increased use of resources that can cause increased waste and pollution. ● Urbanization can lead to depletion of resources and saltwater intrusion in the hydrologic cycle.	

	• Ecological footprints compare resource demands and waste production required for an individual or a society. • Sustainability refers to humans living on Earth and their use of resources without depletion of the resources for future generations. Environmental indicators that can guide humans to sustainability include biological diversity, food production, average global surface. temperatures and CO2 concentrations, human population, and resource depletion. • Methods to increase water infiltration include replacing traditional pavement with permeable pavement, planting trees, increased use of public transportation, and building up, not out. • Integrated pest management (IPM) is a combination of methods used to effectively control pest species while minimizing the disruption to the environment. These methods include biological, physical, and limited chemical methods such as biocontrol, intercropping, crop rotation, and natural predators of the pests.	

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

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="5">ESTABLISHED GOALS:
College Board Big Ideas

● BIG IDEA 1: ENERGY TRANSFER (ENG) 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.
● BIG IDEA 2: INTERACTIONS BETWEEN EARTH SYSTEMS (ERT) The Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in ability to recover from disturbances.
● BIG IDEA 3: INTERACTIONS BETWEEN DIFFERENT SPECIES AND THE ENVIRONMENT (EIN) Humans alter natural systems and 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.
● BIG IDEA 4: SUSTAINABILITY (STB) Human survival depends on developing practices that will achieve sustainable systems. A</td>
<td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Identifying where natural energy resources occur (e.g., coal, crude oil, ores) on a global map.
● Describing other forms of energy and differentiating between nonrenewable and renewable forms of energy.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Humans use energy from a variety of sources, resulting in positive and negative consequences.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Why are fossil fuels the most widely used energy resources if they are nonrenewable?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP

Students will know…

● Nonrenewable energy sources are those that exist in a fixed amount and involve energy transformation that cannot be easily replaced.
● The use of energy resources is not evenly distributed between developed and developing countries.
● Wood is commonly used as fuel in the forms of firewood and charcoal. It is often used in developing countries because it is easily accessible.
● The global distribution of natural energy resources, such as ores, coal, crude oil, and gas, is not uniform and depends on regions’ geologic history.
● The combustion of fossil fuels is a chemical reaction between the fuel and oxygen that yields carbon dioxide and water and releases energy.

Students will be skilled at…

● Explain environmental concepts, processes, or models in applied contexts.
● Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: § In theoretical contexts § In applied contexts.
● Calculate an accurate numeric answer with appropriate units.
● Explain relationships between different characteristics of environmental concepts, processes, or models represented visually:
  ○ In theoretical contexts
  ○ In applied contexts</td></tr>
</table>

suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.	• Nuclear power is generated through fission, where atoms of Uranium-235, which are stored in fuel rods, are split into smaller parts after being struck by a neutron. Nuclear fission releases a large amount of heat, which is used to generate steam, which powers a turbine and generates electricity. • Burning of biomass produces heat for energy at a relatively low cost, but it also produces carbon dioxide, carbon monoxide, nitrogen oxides, particulates, and volatile organic compounds. The overharvesting of trees for fuel also causes deforestation. • Photovoltaic solar cells capture light energy from the sun and transform it directly into electrical energy. Their use is limited by the availability of sunlight. • Hydroelectric power can be generated in several ways. Dams built across rivers collect water in reservoirs. The moving water can be used to spin a turbine. Turbines can also be placed in small rivers, where the flowing water spins the turbine. • Geothermal energy is obtained by using the heat stored in the Earth's interior to heat up water, which is brought back to the surface as steam. The steam is used to drive an electric generator.	

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

Windham School District Curriculum
AP Environmental Science: Atmospheric Pollution

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

● BIG IDEA 1: ENERGY TRANSFER (ENG) 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.
● BIG IDEA 2: INTERACTIONS BETWEEN EARTH SYSTEMS (ERT) The Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in ability to recover from disturbances.
● BIG IDEA 3: INTERACTIONS BETWEEN DIFFERENT SPECIES AND THE ENVIRONMENT (EIN) Humans alter natural systems and 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.
● BIG IDEA 4: SUSTAINABILITY (STB) Human survival depends on developing practices that will achieve sustainable systems. A</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Comparing and predicting patterns and/or trends in a graph or table to explain how the data or representation illustrates environmental concepts.
● Drawing conclusions about an environmental concept based on a comparison of the patterns and trends in a graph or table.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Human activities have physical, chemical, and biological consequences for the atmosphere.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Where does air pollution go once it is airborne?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● Coal combustion releases air pollutants including carbon dioxide, sulfur dioxide, toxic metals, and particulates.
● Photochemical smog is formed when nitrogen oxides and volatile organic hydrocarbons react with heat and sunlight to produce a variety of pollutants.
● During a thermal inversion, the normal temperature gradient in the atmosphere is altered as the air temperature at the Earth's surface is cooler than the air at higher altitudes.</td><td>Students will be skilled at…

● Explaining modifications to an experimental procedure that will alter results.
● Describe relationships among variables in data represented.
● Explaining how environmental concepts and processes represented visually relate to broader environmental issues.
● Identifying a research method, design, and/or measure used.
● Using data and evidence to support a potential solution.</td></tr>
</table>

suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.	- CO2 appears naturally in the atmosphere from sources such as respiration, decomposition, and volcanic eruptions.Carbon monoxide is an indoor air pollutant that is classified as an asphyxiant. - Methods to reduce air pollutants include regulatory practices, conservation practices, and alternative fuels. - Acid rain and deposition is due to nitrogen oxides and sulfur oxides from anthropogenic and natural sources in the atmosphere. - Noise pollution is sound at levels high enough to cause physiological stress and hearing loss.	

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

Windham School District Curriculum
AP Environmental Science: Aquatic and Terrestrial Pollution

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

● BIG IDEA 1: ENERGY TRANSFER (ENG) 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.
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● BIG IDEA 4: SUSTAINABILITY (STB) Human survival depends on developing practices that will achieve sustainable systems. A</td>
<td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Think critically about an environmental problem and evaluate a given solution, articulating the benefits and drawbacks.
● Propose their own solutions to environmental problems.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Human activities, including the use of resources, have physical, chemical, and biological consequences for ecosystems.
● Pollutants can have both direct and indirect impacts on the health of organisms, including humans.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How does pollution impact your health?
● How can you decrease your waste?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● A point source refers to a single, identifiable source of a pollutant, such as a smokestack or waste discharge pipe.
● Organisms have a range of tolerance for various pollutants. Organisms have an optimum range for each factor where they can maintain homeostasis. Outside of this range, organisms may experience physiological stress, limited growth, reduced reproduction, and in extreme cases, death.
● Endocrine disruptors are chemicals that can interfere with the endocrine system of animals.
● Wetlands are areas where water covers the soil, either part or all of the time.
● Eutrophication occurs when a body of water is enriched in nutrients.</td>
<td>Students will be skilled at…

● Describing environmental concepts and processes.
● Applying appropriate mathematical relationships to solve a problem, with work shown (e.g., dimensional analysis).
● Describing potential responses or approaches to environmental problems.
● Identifying a testable hypothesis or scientific question for an investigation.</td></tr>
</table>

suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.	● Thermal pollution occurs when heat released into the water produces negative effects to the organisms in that ecosystem. ● Persistent organic pollutants (POPs) do not easily break down in the environment because they are synthetic, carbon-based molecules (such as DDT and PCBs). ● Bioaccumulation is the selective absorption and concentration of elements or compounds by cells in a living organism, most commonly fat-soluble compounds. ● Solid waste is any discarded material that is not a liquid or gas. It is generated in domestic, industrial, business, and agricultural sectors. ● Recycling is a process by which certain solid waste materials are processed and converted into new products. ● Primary treatment of sewage is the physical removal of large objects, often through the use of screens and grates, followed by the settling of solid waste in the bottom of a tank. ● Lethal dose 50% (LD50) is the dose of a chemical that is lethal to 50% of the population of a particular species. ● A dose response curve describes the effect on an organism or mortality rate in a population based on the dose of a particular toxin or drug. ● It can be difficult to establish a cause and effect between pollutants and human health issues because humans experience exposure to a variety of chemicals and pollutants. ● Pathogens adapt to take advantage of new opportunities to infect and spread through human populations.	● Explaining how environmental concepts and processes represented visually relate to broader environmental issues. ● Determining an approach or method aligned with the problem to be solved.

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

Windham School District Curriculum
AP Environmental Science: Global Change

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** ENERGY TRANSFER (ENG) 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.
- **BIG IDEA 2:** INTERACTIONS BETWEEN EARTH SYSTEMS (ERT) The Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in ability to recover from disturbances.
- **BIG IDEA 3:** INTERACTIONS BETWEEN DIFFERENT SPECIES AND THE ENVIRONMENT (EIN) Humans alter natural systems and 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.
- **BIG IDEA 4:** SUSTAINABILITY (STB) Human survival depends on developing practices that will achieve sustainable systems. A

Transfer: Performance Expectations

Students will be able to independently use their learning to…

- Describe and explain global changes in the environment, the causes of these changes, and their consequences.
- Describe and evaluate solutions, to propose their own solutions as they learn about problems caused by global changes in the environment.

Meaning: Crosscutting

ENDURING UNDERSTANDINGS
Students will understand that…

- Local and regional human activities can have impacts at the global level.
- The health of a species is closely tied to its ecosystem, and minor environmental changes can have a large impact.

ESSENTIAL QUESTIONS
Students will be able to answer…

- Why are laws created to protect endangered species?
- How can local human activities have a global impact?

Acquisition: DCI/SEP

Students will know…

- The stratospheric ozone layer is important to the evolution of life on Earth and the continued health and survival of life on Earth.
- Ozone depletion can be mitigated by replacing ozone-depleting chemicals with substitutes that do not deplete the ozone layer. Hydrofluorocarbons (HFCs) are one such replacement, but some are strong greenhouse gasses.
- The principal greenhouse gasses are carbon dioxide, methane, water vapor, nitrous oxide, and chlorofluorocarbons (CFCs).

Students will be skilled at…

- Describing environmental concepts and processes.
- Describing potential responses or approaches to environmental problems.
- Interpret experimental data and results in relation to a given hypothesis.
- Making a claim that proposes a solution to an environmental problem in an applied context.
- Using data and evidence to support a potential solution.

suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.	● Global climate change, caused by excess greenhouse gasses in the atmosphere, can lead to a variety of environmental problems including rising sea levels resulting from melting ice sheets and ocean water expansion, and disease vectors spreading from the tropics toward the poles. These problems can lead to changes in population dynamics and population movements in response. ● The Earth has undergone climate change throughout geologic time, with major shifts in global temperatures causing periods of warming and cooling as recorded with CO_2 data and ice cores. ● Ocean warming is caused by the increase in greenhouse gasses in the atmosphere. ● Ocean acidification is the decrease in pH of the oceans, primarily due to increased CO_2 concentrations in the atmosphere, and can be expressed as chemical equations. ● Invasive species are species that can live, and sometimes thrive, outside of their normal habitat. Invasive species can sometimes be beneficial, but they are considered invasive when they threaten native species. ● A variety of factors can lead to a species becoming threatened with extinction, such as being extensively hunted, having limited diet, being outcompeted by invasive species, or having specific and limited habitat requirements. ● HIPPCO (habitat destruction, invasive species, population growth, pollution, climate change, and over exploitation) describes the main factors leading to a decrease in biodiversity.	

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

Windham School District Curriculum
Anatomy & Physiology: Introduction to Anatomy & Physiology

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

● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● 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>
<tr><td>Students will know…

How to:
● Define anatomy and physiology and explain how the two areas of study are related.</td><td>Students will be skilled at…

● Using anatomical language to locate an object.
● Identifying the components of negative feedback loops that control variables in the body.</td></tr>
</table>

	• 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 rat 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.	• Locating organs in a human and rat and identifying how they work together.
Used in Content Area Standards		***21st Century Skills***
		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Anatomy & Physiology: The Skeletal System & Articulations

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

● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Distinguish between the axial and appendicular skeleton.
● Explain how bones change over a person’s lifetime due to environmental factors.
● 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
Students will be able to answer…

● 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>
<tr><td>Students will know…

● There are 206 bones in the adult skeleton, each with their own markings. These can be divided into axial and appendicular skeletons.</td><td>Students will be skilled at…

● 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 being able to identify these on bones/drawings.</td></tr>
</table>

	- 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 major anatomical areas of long bones. - Identifying the microscopic anatomy of osseous (bone) tissue. - Identifying and naming 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 identifying structural and functional differences between the three main types.
Used in Content Area Standards		***21st Century Skills***
not applicable		- One to one technology - Collaboration - Communication - Critical thinking - Creativity

Windham School District Curriculum
Anatomy & Physiology: Muscular System

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- **HS-LS1-3:** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Transfer

Students will be able to independently use their learning to…

- Discuss the effects of aerobic and resistance exercise on skeletal muscles.
- Describe the different types of skeletal muscles (prime mover, antagonist, synergist, fixator).
- Identify the muscles responsible for certain significant movements in the body.

Meaning

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.

ESSENTIAL QUESTIONS
Students will be able to answer…

- 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 systems work closely together to produce movement?

Acquisition

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

Students will be skilled a*t…*

- 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).

	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, muscles will continue to work until they enter oxygen debt, leading to muscle fatigue.	● 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.

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

Windham School District Curriculum
Anatomy & Physiology: Human Blood & Cardiovascular System

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

● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Define structure and function of blood and its common elements.
● Understand the way in which human ABO blood groups are determined and how they can be inherited.
● Describe the location of the heart in the body and identify its major anatomical areas and their functions 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 gasses, and other substances throughout the body.
● Blood is composed of nonliving fluid matrices (plasma) and formed elements (cells).
● Blood exerts pressure on blood vessels, and this pressure can be affected by many factors.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How does blood contribute to maintaining homeostasis in the human body?
● 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…

● 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 a nonliving fluid matrix (plasma) and formed elements (cells).</td><td>Students will be skilled at…

● Explaining the process by which blood cells are formed.
● Describing several homeostatic imbalances associated with blood and the effects each would have on the body (anemia, polycythemia, leukopenia, leukocytosis, etc).
● Applying the concepts and knowledge of genetics and ABO blood groups to perform a blood typing lab or simulation.</td></tr>
</table>

	• 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. • That capillaries are important sites of gaseous exchange with tissue cells. • The factors that affect heart physiology include height, weight, general health, emotions, medications, posture, etc.	• Tracing the pathway of blood through the heart, including all chambers, vessels, and valves. • Comparing the pulmonary and systemic circuits of blood flow. • Explain how the heart valves operate and what may occur when they do not operate properly. • Naming the elements of the intrinsic conduction system of the heart and explaining the pathway that electrical impulses follow through the heart. • Identifying 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. • Defining pulse and being able to locate the major pulse points.

Used in Content Area Standards	***21st Century Skills***
not applicable	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Anatomy & Physiology: Digestive System

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

● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
● 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.</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● 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
<table><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 rat, 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.</td></tr></table></td></tr>
</table>

	• 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 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

Windham School District Curriculum
Anatomy & Physiology: Nutrition & Body Metabolism

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

● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
● 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.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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><th colspan="2">Meaning</th></tr>
<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
Students will be able to answer…

● How does nutrition contribute to homeostasis?
● How does poor nutrition affect the other body systems?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

● 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.</td><td>Students will be skilled at…

● Defining nutrients and kilocalorie.
● Identifying the major nutrient categories and understanding the differences between them.
● Identifying important dietary sources of nutrients and their main cellular uses in the body.
● describing the factors that can affect enzyme function.
● Defining: enzyme, metabolism, anabolism, and catabolism.</td></tr>
</table>

	• 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.	• Describing the metabolic role of the liver. • Explaining the importance of energy balance in the body and predicting the consequences of energy imbalance.
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Anatomy & Physiology: Nervous System & Special Senses

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

● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
● 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.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● 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.
● 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
Students will be able to answer…

● 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 do the special senses work together with the nervous system?
● What are the effects of aging on the functioning of the special senses?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>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</td><td>Students will be skilled at…

● Explaining the functional and structural classification of the nervous system.
● Listing the major parts of the central nervous system and peripheral nervous system.</td></tr>
</table>

	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. ● 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.	● Summarizing the events that lead to the generation of a nerve impulse (action potentials) and its conduction from one neuron to another (synaptic transmission). ● Identifying and indicating the functions of major regions of the cerebral hemispheres, diencephalon, brain stem, and cerebellum on a human brain model, diagram, or sheep brain (dissection). ● Naming and describing the 3 meningeal layers and their functions. ● Tracing the pathway of light through the eye, to the retina, and then to the optic cortex of the brain. ● Describing common diseases and disorders and the effects of aging associated with the special senses. ● Explaining the effect of legal and illegal drugs on brain chemistry, especially those that affect the dopamine reward pathways in the brain.

	• 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.	

Used in Content Area Standards	***21st Century Skills***
not applicable	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Anatomy & Physiology: Endocrine System

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

● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● 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
Students will be able to answer…

● Why do we call the pituitary gland the “master gland?”
● How do the nervous and endocrine systems work together to maintain homeostasis?
● 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.
● That the production and secretion of hormones is influenced by other glands or</td>
<td>Students will be skilled at…

● Identifying on a model and/or diagram the location of the major glands of the endocrine system.
● Identifying on a model and/or diagram the organs of the male and female reproductive systems.</td></tr>
</table>

	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.	● Describing the steps in a hormone cascade, especially as they relate to the pituitary-hypothalamic axis. ● Describing numerous negative feedback mechanisms involving the endocrine system. ● Describing the effect of FSH and LH on the function of the testes and the ovaries. ● Describing the phases and events of the menstrual cycle, especially with respect to hormonal changes.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
STEAM PBL: Initial Design Process & Safety

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

● HS-ETS1-3: 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.
● HS-ETS1-2: 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><th colspan="2">Transfer: Performance Expectations</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Use the design process as presented (as a structured method) for approaching and developing solutions to a problem.
● Use the art and skill of brainstorming and begin to develop skills in graphically representing ideas through concept sketching and other methods of brainstorming.</td></tr>
<tr><th colspan="2">Meaning: Crosscutting</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● The nature of an initial problem may be clear and defined, but ultimately evolve into more complex or several new problems throughout the life of a project.
● A problem and subsequent solution(s) to that problem may be presented in different formats.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is the nature of a problem?</td></tr>
<tr><th colspan="2">Acquisition: DCI/SEP</th></tr>
<tr><td>Students will know…

● How to manage the complexity of a problem and identify possible solutions.
● How to research and evaluate existing technologies and apply them to their tasks/projects.
● How real world constraints may affect performance and outcomes.</td><td>Students will be skilled at…

● Designing 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>
</table>

Used in Content Area Standards	***21st Century Skills***
not applicable	● Critical thinking skills ● Problem solving ● Technology integration ● Collaboration

Windham School District Curriculum
STEAM PBL: Technical Drawing and Measurement

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Content Standards:
HS-ETS1-3: 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.
HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Develop an understanding of the purpose and practice of visual representations and communication within engineering in the form of technical sketching and drawing.
Build skill and gain experience in representing three-dimensional objects in two dimensions.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Technical drawings and representations allow students to communicate ideas accurately to their peers.
When using the correct technical drawing process, students essentially create a set of instructions that may be used to replicate the object they are mapping.
There is an appropriate use of perspective to communicate effectively.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
When are drawings helpful?
What view is most appropriate for this scenario and Why are various perspectives essential for communication?
Why are measurements essential for proper communication?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…
The specific drawing views (including isometric, oblique, perspective, and orthographic projections).
How to create specific drawing views using engineering grid paper
The appropriate use of drawing views.</td><td>Students will be skilled at…
Creating various technical representations used in visualization, exploring.
Communicating, and documenting design ideas throughout the design process.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	• Critical thinking skills • Problem solving • Technology integration • Collaboration

Windham School District Curriculum
STEAM - Introduction to CAD

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

● HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Plan 3-dimensional object designs in a 2-dimensional work space.
● Create engineering drawings (using accepted standards) to be used to easily transition into the CAD process and 3D print their CAD representation on a 3D printer.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● CAD is an essential tool within the broad scope of the engineering fields.
● By knowing the basics of this environment, this skill may serve them in their educational and career choices.
● CAD can be used as a powerful tool for communication.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is Computer-aided Design?
● What are the benefits of using this tool compared to technical drawing?
● How can this tool be used to communicate with others?
● What is a 3D printer and how does it work?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● How to create “regularly shaped objects” efficiently using CAD software.
● How to create and separate components within a design.
● The appropriate file type for creating, sharing, and printing.
● How to share files with colleagues/peers.</td><td>Students will be skilled at…

● Using a computer simulation and modeling tool to create a proposed solution to a problem or necessity.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	● Critical thinking skills ● Problem solving ● Technology integration ● Collaboration

Windham School District Curriculum
STEAM PBL - Advanced CAD

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

● HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Create irregularly shaped objects through the use of multiple sketches
● Collaborate and design in the digital workspace using OnShape’s cloud feature</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● CAD is an essential tool within the broad scope of the engineering fields.
● By knowing the more advanced features of this environment, students will be able to make deliberate efficient choices in their design process.
● Students will walk away with the knowledge to create “irregularly shaped” and complex objects efficiently.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do I create complex sketches?
● What is the difference between extrude and press/ pull?
● When is it beneficial to create a single component versus multiple components?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● How to create “irregularly shaped objects” efficiently using CAD software.
● How to properly use the following commands:
○ Sketch, Circular Pattern, Square Pattern, Trim, Fillet, Chamfer, Appearance, Thread, Scale, Assemble, Joint, Construct (Work planes), Insert Canvas, Insert Decal, Make (3D Print).
● They will learn how to modify existing designs, as well as modify specific components within designs.</td><td>Students will be skilled at…

● Using a computer simulation and modeling tool to create a proposed solution or multiple solutions to a problem or necessity.</td></tr>
</table>

Used in Content Area Standards	***21st Century Skills***
not applicable	● Critical thinking skills ● Problem solving ● Technology integration ● Collaboration

Windham School District Curriculum
STEAM PBL: Model Rocket Engineering and Design

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **HS-ETS1-3:** 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.

Transfer: Performance Expectations

Students will be able to independently use their learning to…

- Analyze commercial model rockets to understand and document the visual, functional, and/or structural aspects of its design.
- Create a unique prototype of the newly designed rocket and deliver a presentation of their product to the class.

Meaning: Crosscutting

ENDURING UNDERSTANDINGS
Students will understand that…

- Functional design elements are essential to a product's success/failure.
- Products are an amalgamation of different parts that have unique functions within the overall design.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How does the functional design of a rocket affect its efficiency?
- How do we objectively/subjectively assess the merits of a design?

Acquisition: DCI/SEP

Students will know…

- How to perform a visual analysis of a product.
- How to perform a functional analysis of a product.
- How to disassemble a product and record the various interacting parts.
- How to identify problems with the product's limitations.

Students will be skilled at…

- Designing a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- Working within the constraints of time and available materials.
- Using the visual and functional analysis of a product to assess the strengths and weaknesses of that product.
- Incorporating their own unique solutions into their design, in the hopes of improving upon it.

Used in Content Area Standards	*21st Century Skills*
not applicable	• Critical thinking skills • Problem solving • Technology integration • Collaboration

Windham School District Curriculum
STEAM PBL: Electronics and Circuit Design

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

● HS-ETS1-2: 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><th colspan="2">Transfer: Performance Expectations</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Utilize the engineering design process that can be used to guide the creation of circuits based on a set of design requirements.
● Design and build a launch control circuit for igniting model rocket engines.</td></tr>
<tr><th colspan="2">Meaning: Crosscutting</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Basic designs will be explored and incorporated into their own future designs.
● Resistance, current and voltage are measurements used in measuring electricity.
● Circuits and tools can be used for different applications.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is resistance?
● What is current?
● What is voltage?</td></tr>
<tr><th colspan="2">Acquisition: DCI/SEP</th></tr>
<tr><td>Students will know…

● Electrical circuits, voltage, current, resistance, series and parallel circuits, Ohm’s law, and how to use a digital multimeter to measure voltage.
● How to read and use basic circuit designs and measurement tools.
● How to correctly and effectively solder electrical connections.</td><td>Students will be skilled at…

● Designing simple circuit boards.
● Use of various measurement tools.
● Identifying values within Ohm’s law.
● Use of a soldering iron.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	● Critical thinking skills ● Problem solving ● Technology integration ● Collaboration with peers.

Windham School District Curriculum
Genetics: Inheritance

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

● HS-LS3-2: 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.
● HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Show the cause and effect relationship between parental and offspring traits.
● Create models that explain the role of genes in phenotype expression.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Phenotypic traits are determined from an organism's phenotype.
● Genotypic traits are inherited from an offspring's parents.
● Mutations can occur during reproduction; mutations can be beneficial or detrimental.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Where do our traits come from?
● Why do offspring resemble their parents?
● What happens when biological processes do not occur according to plan?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● Each parent cell passes identical genetic material to both daughter cells.
● 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.
● Chromosomes can sometimes swap sections during reproduction, thereby creating new genetic combinations and thus more genetic variation.</td><td>Students will be skilled at…

● Making and defending a claim based on evidence that genetic variations may result from mutations.
● Applying concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</td></tr>
</table>

	• DNA replication is tightly regulated and remarkably accurate, although errors do occur and result in mutations. • Environmental factors can also cause mutations in genes and viable mutations are inherited.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Genetics: DNA Structure and Function

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

● HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Model the role of DNA and chromosomes in coding the instructions for traits.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Characteristic traits are passed from parents to offspring.
● DNA codes instructions for chromosomes.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How can a chemical contain information?
● How can the function of DNA be explained by its structure?
● What are the consequences of changing the “genetic code”?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● Each chromosome consists of a single very long DNA molecule, and each gene on the molecule 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.</td><td>Students will be skilled at…

● Asking questions to clarify relationships about the role of DNA and chromosomes in coding instructions.</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>

Windham School District Curriculum
Genetics: Genetic Engineering

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

● HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Explain the ways in which science and engineering interact.
● Explain the ethics behind new technologies used in genetics and genomics.
● Create arguments about what is right or wrong in genetics.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Biotechnology has made it possible to utilize the same genetic code because all organisms use DNA.
● Technological advances have made it possible to treat certain genetic disorders and help infertile couples reproduce.
● The study of genetics in a medical setting creates a variety of ethical dilemmas.
● Bioethicists use an agreed set of principles to make decisions considering possible outcomes for all stakeholders in a scenario.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do science and engineering interact, and what are the results of this interaction?
● How are genetic materials manipulated and what are the results?
● What are the rights and responsibilities associated with new technologies related to the science of genetics and genomics?
● What defines “right” and “wrong”, and who gets to decide?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● Ethicists consider scenarios by applying a series of principles to each case.
● The principle of preserving life states that all life is precious and that all possible means should be taken to preserve it.</td><td>Students will be skilled at…

● Use models to represent a microscopic process at the macroscopic scale and develop explanations.
● Change and update existing models as new information becomes available.</td></tr>
</table>

	● Respecting autonomy makes sure that patients have the right to make decisions about their health care and whether or not they wish to receive treatment. ● Biotechnology is the alteration of cells or biochemicals to provide a useful product. It includes extracting natural products, altering an organism's genetic material, and combining DNA from different species. ● A transgenic organism has DNA from a different species in its genome. DNA from two sources is considered recombinant. ● Recombinant DNA technology is possible because of the universality of the genetic code. This technology has matured into a valuable method to produce useful proteins. ● Recombinant technology is used to make drugs, textiles, wood products, food and also used in the process of bioremediation. ● Gene targeting uses the natural attraction of a DNA sequence for its complementary sequence called homologous recombination, to swap one gene for another; it is more precise than transgenic technology. ○ Manipulation is done on an ES cell, which is then inserted into another embryo and transferred to a surrogate mother.	● Use laboratory protocols to introduce a new gene into a microorganism. ● Use evidence to create arguments about the benefits and risks associated with the creation of genetically modified organisms. ● Apply understanding of GMOs to authentic scenarios ● Predict the potential impact on an organism given a change in a specific DNA code, and provide specific real world examples of conditions caused by mutations. ● Identify stakeholders in an ethical conflict. ● Identify the values and bioethical principles that apply to each stakeholder in an ethical conflict.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
Infectious Diseases: How Infections Spread

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

● **HS-LS3-1:** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</td><td colspan="2">***Transfer: Performance Expectations***</td></tr>
<tr><td colspan="2">***Students will be able to independently use their learning to…***

● Model how diseases spread.
● Determine the properties of a microbe that impact infection</td></tr>
<tr><td colspan="2">***Meaning: Crosscutting***</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Infection spread can be modeled using an epidemiological triangle.
● Properties of infection determine how fast they spread.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are different methods for the spread of infections?
● How is the spread of an infection measured?</td></tr>
<tr><td colspan="2">***Acquisition: DCI/SEP***</td></tr>
<tr><td>***Students will know…***

● Infections can be modeled using a triangle composed of the host, the environment, and the agent.
● R_0 is the expected number of cases directly generated by one case in a population where all individuals are susceptible to infection.
● Microbe reproduction is dependent on environmental factors.
● Outbreaks are a sudden rise in the number of cases of a disease.</td><td>***Students will be skilled at…***

● Identifying outbreaks and determining where infections started.
● Measuring the number of bacteria present in different locations.
● Measuring how fast bacteria reproduce.</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>

Windham School District Curriculum
Infectious Diseases: Diseases

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

● HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Research aspects of a disease and how they impact humans.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● A disease can be described and studied from several angles.
● Diseases are caused by different types of infectious sources.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is needed to fully understand the causes of an infectious disease?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● Infectious diseases can be caused by viruses, bacteria, fungi, and protozoa.
● When an infectious disease was first identified and heard in a first person account.
● The symptoms and infection / recovery timeline of a variety of infectious diseases.
● The method of infection and infection / mortality rate of a variety of infectious diseases.
● The current status (cure/eradication, endemic/pandemic) of a variety of infectious diseases.</td><td>Students will be skilled at…

● Researching information about infectious diseases.</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>

Windham School District Curriculum
Course: STEM Seminar Unit: Stem Majors & Careers

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

● Create a college “hit list”
● Understand and optimize the net price for college
● Understand the value proposition associated with a college education

.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Identify potential education and career paths in STEM and develop an understanding of the resources available to move successfully in a desired direction.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Academic major selection is connected to career pathways.
● There are many ways for students to help pay for college.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What makes a “good” college?
● What careers are a good fit for me?
● How does one pay for a college education?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● How to Identify universities with notable academic majors that fall within that student’s academic performance at reach, target, and safety levels.
● Understand academic majors, course sequencing, and graduation requirements.
● Speak to WHS alum, in-person and on Zoom, to allay concerns about social and academic fitment.
● Speak to industry experts, in-person and on Zoom, to discuss careers pathways.
● Evaluate their skills sets and personal attributes in a methodical way using data analytics to match them up to possible career pathways (YouScience).</td><td>Students will be skilled at…

● Evaluating an acceptance package.
● Assessing career and academic fit.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Forensics: Introduction to Forensics & Fingerprinting

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

● HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
● HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Identify different types of evidence and the importance of making a case.
● Use proper procedures in collecting evidence.
● Maintain an evidence chain of custody.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Forensic Scientists use evidence to reconstruct the events of a crime.
● Fingerprints are unique to individuals and can be used as evidence in arguing which individuals were present at a crime scene.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do we catch and convict criminals?
● Can fingerprints identify a criminal with absolute certainty? What should be the standard of proof?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

Forensic Science Intro
● Testimonial Evidence is a witness statement.
● Physical Evidence is an object or material relevant to the crime.
● Class data can be used to narrow a suspect down to one person out of a large group of people based on known characteristics.
● Information at crime scenes must be gathered in a systematic way.

Fingerprints
● Anthropometry/Bertillon Method.</td>
<td>Students will be skilled at…

● Using an equation to calculate probability.
● Following procedures while investigating a crime scene.

Practices:
● Asking Questions and Defining Problems Ask questions that arise from examining models or a theory to clarify relationships.
● Analyzing and Interpreting Data Patterns.
● 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></tr>
</table>

	• Chemical methods for developing latent prints by reacting with the residue left by the finger to create a visible mark. Comparing Fingerprints • All fingerprints fit three basic patterns. • Probability is used to determine the likelihood that a fingerprint belongs to a certain individual by comparing it to population statistics.	• Obtaining, Evaluating, and Communicating Information. • Planning and Carrying Out Investigations. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence.
Used in Content Area Standards		***21st Century Skills***
		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Forensics: Hair, Fiber and Trace Evidence

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

● HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
● HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Perform chemical tests to analyze trace evidence and identify fibers and hair.
● Use statistical tools to construct likely explanations.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Class evidence such as hair and fiber is used to match individuals to crime scenes. Class evidence is not unique to individuals but is used with statistical analysis to place individuals at the crime scene.
● Hair can be used to analyze drugs and poisons.
● Fibers can be identified and characterized by chemical and physical properties.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Can class evidence alone identify a criminal? What other types of evidence may be helpful?
● What information can hair provide?
● How are fibers used to link suspects to the crime scene or to victims?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

Trace Evidence
● Trace evidence is any physical evidence that is too small to make physical matches but large enough to be analyzed. The use of qualitative analysis can be used to identify unknown powders.</td><td>Students will be skilled at…

● Perform tests to identify chemicals.
● Practice safety in the science laboratory.
● Analyze trace evidence from case studies and devise a plan to examine it in order to solve a crime.
● Use a compound microscope.
● Record observations.
● Make conclusions that will help to further students' investigations.</td></tr>
</table>

<table>
<tr>
<td></td>
<td>Hair Analysis

Based on the Locard Exchange Principle, hair (and other materials) can be directly transferred to other materials.
Hair can differ among individuals and animals based on texture, color and cuticle scale patterns.
Drugs and other chemicals can be deposited into hair through the blood system.

Fibers

Fibers can be identified using microscopes and by observing their chemical properties.
Certain properties of fibers help investigators determine its origins.

</td>
<td>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>

Windham School District Curriculum Template
Forensics: Blood Evidence & DNA Analysis

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

● HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
● HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Perform blood typing procedures for A, B, AB, O blood types.
● Explain blood spatter patterns and causes.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Blood spatter shapes and patterns can be used to interpret and reconstruct what happened at the crime scene.
● Differences in DNA sequences can be analyzed with biotechnology to provide statistically significant matches to an individual, used to identify or clear a suspect.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What can blood spatter patterns tell an investigator about a crime? How can these patterns be used to reconstruct a crime?
● What information can DNA tell us about an individual?
● In what ways can investigators use DNA evidence in a court of law?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

Blood Evidence
● Serology is the study of blood. Red blood cells have antigens on their surface.
● There are four blood types: A, B, AB and O. Humans have antibodies against antigens not present in our bodies.
● Blood-spatter evidence can be analyzed by calculating/observing various aspects.
● Forensic scientists use various methods to test for the presence of blood that includes the following tests:</td><td>Students will be skilled at…

● Gather and interpret measurements.
● Interpret graphs.
● Practice safety in the science laboratory.
● Follow experimental procedures.
● Record observations.
● Presumptive blood testing, luminol testing.
● Point of origin helps investigators to compare blood spatter evidence with testimonial evidence of witnesses and victims. Inconsistencies between the two can be determined.</td></tr>
</table>

	What is DNA? • DNA is found in the nuclei of living cells and is the genetic make-up of individuals. • Genes are portions of DNA which code for a specific protein which determine a specific trait. DNA is wound into a specific structure called chromosomes. DNA Analysis in Forensics • DNA Fingerprinting is a method used by investigators. • In cases where there is little DNA evidence at a crime scene, investigators can use the PCR technique to make more copies to work with.	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

Windham School District Curriculum
Forensics: Toxicology

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **HS-ETS1-3:** 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.

Transfer

Students will be able to independently use their learning to…

- Perform tests to identify chemicals.
- Explain Toxicity and dosage.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- The concentration of a substance determines its toxicity. The same substance may be helpful or harmful to a person, depending on the dose.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What makes a substance poisonous?

Acquisition

Students will know…

Poisons and the History of Toxicology
- The dosage of a substance determines whether it is poisonous and how poisonous it is.
- Elements of toxicology:
- Chemical and physical form of a substance
- How it enters the body.
- Body weight and the physiological conditions of the victim (age and sex).
- Time period of exposure.
- Presence of other chemicals in the body or in the dose.
- The lethal dose (LD50) is used to measure toxicity.
- Drugs and Crime.
- Drugs can affect the function and structure of living systems.

Students will be skilled at…

- Perform tests to identify chemicals.
- Compare and contrast legal issues to support an opinion and defend an argument.
- Practice safety in the science laboratory.
- Summarize drug analysis techniques using a case study.
- Read and interpret tables.
- Practice safety in the science laboratory.
- Use a case study to identify the connections between hair analysis and toxicology.

NGSS Practices
- Planning and carrying out investigations.
- Analyzing and interpreting data.
- Constructing explanations (for science) and designing solutions (for engineering).

	• The use and purchase of controlled drugs can lead to increased violence, crime and health and social problems.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Forensics: Handwriting Analysis

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

● HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
● HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Make a legal argument regarding reliability of handwriting evidence.
● Conduct chromatography tests to determine ink type.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Documents can be authenticated using specific unique and identifiable handwriting characteristics as well as the types of ink and paper and other artifacts from the creation process.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What does a person’s handwriting say about them?
● Can handwriting samples identify a person?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td></td><td>Students will know…

Document Evidence and Handwriting Analysis
● Handwriting samples show unique characteristics known as class characteristics and individual characteristics that help. investigators to use samples in a court of law.
● Handwriting experts examine twelve characteristics.
● Use handwriting analysis data to identify patterns.
● Collaborate with peers to perform an investigation.
Forgery
● There are three types of forgery: blind, simulated and traced.</td>
<td>Students will be skilled at…

● Design an experiment using the method of paper chromatography.
● Draw conclusions based on experimental evidence.
● Practice safety in the science laboratory.

NGSS Practices
● Planning and carrying out investigations.
● Analyzing and interpreting data.
● Constructing explanations (for science) and designing solutions (for engineering).</td></tr>
</table>

	• Forgeries include erasures of words or letters which are evident by examining the paper's surface. • Inks from suspected forgeries can be analyzed using the method of chromatography.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Forensics: Ballistics and Impressions

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards
HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Identify marks left by a variety of weapons, shoes and tires.
Use shoe and tire imprints to explain motion of the object.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Guns, tools, teeth, and other weapons leave unique microscopic impressions that can be analyzed and matched to reconstruct a crime scenario.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
What evidence from a gun can be left behind at a crime scene?
How would footprints be used to reconstruct a crime scene?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

Firearms
There are several types of firearms legal in our society such as handguns, rifles, shotguns and BB guns.
Bullets are identified by their caliber (diameter). The weight, dimensions, shape and type of bullet are considered class evidence.
The lands and grooves made on bullets that are rifled are known as class characteristics and can be used to identify weapons.
Tool marks and Other Impressions
Tools can be any object and are defined by the purpose for which the object is used.</td><td>Students will be skilled at…
Participate in class discussions.
Collaborate with peers to draw conclusions.
Gather and use information to solve problems.
Draw conclusions based on experimental evidence.
Practice safety in the science laboratory.
NGSS Practices
Planning and carrying out investigations.
Analyzing and interpreting data.
Constructing explanations (for science) and designing solutions (for engineering).</td></tr>
</table>

	• Both class and individual characteristics can be used to identify a tool used in a crime. • Tool marks are taken into the lab for examination or cast replicas are created. • Shoe Prints can be matched to a shoe using class evidence.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Engineering A - The Basics: Initial Design Process & Safety

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

● HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Use the design process as presented (as a structured method) for approaching and developing solutions to a problem.
● Identify risks associated with shop machinery and demonstrate proper use of equipment.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● The engineering design process is used to facilitate problem solving in engineering.
● Student actions create a safe or unsafe working environment in the shop.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is the nature of a problem and how do we solve it?
● How can we stay safe while working in the shop?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● Use the art and skill of brainstorming and begin to develop skills in graphically representing ideas through concept sketching and other methods of brainstorming.
● The nature of an initial problem may be clear and defined, but ultimately evolve into more complex or several new problems throughout the life of a project.
● Power tools should never be operated without an adult in the room.</td><td>Students will be skilled at…

● Designing a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● Working safely with classmates in a lab setting.</td></tr>
</table>

	• The safety of classmates through proper use of equipment is top priority.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking, • Problem solving • Technology integration • Collaboration

Windham School District Curriculum
Engineering A - The Basics: Technical Sketching and Drawing

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-ETS1-3:** 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.
- **HS-ETS1-4:** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Transfer: Performance Expectations

Students will be able to independently use their learning to…

- Develop an understanding of the purpose and practice of visual representations and communication within engineering in the form of technical sketching and drawing.
- Progress from creating freehand technical sketches using a pencil and paper to developing engineering drawings according to accepted standards and practices that allow for universal interpretation of their design.

Meaning: Crosscutting

ENDURING UNDERSTANDINGS
Students will understand that…

- Technical drawings and representations allow students to communicate ideas accurately to their peers.
- When using the correct technical drawing process, students essentially create a set of instructions that may be used to replicate the object they are mapping.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What makes a drawing help?
- What view is most appropriate for this scenario?
- Why are measurements essential for proper communication?

Acquisition: DCI/SEP

Students will know…

- The drawing views include isometric, oblique, and orthographic projections.
- How to create specific drawing views using engineering grid paper.
- There is an appropriate use of perspective to illustrate a design.
- How to measure objects and basic geometric shapes.

Students will be skilled at…

- Creating various technical representations used in visualization, exploring, communicating, and documenting design ideas throughout the design process.
- Creating perspective views using engineering grid paper.
- Developing models using technology that enhance drawings.

		• Analyzing Engineering drawings identifying details including dimensions, notes, perspective, and layouts.
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Problem solving • Technology integration • Collaboration

Windham School District Curriculum
Engineering A - The Basics: Product Innovation

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2:**Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **HS-ETS1-3:**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.

Transfer: Performance Expectations

Students will be able to independently use their learning to…

- Analyze a product or system in order to understand and document the visual, functional, and/or structural aspects of its design.
- Enhance the product by making improvements to the weaknesses identified in the design.
- Create a unique prototype of the newly designed product and deliver a presentation of their product to the class.

Meaning: Crosscutting

ENDURING UNDERSTANDINGS
Students will understand that…

- Visual design elements are essential to a product's success/failure.
- Products are an amalgamation of different parts that have unique functions within the overall design.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How does the visual design of a product affect its impact on consumers?
- How do parts function together?
- How do we objectively/subjectively assess the merits of a design?
- What is innovation within engineering?

Acquisition: DCI/SEP

Students will know…

- Performing a visual analysis of a product is part of the enhancement process.
- Functional analysis of a product is necessary for creating a unique prototype.
- How to reverse engineer a product to record the various interacting parts as a function of enhancing the product.

Students will be skilled at…

- Using the visual and functional analysis of a product to assess the strengths and weaknesses of that product.
- Analyzing a product design to conduct research on competitive products to enhance product.

	• Researching similar products to a product idea will enhance validity of the design.	• Creating a one-of-a-kind design item and creating production drawings. • Designing a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Used in Content Area Standards	***21st Century Skills***
not applicable	• Critical thinking • Problem solving • Technology integration • Collaboration

Windham School District Curriculum
Engineering A - The Basics: Introduction to Computer-aided Design (CAD)

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

● HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Understand the basic creation and completion of CAD files.
● Use 2D plans to build geometric representations of their objects.
● Produce basic CAD replications of designs and other regular objects to be 3D printed.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● There are mathematical principles behind Computer-aided Design.
● Engineering drawings (using accepted standards) can be used to easily transition into the CAD process.
● CAD is an essential tool within just about every industry.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are the benefits of using this tool compared to technical drawing?
● How can this tool be used to communicate with others?</td></tr>
<tr><td>Acquisition: DCI/SEP
Students will know…

● The math behind the drawing.
● how to read engineering drawings.
● Inventor basics in parts creation, drawing development, and assemblies (assembled and exploded).</td><td>Students will be skilled at…

● Print reading.
● Assembling a drawing sheet packet.
● Using CAD in Problem Solving.
● creating “regularly shaped objects” efficiently using CAD software.</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
● Problem solving
● Technology integration
● Collaboration</td></tr>
</table>

Windham School District Curriculum
Engineering B - Digital Design: Introduction to CAD

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards
HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</td>
<th colspan="2">Transfer: Performance Expectations</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Design and engineer a project with the following steps:
Plan 3-dimensional object designs in a 2-dimensional work space .
Use 2D plans to build physical representations of their objects.
Create engineering drawings (using accepted standards) to be used to easily transition into the CAD process.
Produce CAD replications of their designs and physical objects.
Export acceptable CAD files to be 3D printed.
3D print their CAD representation on a MakerBot (or other) 3D printer.</td></tr>
<tr><th colspan="2">Meaning: Crosscutting</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
CAD is an essential tool within the broad scope of the engineering fields.
By knowing the basics of this environment, this skill may serve them in their educational and career choices.
CAD can be used as a powerful tool for communication.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…
What are the benefits of using this tool compared to technical drawing?
How can this tool be used to communicate with others?</td></tr>
<tr><th colspan="2">Acquisition: DCI/SEP</th></tr>
<tr><td>Students will know…
Separate components within a design are necessary for CAD.</td>
<td>Students will be skilled at…
Using a computer simulation and modeling tool to create a proposed solution to a problem or necessity.</td></tr>
</table>

	2D models can be enhanced with 3D computer modeling. - Mathematical accuracy is important to product validity.	- Creating regularly shaped objects efficiently using CAD software. - Accurately creating and separating components within a design.
Used in Content Area Standards		***21st Century Skills***
not applicable		- Critical thinking - Problem solving - Technology integration - Collaboration

Windham School District Curriculum
Engineering B- Digital Design: Advanced CAD

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

● **HS-ETS1-4:** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem</td><td colspan="2">***Transfer: Performance Expectations***</td></tr>
<tr><td colspan="2">***Students will be able to independently use their learning to…***

● Create irregularly shaped objects through the use of multiple sketches and then improve upon original design.
● Collaborate and design in the digital workspace using CAD features.</td></tr>
<tr><td colspan="2">***Meaning: Crosscutting***</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● CAD is an essential tool within the broad scope of the engineering fields.
● Advanced features make deliberate efficient choices in designs.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● When is it beneficial to create a single component versus multiple components?
● How does CAD software illustrate math as a language?</td></tr>
<tr><td colspan="2">***Acquisition: DCI/SEP***</td></tr>
<tr><td>***Students will know…***

● How to create “irregularly shaped objects” efficiently using CAD software.
● How to properly use the following commands: Sketch, Circular Pattern, Square Pattern, Trim, Fillet, Chamfer, Appearance, Thread, Scale, Assemble, Joint, Construct (Work planes), Insert Canvas, Insert Decal.</td><td>***Students will be skilled at…***

● Using a computer simulation and modeling tool to create a proposed solution or multiple solutions to a problem or necessity.
● Modifying existing designs, as well as modify specific components within designs.</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
● Problem solving
● Technology integration
● Collaboration</td></tr>
</table>

Windham School District Curriculum
Engineering B- Digital Design: Reverse Engineering

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

● HS-ETS1-2:Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● NGSS Science Standards Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Analyze several different products (quadcopter drone, VEX robot, chess piece/board, or other complex system) in order to understand and document the visual, functional, and/or structural aspects of its design.
● Use their analysis to design and create several prototypes of the replicated system.
● Improve upon the original design with each subsequent prototype.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand…

● How to begin the analysis of somewhat complex systems (including minor electrical components).
● That the relationships between all of the functional design elements is key to understanding how the product works as a whole.
● That by deconstructing their product, they will gain insight into the major elements of its design, which will allow them to build and improve upon their own similar product.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How does a functional and visual analysis impact your opinion of a product?
● Can a user fully analyze a product without reverse engineering it?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● The visual, functional, and/or structural aspects of a design impact the overall user experience.</td><td>Students will be skilled at…

● Using a computer simulation and modeling tool to create a proposed solution to a problem or necessity.</td></tr>
</table>

	• Improving upon an original design presents opportunities and further potential problems. • Designs may become more or less complex with each subsequent prototype.	• Designing a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Problem solving • Technology integration • Collaboration

Windham School District Curriculum
Engineering B- Digital Design: Basic Robotics

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

● HS-ETS1-2: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><th colspan="2">Transfer: Performance Expectations</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Use simple robotic systems in the classroom to become real time problem solvers.
● Build basic mechanical robotic systems using the VEX EDR (Legacy), VEX V5, or comparable system.
● Build a robot which can be controlled by a human operator or run autonomously using the included VEX ARM® Cortex®-based Microcontroller and VEXnet Joystick.</td></tr>
<tr><th colspan="2">Meaning: Crosscutting</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Various engineering principles are applied in robotics.
● CAD and Robotics can be integrated seamlessly
● Basic robotic principles can be accessible by everyone.
● Robots need planning and design prior to building.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How are mechanical and electrical components interdependent?
● What are the benefits of plastic vs metal components?
● How can you produce missing components for a robot?</td></tr>
<tr><th colspan="2">Acquisition: DCI/SEP</th></tr>
<tr><td>Students will know…

● Designing a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</td><td>Students will be skilled at…

● How to build a basic mechanical robotic systems. using the VEX EDR (Legacy), VEX V5, or comparable system.
● How to build a robot which can be controlled by a human operator.
● How to properly use provided equipment and tools in a respectful yet engaging environment.</td></tr>
</table>

Used in Content Area Standards	***21st Century Skills***
not applicable	● Critical thinking ● Problem solving ● Technology integration ● Collaboration

Windham School District Curriculum
Engineering B- Digital Design: Basic Programming (Robotic)

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

● HS-ETS1-2:Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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.
● HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</td>
<td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Complete Basic programs using Robot Mesh Studio, VEX Coding Studio (or other comparable program).</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Programming, like CAD, allows students to work in a digital design space, be creative, and develop their problem solving skills.
● Learning a coding language and building functional code that controls a VEX playground setup.
● As the unit progresses, they will create and run code that allows for a robot to run autonomously through a challenge course.
● This progression will provide them with many challenges and opportunities to problem solve.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are autonomous robots?
● What are the benefits of using this tool compared to technical drawing?
● What limitations do our programs and robots have?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● How to create basic programming code using Blockly, Python, or C++ (or other comparable program).
● Use accepted standards and practices for developing robotic code using Robot Mesh studio, VEX Coding Studio, or comparable system.</td>
<td>Students will be skilled at…

● Using a computer simulation and modeling tool to create a proposed solution to a problem or necessity.</td></tr>
</table>

	• Program VEX EDR Cortex (or better) system to perform basic autonomous tasks in VEX "playground". • Program VEX Clawbot (or comparable system) to compete in a series of autonomous challenges.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Problem solving • Technology integration • Collaboration

Windham School District Curriculum
Engineering B- Digital Design: Design Team Challenge and Individual Project(s) - Application of Knowledge

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

● HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
● HS-ETS1-2:Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: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.
● HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Apply their knowledge from former units to create a product that will enhance the typical WHS classroom.
    ○ Constraints determined by teacher and through surveying school.
● Create, present and improve a prototype of their design using CAD software, VEX equipment, or other approved resources.
● Improve upon or invent something new to better society (teacher has final approval with project chosen).</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Creating solutions to a problem involves the use of the design process.
● A prototype of their design is a necessary component to the communication of their ideas.
● Improving upon or inventing something new requires the use of feedback.
● Design Team Challenge -
    ○ Students are given full (mostly) autonomy over their design.
    ○ They may explore whichever pathway they wish to pursue while still meeting the constraints of the project.
    ○ Improvements must be made upon a typical WHS classroom.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are the limitations of my project choices?
● What does feasibility mean and how does it relate to my project?
● What branches of engineering can be incorporated into my design?</td></tr>
</table>

<table>
<tr><td rowspan="3"></td><td>
<li style="list-style:none">
They are limited in the size and scope of their project, but have full control over the rest of their decisions.
Individual Project(s) -
They are given few constraints.
May pursue a project of their choice.
They must work individually or with one additional peer.
They have increased personal accountability.
</td><td></td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…
The use of feedback from their presentation is meant to inform decision making (group project).
The use of feedback from prior units and presentations is meant to inform their decision making (individual project).
How to communicate ideas effectively.
How to incorporate the use of mechanical, digital, and robotic engineering.
</td><td>Students will be skilled at…
Using a computer simulation and modeling tool to create a proposed solution to a problem or necessity.
Evaluating 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.
Analyzing 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.
</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
Problem solving
Technology integration
Collaboration
</td></tr>
</table>

Windham School District Curriculum
Honors Engineering Capstone - Skills Development

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

● HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device
● HS PS2-1: 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.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● 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
● Collaboration
● Communication
● Critical thinking
● Creativity</td></tr>
</table>

Windham School District Curriculum
Honors Engineering Capstone: Idea Development and Public Speaking

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

● HSPS4-2: Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
● HS-PS4-1: Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations
● HSPS4-5: 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).</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Define a problem and propose a preliminary solution.</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Not all problems are worth the effort to solve.
● Solutions take multiple iterations and usually involve input from many people.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● 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?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…

● Define a problem to solve.
● Prepare a preliminary design of a solution.
● Meet with industry mentors and receive technical feedback.</td><td>Students will be skilled at…

● Researching the aspects of a problem.
● Presenting preliminary ideas to industry mentors.
● Revising ideas to improve them.
● Preparing a formal presentation to “Shark Tank”.</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>

Windham School District Curriculum
Honors Engineering Capstone - Prototype Construction

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

● HS-PS3-4: 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 .</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● How can I find a technical solution to this problem?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>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.</td><td>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.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
AP Computer Science A: Primitive Types

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

● BIG IDEA 1: MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
● BIG IDEA 2: VARIABLES (VAR) Information used as a basis for reasoning, discussion, or calculation is referred to as data. Programs rely on variables to store data, on data structures to organize multiple values when program complexity increases, and on algorithms to sort, access, and manipulate this data. Variables create data abstractions, as they can represent a set of possible values or a group of related values.
● BIG IDEA 3: CONTROL (CON) Doing things in order, making decisions, and doing the same process multiple times are represented in code by using control structures and specifying the order in which instructions are executed. Programmers need to think algorithmically in order to define and interpret processes that are used in a program.
● BIG IDEA 4: IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand how our programs will be used and be responsible for the consequences.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Identify errors in program code.
● Apply the meaning of specific operators.
● Explain why a code segment will not compile or work as intended.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Some objects or concepts are so often represented that programmers can draw on existing tested code.
● To find specific solutions to generalizable problems, programmers include variables in their code so the same algorithm runs using different input values.
● The way variables and operators are sequenced and combined in an expression determines the completed result.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How can we use programs to solve problems?
● In what ways are numbers used in the programs and apps you use most often?
● How are mathematical concepts being used in the programs and apps you use most often?</td></tr>
<tr><td>Acquisition
Students will know…

● How to call System class methods to generate output to the console
● How to create string literals.
● How to identify the most appropriate data type category for a particular specification.
● How to declare variables of the correct types to represent primitive data.</td><td>Students will be skilled at…

● Determining the result or output based on statement execution order in a code segment without method calls.
● Determining code that would be used to complete code segments.
● Using primitive data types.</td></tr>
</table>

	• The way the compiler will evaluate arithmetic expressions in a program code. • The way the compiler will evaluate arithmetic expressions that use casting.	• Using compound, increment, and decrement operators correctly. • Describing the behavior of a given segment of program code. • Using casting operators to create a temporary value converted to a different data type.

Used in Content Area Standards	***21st Century Skills***
not applicable	• One to one technology • Collaboration • Communication • Critical thinking

Windham School District Curriculum
AP Computer Science A: Using Objects

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

● BIG IDEA 1: MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
● BIG IDEA 2: VARIABLES (VAR) Information used as a basis for reasoning, discussion, or calculation is referred to as data. Programs rely on variables to store data, on data structures to organize multiple values when program complexity increases, and on algorithms to sort, access, and manipulate this data. Variables create data abstractions, as they can represent a set of possible values or a group of related values.
● BIG IDEA 3: CONTROL (CON) Doing things in order, making decisions, and doing the same process multiple times are represented in code by using control structures and specifying the order in which instructions are executed. Programmers need to think algorithmically in order to define and interpret processes that are used in a program.
● BIG IDEA 4: IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand how our programs will be used and be responsible for the consequences.</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● 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.
● References.
● Java library classes.
● Creating random numbers.</td>
<td>Students will be skilled at…

● Converting from decimal to binary and binary to decimal.
● Explaining the value of a byte.
● Explaining how data is stored.</td></tr>
</table>

Used in Content Area Standards	***21st Century Skills***
not applicable	• One to one technology • Collaboration • Communication • Critical thinking

Windham School District Curriculum
AP Computer Science A: Boolean Expressions and If Statements

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
College Board Big Ideas
BIG IDEA 1: MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
BIG IDEA 2: VARIABLES (VAR) Information used as a basis for reasoning, discussion, or calculation is referred to as data. Programs rely on variables to store data, on data structures to organize multiple values when program complexity increases, and on algorithms to sort, access, and manipulate this data. Variables create data abstractions, as they can represent a set of possible values or a group of related values.
BIG IDEA 3: CONTROL (CON) Doing things in order, making decisions, and doing the same process multiple times are represented in code by using control structures and specifying the order in which instructions are executed. Programmers need to think algorithmically in order to define and interpret processes that are used in a program.
BIG IDEA 4: IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand how our programs will be used and be responsible for the consequences.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Students will understand how computers are connected into networks and the tradeoffs involved in building different types of networks.
Students will understand how computers are able to send information across a network using the internet protocols and routing.
Students will investigate and describe issues that contribute to the digital divide.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
The digital divide occurs worldwide.
The Internet is composed of multiple interconnected networks and devices.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
What is the digital divide?
What is a network?
How are networks important to the Internet?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
What the digital divide is.
What a network is and how it relates to the Internet.</td><td>Students will be skilled at…
Describing the digital divide.
Understanding what a network is.
Understanding how networks are related to the Internet.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
AP Computer Science A: Iteration

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

● BIG IDEA 1: MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
● BIG IDEA 2: VARIABLES (VAR) Information used as a basis for reasoning, discussion, or calculation is referred to as data. Programs rely on variables to store data, on data structures to organize multiple values when program complexity increases, and on algorithms to sort, access, and manipulate this data. Variables create data abstractions, as they can represent a set of possible values or a group of related values.
● BIG IDEA 3: CONTROL (CON) Doing things in order, making decisions, and doing the same process multiple times are represented in code by using control structures and specifying the order in which instructions are executed. Programmers need to think algorithmically in order to define and interpret processes that are used in a program.</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Students will explain how the use of computing can raise legal and ethical concerns.
● Students will describe the risks to privacy from collecting and storing personal data on a computer system.
● Students will explain how unauthorized access to computing resources happens and explore ways to prevent it.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Students will understand what big data is and how it is collected and stored.
● Students will examine the beneficial and harmful effects of computing.
● Students will learn about the various cyberattacks included: phishing, rogue access points, malware, and DDoS attacks.
● Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is big data and how is it collected?
● What is cybersecurity?
● What is a cyberattack?
● What are the effects of computing?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● What cybersecurity is and why it's necessary.
● What big data is.</td>
<td>Students will be skilled at…

● Understanding how and why to use antivirus and antimalware software.
● Understanding what big data is and how it is collected and used.</td></tr>
</table>

• **BIG IDEA 4:** IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand how our programs will be used and be responsible for the consequences.	• Iteration statements change the flow of control by repeating a set of statements zero or more times until a condition is met. • There are three parts in a for loop header: the initialization, the Boolean expression, and the increment. The increment statement can also be a decrement statement. • Nested iteration statements are iteration statements that appear in the body of another iteration statement. • A statement execution count indicates the number of times a statement is executed by the program.	• Writing program code to satisfy method specifications using expressions, conditional statements, and iterative statements. • Determining if two or more code segments yield equivalent results. • Determining code that would be used to complete code segments. • Determining the result or output based on statement execution order in a code segment without method calls (other than output).

Used in Content Area Standards	***21st Century Skills***
not applicable	• One to one technology • Collaboration • Communication • Critical thinking

Windham School District Curriculum
AP Computer Science A: Writing Classes

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
- **BIG IDEA 2:** VARIABLES (VAR) Information used as a basis for reasoning, discussion, or calculation is referred to as data. Programs rely on variables to store data, on data structures to organize multiple values when program complexity increases, and on algorithms to sort, access, and manipulate this data. Variables create data abstractions, as they can represent a set of possible values or a group of related values.
- **BIG IDEA 3:** CONTROL (CON) Doing things in order, making decisions, and doing the same process multiple times are represented in code by using control structures and specifying the order in which instructions are executed. Programmers need to think algorithmically in order to define and interpret processes that are used in a program.

Transfer

Students will be able to independently use their learning to…

- Apply a creative development process when creating computational artifacts.
- Collaborate in the creation of computational artifacts.
- Use computing tools and techniques for creative expressions.
- Develop an abstraction when writing a program.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Creative development can be an essential process for creating computations artifacts.
- A variety of abstractions built on binary sequences can be used to represent all data.
- Algorithms are precise sequences for instructions for processes that can be executed by a computer and are implemented using programming languages.
- Multiple levels of abstraction are used to write programs or create other computational artifacts.
- Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge or to solve problems.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How can computing and the use of computational tools foster creative expression?
- How can computational models and simulations help generate new understanding and knowledge?
- How are algorithms implemented and executed on computers and other computational devices?
- How are algorithms evaluated?
- How are computer programs developed and tested?
- 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?
- Why are some languages better than others when used to implement algorithms?
- Which mathematical and logical concepts are fundamental to computer programming?

<table>
<tr><td rowspan="2">

- **BIG IDEA 4:** IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand how our programs will be used and be responsible for the consequences.

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

Students will know…

- A computational artifact is something created by a human using a computer and can be a program, an image, a video, a presentation, or an audio file.
- A collaboratively created computational artifact reflects effort by more than one person.
- Effective collaborative teams practice interpersonal communication, consensus building, conflict resolution, and negotiation.
- 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.
- Different algorithms can be developed to solve the same problem.
- Collaboration can decrease the size and complexity of tasks required of individual programmers.
- Procedures are reusable programming abstractions.

</td><td>

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 different algorithms to solve the same problem.

</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

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

Windham School District Curriculum
AP Computer Science: Array

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

● BIG IDEA 1: MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
● BIG IDEA 2: VARIABLES (VAR) Information used as a basis for reasoning, discussion, or calculation is referred to as data. Programs rely on variables to store data, on data structures to organize multiple values when program complexity increases, and on algorithms to sort, access, and manipulate this data. Variables create data abstractions, as they can represent a set of possible values or a group of related values.
● BIG IDEA 3: CONTROL (CON) Doing things in order, making decisions, and doing the same process multiple times are represented in code by using control structures and specifying the order in which instructions are executed. Programmers need to think algorithmically in order to define and interpret processes that are used in a program.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Make decisions about which loop structure is most effective given the problem they are trying to solve.
● Identify and correct errors related to traversing and manipulating 1D array structures.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● To manage large amounts of data or complex relationships in data, programmers write code that groups the data together into a single data structure without creating individual variables for each value.
● Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How can programs leverage volcano data to make predictions about the date of the next eruption?
● How can knowing standard algorithms be useful when solving new problems?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● The use of array objects allows multiple related items to be represented using a single variable.
● Iteration statements can be used to access all the elements in an array. This is called traversing the array.</td><td>Students will be skilled at…

● Determining code that would be used to interact with completed program code.
● Writing program code to create, traverse, and manipulate elements in 1D array or ArrayList objects.
● Determining the result or output based on statement execution order in a code segment without method calls (other than output).</td></tr>
</table>

• **BIG IDEA 4:** IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand how our programs will be used and be responsible for the consequences.	• An enhanced for loop header includes a variable, referred to as the enhanced for loop variable. • There are standard array algorithms that utilize traversals to: § Shift or rotate elements left or right § Reverse the order of the elements. • Assigning a new value to the enhanced for loop variable does not change the value stored in the array.	• Identifying errors in program code. • Describing the initial conditions that must be met for a program segment to work as intended or described.

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

Windham School District Curriculum
AP Computer Science: ARRAYLIST

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
- **BIG IDEA 2:** VARIABLES (VAR) Information used as a basis for reasoning, discussion, or calculation is referred to as data. Programs rely on variables to store data, on data structures to organize multiple values when program complexity increases, and on algorithms to sort, access, and manipulate this data. Variables create data abstractions, as they can represent a set of possible values or a group of related values.
- **BIG IDEA 3:** CONTROL (CON) Doing things in order, making decisions, and doing the same process multiple times are represented in code by using control structures and specifying the order in which instructions are executed. Programmers need to think algorithmically in order to define and interpret processes that are used in a program.

Transfer

Students will be able to independently use their learning to…

- Consider the impact using ArrayList rather than an array has on the structure of their program code.
- Focus on the algorithm and ensuring that it will work in all situations rather than on an individual result.
- While programs are typically designed to achieve a specific purpose, they may have unintended consequences.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- To manage large amounts of data or complex relationships in data, programmers write code that groups the data together into a single data structure without creating individual variables for each value.
- Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values.

ESSENTIAL QUESTIONS
Students will be able to answer…

- Why is an ArrayList more appropriate for storing your music playlist, while an array might be more appropriate for storing your class schedule?
- How can we use statement execution counts to choose appropriate algorithms?
- What personal data is currently being collected, and how?

Acquisition

Students will know…

- An ArrayList object is mutable and contains object references.
- The ArrayList class is part of java. util package. An import statement can be used to make this class available for use in the program.

Students will be skilled at…

- Determine code that would be used to complete code segments.
- Write program code to create, traverse, and manipulate elements in 1D array or ArrayList objects.

• **BIG IDEA 4:** IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand how our programs will be used and be responsible for the consequences.	• Iteration statements can be used to access all the elements in an ArrayList. This is called traversing the ArrayList. • Some algorithms require multiple String, array, or ArrayList objects to be traversed simultaneously. • Sequential/linear search algorithms check each element in order until the desired value is found or all elements in the array or ArrayList have been checked. • Informal run-time comparisons of program code segments can be made using statement execution counts. • When using the computer, personal privacy is at risk. Programmers should attempt to safeguard personal privacy.	• Determine the result or output based on the statement execution order in a code segment containing method calls. • Explain how the result of program code changes, given a change to the initial code.

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

Windham School District Curriculum
AP Computer Science: 2D Array

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

● BIG IDEA 1: MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
● BIG IDEA 2: VARIABLES (VAR) Information used as a basis for reasoning, discussion, or calculation is referred to as data. Programs rely on variables to store data, on data structures to organize multiple values when program complexity increases, and on algorithms to sort, access, and manipulate this data. Variables create data abstractions, as they can represent a set of possible values or a group of related values.
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<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Determine the result of program code that traverses and manipulates the elements in a 2D array.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● To manage large amounts of data or complex relationships in data, programmers write code that groups the data together into a single data structure without creating individual variables for each value.
● Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Why might you want to use a 2D array to store the spaces on a game board or the pixels in a picture, rather than a 1D array or ArrayList?
● Why does the order in which elements are accessed in 2D array traversal matter in some situations?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● 2D arrays are stored as arrays of arrays. Therefore, the way 2D arrays are created and indexed is similar to 1D array objects.
● Nested iteration statements are used to traverse and access all elements in a 2D array. Since 2D arrays are stored as arrays of arrays, the way 2D arrays are traversed using for loops and enhanced for loops is similar to 1D array objects.</td>
<td>Students will be skilled at…

● Determining code that would be used to complete code segments.
● Writing program code to create, traverse, and manipulate elements in 2D array objects.
● Determining the result or output based on statement execution order in a code segment without method calls (other than output).
● Determining the number of times a code segment will execute.</td></tr>
</table>

• **BIG IDEA 4:** IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand how our programs will be used and be responsible for the consequences.	• When applying sequential/linear search algorithms to 2D arrays, each row must be accessed then sequential/linear search applied to each row of a 2D array.	• Using test-cases to find errors or validate results.

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

Windham School District Curriculum
AP Computer Science: Inheritance

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="5">ESTABLISHED GOALS:
College Board Big Ideas
BIG IDEA 1: MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
BIG IDEA 2: VARIABLES (VAR) Information used as a basis for reasoning, discussion, or calculation is referred to as data. Programs rely on variables to store data, on data structures to organize multiple values when program complexity increases, and on algorithms to sort, access, and manipulate this data. Variables create data abstractions, as they can represent a set of possible values or a group of related values.
BIG IDEA 3: CONTROL (CON) Doing things in order, making decisions, and doing the same process multiple times are represented in code by using control structures and specifying the order in which instructions are executed. Programmers need to think algorithmically in order to define and interpret processes that are used in a program.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Design hierarchies by listing the attributes and behaviors for each object and pulling common elements into a superclass, leaving unique attributes and behaviors in the subclass.
Write common program code one time, reducing potential errors and implementation time.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
When multiple classes contain common attributes and behaviors, programmers create a new class containing the shared attributes and behaviors forming a hierarchy. Modifications made at the highest level of the hierarchy apply to the subclasses.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
How might the use of inheritance help in writing a program that simulates crops being grown in a virtual world?
How does inheritance make programs more versatile?</td></tr>
<tr><td colspan="2">Acquisition
<table><tr><td>Students will know…
A class hierarchy can be developed by putting common attributes and behaviors of related classes into a single class called a superclass.
The superclass constructor can be called from the first line of a subclass constructor by using the keyword super and passing appropriate parameters.
Method overriding occurs when a public method in a subclass has the same method signature as a public method in the superclass.</td><td>Students will be skilled at…
Determining an appropriate program design to solve a problem or accomplish a task (not assessed).
Writing program code to define a new type by creating a class.
Describing the behavior of a given segment of program code.
Describing the initial conditions that must be met for a program segment to work as intended or described.
Determining code that would be used to interact with completed program code.</td></tr></table></td></tr>
</table>

• **BIG IDEA 4:** IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand how our programs will be used and be responsible for the consequences.	• The keyword super can be used to call a superclass's constructors and methods. • When a class S "is-a" class T, T is referred to as a superclass, and S is referred to as a subclass. • Utilize the Object class through inheritance. • The Object class is the superclass of all other classes in Java.	• Explaining why a code segment will not compile or work as intended.
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Communication skills • Creativity • Collaboration

Windham School District Curriculum
AP Computer Science: Recursion

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
College Board Big Ideas
BIG IDEA 1: MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
BIG IDEA 2: VARIABLES (VAR) Information used as a basis for reasoning, discussion, or calculation is referred to as data. Programs rely on variables to store data, on data structures to organize multiple values when program complexity increases, and on algorithms to sort, access, and manipulate this data. Variables create data abstractions, as they can represent a set of possible values or a group of related values.
BIG IDEA 3: CONTROL (CON) Doing things in order, making decisions, and doing the same process multiple times are represented in code by using control structures and specifying the order in which instructions are executed. Programmers need to think algorithmically in order to define and interpret processes that are used in a program.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Better understand how recursion works by spending time writing recursive methods.
Determine the result of recursive method calls.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
What real-world processes do you follow that are recursive in nature?
Why do programmers sometimes prefer using recursive solutions when sorting data in a large data set?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
A recursive method is a method that calls itself.
Data must be in sorted order to use the binary search algorithm.
The binary search algorithm starts at the middle of a sorted array or ArrayList and eliminates half of the array or ArrayList in each iteration until the desired value is found or all elements have been eliminated.
Binary search can be more efficient than sequential/linear search.</td><td>Students will be skilled at…
Determining code that would be used to complete code segments.
Describing the behavior of a given segment of program code.
Determining the result or output based on the statement execution order in a code segment containing method calls.
Determining the number of times a code segment will execute.</td></tr>
</table>

• **BIG IDEA 4:** IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand how our programs will be used and be responsible for the consequences.		
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Communication skills • Creativity • Collaboration

Windham School District Curriculum
AP/Honors Computer Science Principles: Intro to Computer Science

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** MODULARITY (MOD) Incorporating elements of abstraction, by breaking problems down into interacting pieces, each with their own purpose, makes writing complex programs easier. Abstracting simplifies concepts and processes by looking at the big picture rather than being overwhelmed by the details. Modularity in object-oriented programming allows us to use abstraction to break complex programs down into individual classes and methods.
- **BIG IDEA 3:** CONTROL (CON) Doing things in order, making decisions, and doing the same process multiple times are represented in code by using control structures and specifying the order in which instructions are executed. Programmers need to think algorithmically in order to define and interpret processes that are used in a program.

Transfer

Students will be able to independently use their learning to…

- Understand the benefits of collaboration.
- Understand the difference between hardware and software.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Collaboration is useful when working on large projects.
- A program's function and purpose are used to explain why the program is created and what problem is being solved.
- Hardware is physical, able to be touched.
- Software is used to perform a task or solve a problem.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What is collaboration and why use it?
- What is the difference between a program's function and its purpose?
- What is the difference between hardware and software?

Acquisition

Students will know…

- Collaboration allows for problems to be broken down into manageable parts.
- Describe a program's purpose and function.
- Identifying the hardware parts of a computer.

Students will be skilled at…

- Collaborating with others in order to complete a task.
- Describing a program's purpose and function.
- Disassembling and reassembling a computer.

Used in Content Area Standards	*21st Century Skills*
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
AP/Honors Computer Science Principles: Digital Information

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

BIG IDEA 2: DATA (DAT) Data are central to computing innovations because they communicate initial conditions to programs and represent new knowledge. Computers consume data, transform data, and produce new data, allowing users to create new information or knowledge to solve problems through the interpretation of those data. Computers store data digitally, which means that the data must be manipulated in order to be presented in a useful way to the user.
BIG IDEA 3: ALGORITHMS AND PROGRAMMING (AAP) Programmers integrate algorithms and abstraction to create programs for creative purposes and to solve problems. Using multiple program statements in a specified order, making decisions, and repeating the same process multiple times are the building blocks of programs. Incorporating elements of abstraction—by breaking problems down into interacting pieces, each with their own purpose—makes writing complex programs easier. Programmers need to think algorithmically and use abstraction to define and interpret processes that are used in a program.
BIG IDEA 5: IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand the potential impacts of our programs and be responsible for the

</td>
<th colspan="2">Transfer</th>
</tr>
<tr>
<td colspan="2">Students will be able to independently use their learning to…

Understand the size of a byte.
Convert binary to decimal and decimal to binary.
Understand how data is represented inside a computer and how it is stored.
Know the difference between data compression algorithms.

</td>
</tr>
<tr><th colspan="2">Meaning</th></tr>
<tr>
<td>ENDURING UNDERSTANDINGS
Students will understand that…

There are 8 bits in a byte.
Decimal is base 10 and Binary is base 2.
How to convert between decimal and binary.
There is a difference between data compression algorithms.
Computers store information/data in temporary memory for use in a running program.

</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

How many bits are in a byte?
What is the binary number system represented as?
What are the values of each bit in a byte?
How do computers store data for use in a program?

</td>
</tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr>
<td>Students will know…

How to read a byte and calculate the value in decimal.
Computers store complex information like numbers, text, images, and sound.
Data is stored as numbers (binary).

</td>
<td>Students will be skilled at…

Converting from decimal to binary and binary to decimal.
Explaining the value of a byte.
Explaining how data is stored.

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

consequences. As computer users, we need to understand any potential beneficial or harmful effects and how to protect ourselves and our privacy when using a computer.		
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
AP Computer Science Principles: The Internet

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 4:** COMPUTING SYSTEMS AND NETWORKS (CSN) Computer systems and networks are used to transfer data. One of the largest and most commonly used networks is the Internet. Through a series of protocols, the Internet can be used to send and receive information and ideas throughout the world. Transferring and processing information can be slow when done on a single computer, but leveraging multiple computers to do the work at the same time can significantly shorten the time it takes to complete tasks or solve problems.
- **BIG IDEA 5:** IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand the potential impacts of our programs and be responsible for the consequences. As computer users, we need to understand any potential beneficial or harmful effects and how to protect ourselves and our privacy when using a computer.

Transfer

Students will be able to independently use their learning to…

- Students will understand how computers are connected into networks and the tradeoffs involved in building different types of networks.
- Students will understand how computers are able to send information across a network using the internet protocols and routing.
- Students will investigate and describe issues that contribute to the digital divide.

Meaning

ENDURING UNDERSTANDINGS
Students will understand…

- The digital divide occurs worldwide.
- The Internet is composed of multiple. interconnected networks and devices.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What is the digital divide?
- What is a network?
- How are networks important to the Internet?

Acquisition

Students will know…

- What the digital divide is.
- What a network is and how it relates to the Internet.

Students will be skilled at…

- Describing the digital divide.
- Understanding what a network is.
- Understanding how networks are related to the Internet.

Used in Content Area Standards	***21st Century Skills***
not applicable	• One to one technology • Collaboration • Communication • Critical thinking

Windham School District Curriculum
AP Computer Science Principles: Big Data and Privacy

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

● BIG IDEA 4: COMPUTING SYSTEMS AND NETWORKS (CSN) Computer systems and networks are used to transfer data. One of the largest and most commonly used networks is the Internet. Through a series of protocols, the Internet can be used to send and receive information and ideas throughout the world. Transferring and processing information can be slow when done on a single computer, but leveraging multiple computers to do the work at the same time can significantly shorten the time it takes to complete tasks or solve problems.
● BIG IDEA 5: IMPACT OF COMPUTING (IOC) Computers and computing have revolutionized our lives. To use computing safely and responsibly, we need to be aware of privacy, security, and ethical issues. As programmers, we need to understand the potential impacts of our programs and be responsible for the consequences. As computer users, we need to understand any potential beneficial or harmful effects and how to protect ourselves and our privacy when using a computer.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Students will explain how the use of computing can raise legal and ethical concerns.
● Students will describe the risks to privacy from collecting and storing personal data on a computer system.
● Students will explain how unauthorized access to computing resources happens and explore ways to prevent it.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Students will understand what big data is and how it is collected and stored.
● Students will examine the beneficial and harmful effects of computing.
● Students will learn about the various cyberattacks included: phishing, rogue access points, malware, and DDoS attacks.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is big data and how is it collected?
● What is cybersecurity?
● What is a cyberattack?
● What are the effects of computing?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● What cybersecurity is and why it's necessary.
● What big data is.
● What the beneficial and harmful effect of computing is.</td><td>Students will be skilled at…

● Knowing how to avoid falling victim to cyberattacks.
● Understanding how and why to use antivirus and antimalware software.
● Understanding what big data is and how it is collected and used.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	• One to one technology • Collaboration • Communication • Critical thinking

Windham School District Curriculum
AP Computer Science Principles: Programming

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** CREATIVE DEVELOPMENT (CRD) When developing computing innovations, developers can use a formal, iterative design process or a less rigid process of experimentation. While using either approach, developers will encounter phases of investigating and reflecting, designing, prototyping, and testing. Additionally, collaboration is an important tool at any phase of development, because considering multiple perspectives allows for improvement of innovations.
- **BIG IDEA 2:** DATA (DAT) Data are central to computing innovations because they communicate initial conditions to programs and represent new knowledge. Computers consume data, transform data, and produce new data, allowing users to create new information or knowledge to solve problems through the interpretation of those data. Computers store data digitally, which means that the data must be manipulated in order to be presented in a useful way to the user.
- **BIG IDEA 3:** ALGORITHMS AND PROGRAMMING (AAP) Programmers integrate algorithms and abstraction to create programs for creative purposes

Transfer

Students will be able to independently use their learning to…

- Apply a creative development process when creating computational artifacts.
- Collaborate in the creation of computational artifacts.
- Use computing tools and techniques for creative expressions.
- Develop an abstraction when writing a program.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Creative development can be an essential process for creating computations artifacts.
- A variety of abstractions built on binary sequences can be used to represent all data.
- Algorithms are precise sequences for instructions for processes that can be executed by a computer and are implemented using programming languages.
- Multiple levels of abstraction are used to write programs or create other computational artifacts.
- Programs can be developed for creative expression, to satisfy personal curiosity, to create new knowledge or to solve problems.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How can computing and the use of computational tools foster creative expression?
- How can computational models and simulations help generate new understanding and knowledge?
- How are algorithms implemented and executed on computers and other computational devices?
- How are algorithms evaluated?
- How are computer programs developed and tested?
- 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?
- Why are some languages better than others when used to implement algorithms?
- Which mathematical and logical concepts are fundamental to computer programming?

<table>
<tr><td rowspan="2">and to solve problems. Using multiple program statements in a specified order, making decisions, and repeating the same process multiple times are the building blocks of programs. Incorporating elements of abstraction—by breaking problems down into interacting pieces, each with their own purpose—makes writing complex programs easier. Programmers need to think algorithmically and use abstraction to define and interpret processes that are used in a program.
● BIG IDEA 4: COMPUTING SYSTEMS AND NETWORKS (CSN) Computer systems and networks are used to transfer data. One of the largest and most commonly used networks is the Internet. Through a series of protocols, the Internet can be used to send and receive information and ideas throughout the world. Transferring and processing information can be slow when done on a single computer, but leveraging multiple computers to do the work at the same time can significantly shorten the time it takes to complete tasks or solve problems.</td><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

● A computational artifact is something created by a human using a computer and can be a program, an image, a video, a presentation, or an audio file.
● A collaboratively created computational artifact reflects effort by more than one person.
● Effective collaborative teams practice interpersonal communication, consensus building, conflict resolution, and negotiation.
● 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.
● Different algorithms can be developed to solve the same problem.
● Collaboration can decrease the size and complexity of tasks required of individual programmers.
● Procedures are reusable programming abstractions.</td><td>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 different algorithms to solve the same problem.</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>● One to one technology
● Collaboration
● Communication
● Critical thinking</td></tr>
</table>

Windham School District Curriculum
IT Essentials: Introduction to the Personal Computer

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Professional certification proves to employers that the certificate holder has gained a level of knowledge and experience that is confirmed by a respected third party. For example, the successful completion of CompTIA’s A+ exams demonstrates that the certificate holder has sufficient basic knowledge to work effectively in many different IT positions.
A personal computer is designed to run software programs that help people work, play and learn. This chapter discusses the hardware that is required to build a desktop computer. It covers the hardware components that are found in most personal computers. It explains the unique purpose of each component and how these components work together.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Identify the names, purposes and characteristics of all internal parts of a PC.
Explore the types of IT certifications available.
Describe a computer system.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
There are many different types of certifications available in the IT industry.
Each individual part in a PC has a job and how each part interacts with a system as a whole.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
What are the names, purposes and characteristics of computer cases, power supplies and other components of a P?
What is the purpose of thermal paste and canned air in computer repair?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
There are a number of IT industry certifications available and specific knowledge is required for each of them.
What the different parts of a PC are and how to identify them.</td><td>Students will be skilled at…
Explaining IT industry certifications.
Disassembling and reassembling a PC.
Identifying parts in a PC and their uses.</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</td></tr>
</table>

Windham School District Curriculum
IT Essentials: Safe Lab Procedures and Tool Use

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
This chapter discusses safe lab procedures, tool use for computer maintenance, and proper disposal of hazardous materials. It provides an overview of safe working conditions in the lab and in other environments. Basic electrical, fire, and chemical safety guidelines are covered, as well as other potential workplace hazards. Much of this chapter is devoted to identification and proper usage of hand tools and software tools. It also discusses the importance of organization of tools, and cleaning procedures for all computer components.
IT technicians have cut, burned, and even electrocuted themselves while working on computers. IT technicians have short-circuited working components, thus rendering the components unusable. This chapter is important because it explains the good work habits that all technicians must develop in order to avoid injury to themselves or others, and to avoid damaging or destroying equipment, or losing data.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Navigate hardware and software, operating systems, networking concepts, mobile devices, IT security, and troubleshooting.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
There are many tools that serve a multitude of purposes on helping a computer to function and working to ensure its safety.
Thermal paste and canned air are tools that are used in computer repair.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
What are the names, purposes and characteristics of computer cases, power supplies and other components of a PC?
What is the purpose of thermal paste and canned air in computer repair?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
Several different operating systems are available, considering the customer's needs and environment when choosing an OS is addressed.
The main steps in setting up a customer's computer include preparing the drive, installing the OS, creating user accounts, and configuring installation options.
Preventive maintenance techniques help to ensure optimal performance of the OS.
Backup strategies and recovery processes are covered.</td><td>Students will be skilled at…
Developing the skills required to correctly install Windows® operating systems.
installing, configuring, and troubleshooting an operating system.</td></tr>
</table>

	• The tools available for troubleshooting an OS problem include administrative tools, system tools, and CLI commands.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking

Windham School District Curriculum
AP Physics 1: Kinematics

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

● HS-PS2-1: 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.
● HS-PS2-2: 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.
● HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
● HS-PS2-4: Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and electrostatic forces between objects.
● HS-PS2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Convert Units and conduct a dimensional analysis.
● Solve One Dimensional Motion Problems – (Position, Velocity, Acceleration) using algebra.</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
Students will be able to answer…

● What is displacement?
● What is velocity and how is it different from 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
<table><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 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</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.
● 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.</td></tr></table></td></tr>
</table>

a changing magnetic field can produce an electric current. ● **HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. ● **HS-ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. .	an appropriate differential equation and solve it for *u* by separation of variables, correctly incorporating 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.	
Used in Content Area Standard		***21st Century Skills***
		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum Template
AP Physics 1: Newton's Laws of Motion

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards
HS-PS3-1: 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.
HS-PS3-2: 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 positions of particles (objects).
HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-PS3-4: 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).
HS-PS3-5: 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.
HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…
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.
Two Dimensional Force Problems (including Inclined Planes).
Friction.</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 on which they act, and state the magnitude and direction of each force.</td></tr>
</table>

• **HS-ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. • **HS-ETS1-3:** 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.		• 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

Windham School District Curriculum
AP Physics 1: Work, Energy, Power and Conservation Laws

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

● HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information.
● HS-PS4-3: 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.
● HS-PS4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
● HS-PS4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Momentum.
● Energy.
● Work and Power.
● Collisions.
● Conservation.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is Energy? And What are the types of Energy?
● How is energy transformed to other objects?
● What is momentum, Conservation and a Collision?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Impulse and Momentum.
● Linear Momentum.
● Conservation of Linear Momentum in an elastic and inelastic collision.
● 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.</td><td>Students will be skilled at…

Impulse and Momentum.
● Relating impulse to the change in linear momentum and the average force acting on an object.
● Calculating the area under a force versus time graph and relate it to the change in momentum of an object.
● Identifying situations in which linear momentum, or a component of the linear momentum vector, is conserved.
● Applying linear momentum conservation to one-dimensional elastic and inelastic collisions and two-dimensional completely inelastic collisions.
Conservation of energy</td></tr>
</table>

transmit and capture information and 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.	• Applying conservation of energy in analyzing the motion of systems of connected objects, such as an Atwood's machine. • Applying conservation of energy in analyzing the motion of objects that move under the influence of springs. Power • Calculating the power required to maintain the motion of an object with constant acceleration. • Calculating 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

Windham School District Curriculum
AP Physics 1: Gravitation and Circular Motion

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

● HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information.
● HS-PS4-3: 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.
● HS-PS4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
● HS-PS4-5: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● 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>

<table>
<tr><td rowspan="2"></td><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

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.
</td>
<td>Students will be skilled at…

Circular motion and rotation .
Uniform circular motion:

Relating the radius of the circle and the speed or rate of revolution of the particle to the magnitude of the centripetal acceleration.
Determining the components of the velocity and acceleration vectors at any instant, and sketch or identify graphs of these quantities.
Analyzing 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.

Newton’s law of gravity

Determining the force that one spherically symmetrical mass exerts on another.
Determining the strength of the gravitational field at a specified point outside a spherically symmetrical mass.
Describing the gravitational force inside and outside a uniform sphere, and calculating how the field at the surface depends on the radius and density of the sphere.
</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>

Windham School District Curriculum
AP Physics 1: Simple Harmonic Motion, Waves, and Sound

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

● HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information.
● HS-PS4-3: 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.
● HS-PS4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
● HS-PS4-5: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● 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.</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>

	• Construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force. • 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. • 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 calculating 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

Windham School District Curriculum
AP Physics 1: Electrostatics and Simple Electric Circuits

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-PS4-1:** Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
- **HS-PS4-2:** Evaluate questions about the advantages of using a digital transmission and storage of information.
- **HS-PS4-3:** 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.
- **HS-PS4-4:** Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
- **HS-PS4-5:** 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.

Transfer

Students will be able to independently use their learning 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.

Meaning

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.

ESSENTIAL QUESTIONS
Students will be able to answer…

- 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?

Acquisition

Students will know…

- Connect the concepts of gravitational force and electric force to compare similarities and differences between the forces.
- 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.

Students will be skilled at…

- Using Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges.
- 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.

	● 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.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
AP Physics C: Mechanics - Kinematics

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** CHANGE (CHA) Interactions produce changes in motion
- **BIG IDEA 2:** FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.
- **BIG IDEA 3:** FIELDS (FLD) Fields predict and describe interactions.
- **BIG IDEA 4:** CONSERVATION (CON) Conservation laws constrain interactions.

Transfer

Students will be able to independently use their learning 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.

Meaning

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.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What is displacement?
- What is velocity and how is it different from 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?

Acquisition

Students will know…

- Units, conversions, dimensional analysis.
- One Dimensional Motion – (Position, Velocity, Acceleration) Students should understand the general relationships among position, velocity, and acceleration for the motion of a particle along a straight line.
- Students should understand the special case of motion with constant acceleration.

Students will be skilled at…

- How to express the motion of an object using narrative, mathematical, and graphical representations.
- Designing an experimental investigation of the motion of an object.
- Analyzing 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.

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

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, correctly incorporating 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.

</td><td></td></tr>
<tr><th colspan="2">Used in Content Area Standard</th><th>21st Century Skills</th></tr>
<tr><td colspan="2"></td><td>

Collaboration
Communication
Critical thinking
Creativity

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

Windham School District Curriculum Template
AP Physics C: Mechanics - Newton’s Laws of Motion

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
College Board Big Ideas
BIG IDEA 1: CHANGE (CHA) Interactions produce changes in motion
BIG IDEA 2: FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.
BIG IDEA 3: FIELDS (FLD) Fields predict and describe interactions.
BIG IDEA 4: CONSERVATION (CON) Conservation laws constrain interactions.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…
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.
Connected objects.
Two Dimensional Force Problems (including Inclined Planes).
Friction.</td><td>Students will be skilled at…
Solving problems in which application of Newton’s laws leads to two or three simultaneous linear equations involving unknown forces or accelerations.
Linearizing data and/or determining a best fit line or curve.
Demonstrating consistency between different types of representations of the same physical situation.</td></tr>
</table>

Used in Content Area Standards	*21st Century Skills*
not applicable	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
AP Physics C: Mechanics - Work, Energy, Power

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

● BIG IDEA 1: CHANGE (CHA) Interactions produce changes in motion
● BIG IDEA 2: FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.
● BIG IDEA 3: FIELDS (FLD) Fields predict and describe interactions.
● BIG IDEA 4: CONSERVATION (CON) Conservation laws constrain interactions.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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.</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
Students will be able to answer…

● 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>Students will know…

● Weight / Mass.
● Newton's Laws.
● One Dimensional Force Problems.
● Connected objects.
● Two Dimensional Force Problems (including Inclined Planes).
● Friction.</td><td>Students will be skilled at…

● Selecting and plot appropriate data.
● Solve problems in which application of Newton's laws leads to two or three simultaneous linear equations involving unknown forces or accelerations.
● Extracting quantities from narratives or mathematical relationships to solve problems.</td></tr>
</table>

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

Windham School District Curriculum
AP Physics C: Mechanics - Gravitation and Circular Motion

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

● BIG IDEA 1: CHANGE (CHA) Interactions produce changes in motion
● BIG IDEA 2: FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.
● BIG IDEA 3: FIELDS (FLD) Fields predict and describe interactions.
● BIG IDEA 4: CONSERVATION (CON) Conservation laws constrain interactions.</td><th colspan="2">Transfer</th></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><th colspan="2">Meaning</th></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
Students will be able to answer…

● 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>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>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.</td><td>Students will be skilled at…

Circular motion and rotation
● Relating the radius of the circle and the speed or rate of revolution of the particle to the magnitude of the centripetal acceleration.</td></tr>
</table>

	● Angular Velocity. ● Angular Displacement. ● Gravitational Force between objects.	● Determining the components of the velocity and acceleration vectors at any instant, and sketch or identify graphs of these quantities. ● Determining the force that one spherically symmetrical mass exerts on another. ● Determining the strength of the gravitational field at a specified point outside a spherically symmetrical mass. ● Describing the gravitational force inside and outside a uniform sphere, and calculating 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

Windham School District Curriculum
AP Physics C: Mechanics - Simple Harmonic Motion and Waves

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS:
College Board Big Ideas

● BIG IDEA 1: CHANGE (CHA) Interactions produce changes in motion
● BIG IDEA 2: FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.
● BIG IDEA 3: FIELDS (FLD) Fields predict and describe interactions.
● BIG IDEA 4: CONSERVATION (CON) Conservation laws constrain interactions.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● 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.</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>

	• 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.	• 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	• Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
AP Physics C: Electricity and Magnetism - Electrostatics

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

● BIG IDEA 1: CHANGE (CHA) Interactions produce changes in motion
● BIG IDEA 2: FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.
● BIG IDEA 3: FIELDS (FLD) Fields predict and describe interactions.
● BIG IDEA 4: CONSERVATION (CON) Conservation laws constrain interactions.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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><th colspan="2">Meaning</th></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
Students will be able to answer…

● How is gravitational force similar to electrical force, and in what ways are these forces very different?</td></tr>
<tr><th colspan="2">Acquisition</th></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 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.</td><td>Students will be skilled at…

● Making predictions about the interaction between two electric point charges using Coulomb’s Law.
● Analyzing the motion of a particle of specified charge under an electrostatic force.
● Calculating the electrical work done on a charge
● Determine the speed of a charge that moves through a specified potential difference.
● Determining the direction and approximate magnitude of the electric field at various positions given a sketch of equipotentials.</td></tr>
</table>

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

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.

</td><td>

Calculating the potential difference between two points in a uniform electric field, and state which point has a higher potential.
Calculating how much work is required to move a test charge from one location to another in the field of fixed point charges.
Calculating the electrostatic potential energy of a system of two or more point charges, and calculating how much work is required to establish the charge system.
Using integration to determine electric potential difference between two points on a line.
Calculating the flux of an electric field over a Gaussian surface and perpendicular to it.
Calculating the flux of electric field through a rectangle when the field is perpendicular to the rectangle and a function of one coordinate only.
Using the principle of superposition to calculate by integration the electric field of a straight, uniformly charged wire.
Calculating the electric potential on the axis of a uniformly charged disk.
Deriving expression for electric potential as a function of position.

</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>

Windham School District Curriculum
AP Physics C: Electricity & Magnetism - Conductors, Capacitors & Dielectrics

Stage 1 Desired Results

<table>
<tr><td rowspan="5">
ESTABLISHED GOALS:

College Board Big Ideas

BIG IDEA 1: CHANGE (CHA) Interactions produce changes in motion

BIG IDEA 2: FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.

BIG IDEA 3: FIELDS (FLD) Fields predict and describe interactions.

BIG IDEA 4: CONSERVATION (CON) Conservation laws constrain interactions.
</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">
Students will be able to independently use their learning 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
Students will be able to answer…

● How can electric fields be changed to serve different purposes?
</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td></td><td>
Students will know…

Electrostatics with conductors
● 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
</td><td>
Students will be skilled at…

Electrostatics with conductors
● Showing 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 .
● Describing and sketching a graph of the electric field and potential inside and outside a charged conducting sphere.

Capacitors
● Relating 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.
</td></tr>
</table>

	by a single conductor, and recognize the 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: ● Describe the electric field inside eachDielectrics 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.	● Deriving and applying expressions for the energy stored in a parallel-plate capacitor and for the energy density in the field between the plates. ● Analyzing 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. ● Understanding cylindrical and spherical capacitors, so they can derive an expression for the capacitance of each. ● Analyzing situations in which a dielectric slab is inserted between the plates of a capacitor.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum

AP Physics C: Electricity and Magnetism - Electric Circuits

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

● BIG IDEA 1: CHANGE (CHA) Interactions produce changes in motion
● BIG IDEA 2: FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.
● BIG IDEA 3: FIELDS (FLD) Fields predict and describe interactions.
● BIG IDEA 4: CONSERVATION (CON) Conservation laws constrain interactions.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● 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 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</td><td>Students will be skilled at…

● Relating current and voltage for a resistor.
● Deriving 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.
● Deriving expressions that relate the current, voltage and resistance to the rate at which heat is produced when current passes through a resistor.
● Applying the relationships for the rate of heat production in a resistor.
● Identifying on a circuit diagram whether resistors are in series or in parallel.</td></tr>
</table>

	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.	● Determining the ratio of the voltages across resistors connected in series or the ratio of the currents through resistors connected in parallel. ● Calculating the equivalent resistance of a network of resistors that can be broken down into series and parallel combinations. ● Calculating the voltage, current and power dissipation for any resistor in such a network of resistors connected to a single power supply . ● Designing a simple series-parallel circuit that produces a given current through and potential difference across one specified component, and drawing a diagram for the circuit using conventional symbols. ● Calculating the terminal voltage of a battery of specified emf and internal resistance from which a known current is flowing.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
AP Physics C: Electricity and Magnetism - Magnetic Fields

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

● BIG IDEA 1: CHANGE (CHA) Interactions produce changes in motion
● BIG IDEA 2: FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.
● BIG IDEA 3: FIELDS (FLD) Fields predict and describe interactions.
● BIG IDEA 4: CONSERVATION (CON) Conservation laws constrain interactions.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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><th colspan="2">Meaning</th></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
Students will be able to answer…

● 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…

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.</td><td>Students will be skilled at…

● Deriving and applying the formula for the radius of the circular path of a charge that moves perpendicular to a uniform magnetic field .
● Calculating the magnitude and direction of the force on a straight segment of current-carrying wire in a uniform magnetic field.
● Calculating the magnitude and direction of the torque experienced by a rectangular loop of wire carrying a current in a magnetic field.</td></tr>
</table>

	○ 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 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.	● Calculating 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. ● Calculating the magnitude and direction of the force in terms of q, v, and B, and explain why the magnetic force can perform no work. ● Calculating the force of attraction or repulsion between two long current- carrying wires. ● Deriving and applying the expression for the magnitude of B on the axis of a circular loop of current. ● Using 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

Windham School District Curriculum
AP Physics C: Electricity and Magnetism - Electromagnetism

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
College Board Big Ideas
BIG IDEA 1: CHANGE (CHA) Interactions produce changes in motion
BIG IDEA 2: FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.
BIG IDEA 3: FIELDS (FLD) Fields predict and describe interactions.
BIG IDEA 4: CONSERVATION (CON) Conservation laws constrain interactions.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…
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 can determine the mechanical consequences of those forces.
Students should understand the transient and steady state behavior of DC circuits containing resistors and inductors.
Apply Kirchhoff's rules to a simple LR series circuit to obtain a differential equation for the current as a function of time.</td><td>Students will be skilled at…
Calculating the flux of a uniform magnetic field through a loop of arbitrary orientation.
Using 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.
The magnitude of a related quantity such as magnetic field or area of the loop is a specified non-linear function of time.
Calculating the magnitude and sense of the emf in an inductor through which a specified changing current is flowing.
Deriving and applying the expression for the self-inductance of a long solenoid.</td></tr>
</table>

	• Students should be familiar with Maxwell's equations so they can associate each equation with its implications.	• Solving the differential equation obtained in (1) for the current as a function of time through the battery, using separation of variables. • Calculating 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.
Used in Content Area Standards		***21st Century Skills***
not applicable		• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
CP Physics: Kinematics

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** CHANGE (CHA) Interactions produce changes in motion
- **BIG IDEA 2:** FORCE INTERACTIONS (INT) Forces characterize interactions between objects or systems.
- **BIG IDEA 3:** FIELDS (FLD) Fields predict and describe interactions.
- **BIG IDEA 4:** CONSERVATION (CON) Conservation laws constrain interactions.

NGSS Science Standards

- **HS-PS2-1:** 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.
- **HS-PS2-2:** 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.
- **HS-PS2-3:** Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

Transfer

Students will be able to independently use their learning to…

- Convert units and conduct dimensional analysis.
- Solve 1-D and 2-D Motion Problems – (Position, Velocity, Acceleration).

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- The motion of an object is always judged with respect to some other object or point. The idea of absolute motion or rest is misleading.
- Scalar quantities are simply magnitude and vector quantities are magnitude with direction.
- The motion of an object can be described by its position, direction and speed.
- Horizontal and vertical motion of a projectile are independent of each other.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What is the difference between scalar and vector quantities?
- How can we develop and use mathematical models, diagrams and graphs to describe and predict the motion of an object in 1D and 2D?
- How do we find the range, hang time and velocity of a projectile?

Acquisition

Students will know…

- The importance of including a unit with each number.
- all motion must be compared to a frame of reference.
- The general relationships among position, velocity, and acceleration for the motion of an object along a straight line.

Students will be skilled at…

- Converting units by using dimensional analysis.
- Using appropriate academic content language in written evaluations and discussions.

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- **HS-PS2-4:** Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
- **HS-PS2-5:** 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.
- **HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **HS-ETS1-3:** 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>
<td>

- An object in linear motion may travel with a constant velocity or have accelerated motion.
- An object in free fall accelerated due to the force of gravity.
- In the absence of air resistance, all objects fall with the same acceleration.
- Vectors can be added, subtracted, and resolved into X and Y displacement and velocity vectors.
- Projectile motion has vertical and horizontal components and is motion under the influence of gravity.
- The slope of a Pvt graph is velocity.
- The slope of a Vvt graph is acceleration.
- The area under a Vvt graph is displacement.
- The area under a Avt graph is the velocity.
- Distance (m)- describes a change in position regardless of direction.
- Displacement (m)- describes a change in position relative to a point and direction.
- Speed (m/s)- the distance that an object travels in a specific amount of time.
- Velocity (m/s)- describes the change of an object's position in a given amount of time.

</td>
<td>

- Expressing the motion of an object using narrative, mathematical, and graphical representations.
- Designing an experimental investigation of the motion of an object.
- Analyzing 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.

</td>
</tr>
<tr>
<td colspan="2">Used in Content Area Standards</td>
<td>21st Century Skills</td>
</tr>
<tr>
<td colspan="2"></td>
<td>

- One to one technology
- Collaboration
- Communication
- Critical thinking
- Creativity

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

Windham School District Curriculum
Course: CP Physics: Dynamics

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

● HS-PS2-1: 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.
● HS-PS2-2: 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.
● HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
● HS-PS2-4: Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and electrostatic forces between objects.</td><td>Transfer</td></tr>
<tr><td>Students will be able to independently use their learning to…

● Apply Newton’s Laws of Motion to solve One and Two Dimensional Force Problems.
● Apply Newton’s Laws of Motion to solve connected objects Force problems.</td></tr>
<tr><td>Meaning</td></tr>
</table>

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

HS-PS2-5: 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.
HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3: 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>
<td>ENDURING UNDERSTANDINGS
Students will understand that…

Forces and momentum are used to predict interaction between systems.
Unbalanced forces cause a change in the motion of an object.
A change in velocity indicates that an object is accelerating.

</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

How can one explain and predict interactions between systems?
What causes the change in motion of an object?
How do you know if an object is accelerating?

</td>
</tr>
<tr>
<td colspan="2">Acquisition</td>
</tr>
<tr>
<td>Students will know…

Inertia and mass are synonymous with each other.
Weight and mass are different.
Newton’s first and second law accurately predicts. changes in the motion of macroscopic objects.
Free-body diagrams (FBD) are used to represent all forces acting on an object.
There are four universal forces.
Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.
Impulse can cause a change in momentum.
Momentum is always conserved in collisions.
If a system interacts with objects outside itself, the total momentum of the system can change.
Gravitational force is based on the mass and distance between two objects.

</td>
<td>Students will be skilled at…

Using appropriate academic content language in written evaluations and discussions.
Planning and conducting an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design.
Analyzing 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).

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

	● Newton's Three Laws of Motion.	

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

Windham School District Curriculum
CP Physics: Energy

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

● HS-PS2-1: 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.
● HS-PS2-2: 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.
● HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● 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.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Energy comes in different forms and can change from one form to another.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is energy and how does it interact with matter?</td></tr>
</table>

force on a macroscopic object during a collision. ● **HS-PS2-4:** Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. ● **HS-PS2-5:** 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. ● **HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	● Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.	
	Acquisition	
	Students will know… ● Work is done when an object and force move in the same direction. ● Work is energy and energy is work. ● Power is the rate of change in work. ● Energy is always conserved, it simply changes form. ● 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. ● Mathematical expressions that 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.	***Students will be skilled at…*** ● Creating and using models to explain how energy transfers within a system. ● Planning and carrying out an investigation that relates concepts from motion and forces to energy. ● Analyzing and interpreting energy diagrams to predict what may have caused the energy transformations. ● Creating a computational model or simulation of a phenomenon, design device, process or system. ● Using mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
CP Physics: Waves and Electromagnetic Radiation

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

● HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● HS-PS4-2: Evaluate questions about the advantages of using digital transmission and storage of information.
● HS-PS4-3: 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.
● HS-PS4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● 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…

● 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.
● Information can be digitized and can be stored reliably in computer memory and sent over long distances as a series of wave pulses.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are the characteristics and behaviors of different types of waves?
● How are waves used to transfer energy and send and store information?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Waves can be classified as mechanical or electromagnetic.
● Waves can be classified as transverse or longitudinal.</td><td>Students will be skilled at…

● Using appropriate academic content language in written evaluations and discussions.</td></tr>
</table>

of electromagnetic radiation have when absorbed by matter. ● **HS-PS4-5:** 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.	● Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. ● 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. ● Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. ● 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.	● Evaluating questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. ● Using mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. ● Evaluating the claims, evidence, and reasoning 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 ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
Honors Physics: Motion and Measurement

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

● HS-PS2-1: 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.
● HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
● HS-ETS1-3: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Convert Units and conduct a dimensional analysis.
● Evaluate graphs of motion to describe motion events using words.
● Solve One Dimensional Motion Problems – (Position, Velocity, Acceleration).</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
Students will be able to answer…

● What is displacement?
● What is velocity and how is it different from speed?
● How do we find the position, velocity, acceleration of an object moving in one dimension?</td></tr>
<tr><td colspan="2"></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 for the motion of a particle along a straight line.
● Students should understand the special case of motion with constant acceleration.
● Projectile Motion includes hangtime, acceleration and velocity.</td><td>Students will be skilled at…

● Expressing the motion of an object using narrative, mathematical, and graphical representations.
● Designing an experimental investigation of the motion of an object.
● Analyzing 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.</td></tr>
</table>

Used in Content Area Standard	*21st Century Skills*
	• One to one technology • Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
Honors Physics: Forces and Interactions

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-PS2-1:** 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.
- **HS-PS2-2:** 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.
- **HS-PS2-3:** Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
- **HS-PS2-4:** Use mathematical representations of Newton's Law of Gravitation to describe and predict the gravitational forces between objects.
- **HS-PS2-5:** 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.
- **HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Transfer

Students will be able to independently use their learning 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.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- 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.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How can one explain and predict interactions between systems?
- What causes the motion of an object?
- How are free-body diagrams (FBD) used to explain outcomes of force interactions?

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.
- If a system interacts with objects outside itself, the total momentum of the system can change
- "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents.

Students will be skilled at…

- Planning and conducting an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design
- Deciding on types, how much, and accuracy of data needed to produce reliable data. measurements and consider limitations on the precision of the data (e.g., number of trials, cost,

● **HS-ETS1-3:** 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.	● 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.	risk, time), and refine the design accordingly. ● Analyzing 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. ● Analyzing 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). . ● Using the data as empirical evidence to distinguish between causal and correlational relationships linking force, mass, and acceleration. ● Defining the system of the interacting objects that is mathematically represented.
Used in Content Area Standards		***21st Century Skills***
		● One to one technology ● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
Honors Physics: Energy

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-PS3-1:** 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.
- **HS-PS3-2:** 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).
- **HS-PS3-3:** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
- **HS-ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2:** Design a solution to a complex real-word problem by breaking it down into smaller,

Transfer

Students will be able to independently use their learning 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).

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.
- 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.
- Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What is the First Law of Thermodynamics?
- What is energy and how does it interact with matter?
- How do we use models to demonstrate how energy is transferred?

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.
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.

Students will be skilled at…

- Developing and using a model based on evidence to illustrate the relationships between systems or between components of a system.
- Creating a computational model or simulation of a phenomenon, designed device, process, or system.

more manageable problems that can be solved through engineering. ● **HS-ETS1-3:** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-ffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.	● 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. ● 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.	● Designing, evaluating and/or refining a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. ● Creating a computational model or simulation of a phenomenon, design device, process or system. ● Analyzing complex real-world problems by specifying criteria and constraints for successful solutions. ● Using mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.

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

Windham School District Curriculum
Honors Physics: Waves and Electromagnetic Radiation

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards
● HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information.
● HS-PS4-3: 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.
● HS-PS4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
● HS-PS4-5: 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><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● 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 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.
● Modern civilization depends on major technological systems.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
● 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 do I see and why do I wear glasses or contact lenses?
● What is color and why are some things in nature certain colors?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
● Solar cells are human-made devices that capture the sun’s energy and produce electrical energy.</td><td>Students will be skilled at…
● Describe the relevant components in the mathematical representations.
● Describe the stability and importance of the systems that employ digital information as they relate to the</td></tr>
</table>

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

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.
Photoelectric materials emit electrons when they absorb light of a high-enough frequency.
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.

</td><td>
advantages and disadvantages of digital transmission and storage of information.

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.
Evaluating 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.
Evaluating the phenomenon of the photoelectric effect to determine how it supports the argument that electromagnetic radiation can be described by a particle model.
Evaluating questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
Using mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.

</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>

Windham School District Curriculum
AP Chemistry: Atomic Structure and Properties

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

● BIG IDEA 1: SCALE, PROPORTION, AND QUANTITY (SPQ) Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.
● BIG IDEA 2: STRUCTURE AND PROPERTIES (SAP) Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.
● BIG IDEA 3: TRANSFORMATIONS (TRA) At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both macroscopically and at the atomic level during the process. This reasoning can be as simple as monitoring amounts of</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Practice identifying components of commonly used models and representations to illustrate chemical phenomena.
● Construct models and representations and explain whether they are consistent with chemical theories.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● The mole allows different units to be compared.
● Chemical formulas identify substances by their unique combination of atoms.
● Atoms and molecules can be identified by their electron distribution and energy.
● The periodic table shows patterns in electronic structure and trends in atomic properties.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How can the same element be used in nuclear fuel rods and fake diamonds?
● Why are eggs sold as a dozen?</td></tr>
<tr><td colspan="2">Acquisition
<table><tr><td>Students will know…

● One cannot count particles directly while performing laboratory work. Thus, there must be a connection between the masses of substances reacting and the actual number of particles undergoing chemical changes.
● The mass spectrum of a sample containing a single element can be used to determine the identity of the isotopes of that element and the relative abundance of each isotope in nature.</td><td>Students will be skilled at…

● Identifying an appropriate theory, definition, or mathematical relationship to solve a problem.
● Identifying quantities needed to solve a problem from given information (e.g., text, mathematical expressions, graphs, or tables).
● Describing the components of and quantitative information from models and representations that illustrate particulate-level properties only.</td></tr></table></td></tr>
</table>

products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events. ● **BIG IDEA 4:** ENERGY (ENE) Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.	● Some pure substances are composed of individual molecules, while others consist of atoms or ions held together in fixed proportions as described by a formula unit. ● While pure substances contain molecules or formula units of a single type, mixtures contain molecules or formula units of two or more types, whose relative proportions can vary. ● The energies of the electrons in a given shell can be measured experimentally with photoelectron spectroscopy (PES). The position of each peak in the PES spectrum is related to the energy required to remove an electron from the corresponding subshell, and the height of each peak is (ideally) proportional to the number of electrons in that subshell. ● The organization of the periodic table is based on the recurring properties of the elements and explained by the pattern of electron configurations and the presence of completely or partially filled shells (and subshells) of electrons in atoms. ● The likelihood that two elements will form a chemical bond is determined by the interactions between the valence electrons and nuclei of elements.	● Explaining chemical properties or phenomena (e.g., of atoms or molecules) using given chemical theories, models, and representations. ● Explaining whether a model is consistent with chemical theories.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
AP Chemistry: Molecular & Ionic Compound Structure & Properties

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
College Board Big Ideas
BIG IDEA 1: SCALE, PROPORTION, AND QUANTITY (SPQ) Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.
BIG IDEA 2: STRUCTURE AND PROPERTIES (SAP) Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.
BIG IDEA 3: TRANSFORMATIONS (TRA) At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both</td>
<th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Interpret simple graphical representations of changes in potential energy as two atoms approach each other to explain optimal bond length as well as why bonds may or may not occur.
Constructing representations and models for chemical phenomena (e.g., ionic and metallic solids) and using representations to make claims or predictions.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Atoms or ions bond due to interactions between them, forming molecules.
Molecular compounds are arranged based on Lewis diagrams and Valence Shell Electron Pair Repulsion (VSEPR) theory.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…
How has the discovery of DNA changed the world?
How are molecular compounds arranged?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
Electronegativity values for the representative elements increase going from left to right across a period and decrease going down a group. These trends can be understood qualitatively through the electronic structure of the atoms, the shell model, and Coulomb's law.
A graph of potential energy versus the distance between atoms is a useful representation for describing the interactions between atoms. Such graphs illustrate both the equilibrium bond length (the separation between atoms at which the</td>
<td>Students will be skilled at…
Making a scientific claim.
Represent chemical phenomena using appropriate graphing techniques, including correct scale and units.
Supporting a claim with evidence from representations or models at the particulate level, such as the structure of atoms and/or molecules.
Representing chemical substances or phenomena with appropriate diagrams or models (e.g., electron configuration).</td></tr>
</table>

macroscopically and at the atomic level during the process. This reasoning can be as simple as monitoring amounts of products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events. ● **BIG IDEA 4:** ENERGY (ENE) Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.	potential energy is lowest) and the bond energy (the energy required to separate the atoms). ● The cations and anions in an ionic crystal are arranged in a systematic, periodic 3-D array that maximizes the attractive forces among cations and anions while minimizing the repulsive forces. ● Metallic bonding can be represented as an array of positive metal ions surrounded by delocalized valence electrons (i.e., a "sea of electrons"). ● Lewis diagrams can be constructed according to an established set of principles. ● In cases where more than one equivalent Lewis structure can be constructed, resonance must be included as a refinement to the Lewis structure. In many such cases, this refinement is needed to provide qualitatively accurate predictions of molecular structure and properties. ● VSEPR theory uses the Coulombic repulsion between electrons as a basis for predicting the arrangement of electron pairs around a central atom.	● Explaining the connection between particulatelevel and macroscopic properties of a substance using models and representations.

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
AP Chemistry: Intermolecular Forces and Properties

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

● BIG IDEA 1: SCALE, PROPORTION, AND QUANTITY (SPQ) Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.
● BIG IDEA 2: STRUCTURE AND PROPERTIES (SAP) Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.
● BIG IDEA 3: TRANSFORMATIONS (TRA) At its heart, chemistry is about the rearrangement of</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Draw upon claims made in Unit 2 about molecular geometry and polarity to support claims about intermolecular forces between molecules.
● Build proficiency with mathematical reasoning skills, essential for success in the remainder of the course. Students should be able to explain relationships between variables in an equation (e.g., the ideal gas law) and then estimate the approximate value of one variable within an equation when the value of another variable changes.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Intermolecular forces can explain the physical properties of a material.
● Matter exists in three states: solid, liquid, and gas, and their differences are influenced by variances in spacing and motion of the molecules.
● Gas properties are explained macroscopically—using the relationships among pressure, volume, temperature, moles, gas constant—and molecularly by the motion of the gas.
● Interactions between intermolecular forces influence the solubility and separation of mixtures.
● Spectroscopy can determine the structure and concentration in a mixture of a chemical species.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Why does the smell of perfume only last a short time?
● Why can you swim in water but you cannot walk through a wall? § How are the properties of gasses described?
● How can you determine the structure and concentration of a chemical species in a mixture?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● London dispersion forces are a result of the Coulombic interactions between temporary,</td>
<td>Students will be skilled at…

● Explaining the degree to which a model or representation describes the connection between</td></tr>
</table>

matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both macroscopically and at the atomic level during the process. This reasoning can be as simple as monitoring amounts of products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events. ● **BIG IDEA 4:** ENERGY (ENE) Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.	fluctuating dipoles. London dispersion forces are often the strongest net intermolecular force between large molecules. ● Many properties of liquids and solids are determined by the strengths and types of intermolecular forces present. Because intermolecular interactions are broken when a substance vaporizes, the vapor pressure and boiling point are directly related to the strength of those interactions. Melting points also tend to correlate with interaction strength, but because the interactions are only rearranged, in melting, the relations can be more subtle. ● Solids can be crystalline, where the particles are arranged in a regular three-dimensional structure, or they can be amorphous, where the particles do not have a regular, orderly arrangement. In both cases, the motion of the individual particles is limited, and the particles do not undergo overall translation with respect to each other. The structure of the solid is influenced by interparticle interactions and the ability of the particles to pack together. ● The macroscopic properties of ideal gasses are related through the ideal gas law: EQN: $PV = nRT$. ● The kinetic molecular theory (KMT) relates the macroscopic properties of gasses to motions of the particles in the gas. The Maxwell-Boltzmann distribution describes the distribution of the kinetic energies of particles at a given temperature. ● The ideal gas law does not explain the actual behavior of real gasses. Deviations from the ideal gas law may result from interparticle attractions among gas molecules, particularly at conditions that are close to those resulting in condensation. Deviations may also arise from particle volumes, particularly at extremely high pressures. ● Solutions, also sometimes called homogeneous mixtures, can be solids, liquids, or gasses. In a solution, the macroscopic properties do not vary throughout the sample. In a heterogeneous mixture,	particulate-level properties and macroscopic properties. ● Representing visually the relationship between the structures and interactions across multiple levels or scales (e.g., particulate to macroscopic). ● Explaining the relationship between variables within an equation when one variable changes. ● Calculating, estimate, or predict an unknown quantity from known quantities by selecting and following a logical computational pathway and attending to precision (e.g., performing dimensional analysis and attending to significant figures). ● Providing reasoning to justify a claim using connections between particulate and macroscopic scales or levels. ● Identifying experimental procedures that are aligned to the question (which may include a sketch of a lab setup).

	the macroscopic properties depend on location in the mixture. ● Particulate representations of solutions communicate the structure and properties of solutions, by illustration of the relative concentrations of the components in the solution and drawings that show interactions among the components.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
AP Chemistry: Chemical Reactions

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

● BIG IDEA 1: SCALE, PROPORTION, AND QUANTITY (SPQ) Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.
● BIG IDEA 2: STRUCTURE AND PROPERTIES (SAP) Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.
● BIG IDEA 3: TRANSFORMATIONS (TRA) At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both macroscopically and at the atomic level during the process. This reasoning can be as simple as monitoring amounts of</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Describe and construct equations of chemical systems and learn to balance equations.
● Students should be able to identify and effectively represent types of reactions (e.g., acid-base, redox, precipitation) and then use that knowledge to make hypotheses or predictions about the outcome of a reaction.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● A substance that changes its properties, or that changes into a different substance, can be represented by chemical equations.
● When a substance changes into a new substance, or when its properties change, no mass is lost or gained.
● A substance can change into another substance through different processes, and the change itself can be classified by the sort of processes that produced it.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Why is the mass of a raw egg different from a boiled egg?
● What are the processes related to changes in a substance?
● What makes fireworks explode?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● All physical and chemical processes can be represented symbolically by balanced equations.
● Balanced chemical equations in their various forms can be translated into symbolic particulate representations.
● Processes that involve the breaking and/or formation of chemical bonds are typically classified as chemical processes. Processes that involve only changes in</td>
<td>Students will be skilled at…

● Formulating a hypothesis or predicting the results of an experiment.
● Determine a balanced chemical equation for a given chemical phenomena.
● Representing chemical substances or phenomena with appropriate</td></tr>
</table>

products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events. ● **BIG IDEA 4:** ENERGY (ENE) Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.	intermolecular interactions, such as phase changes, are typically classified as physical processes. ● Because atoms must be conserved during a chemical process, it is possible to calculate product amounts by using known reactant amounts, or to calculate reactant amounts given known product amounts. ● Titrations may be used to determine the concentration of an analyte in solution. The titrant has a known concentration of a species that reacts specifically and quantitatively with the analyte. The equivalence point of the titration occurs when the analyte is totally consumed by the reacting species in the titrant. The equivalence point is often indicated by a change in a property (such as color) that occurs when the equivalence point is reached. This observable event is called the endpoint of the titration. ● Acid-base reactions involve transfer of one or more protons between chemical species. ● By definition, a Brønsted-Lowry acid is a proton donor and a Brønsted-Lowry base is a proton acceptor. ● Balanced chemical equations for redox reactions can be constructed from half-reactions.	diagrams or models (e.g., electron configuration). ● Supporting a claim with evidence from experimental data. ● Representing chemical phenomena using appropriate graphing techniques, including correct scale and units. ● Supporting a claim with evidence from experimental data. ● Describing the components of and quantitative information from models and representations that illustrate both particulate level and macroscopic-level properties.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
AP Chemistry: Kinetics

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

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● BIG IDEA 2: STRUCTURE AND PROPERTIES (SAP) Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.
● BIG IDEA 3: TRANSFORMATIONS (TRA) At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both macroscopically and at the atomic level during the process. This reasoning can be as simple as monitoring amounts of</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Constructing and describing rate laws consistent with experimental evidence.
● Students will examine proposed reaction mechanisms to determine if there is a match between observed experimental data and constructed rate law expressions.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Some reactions happen quickly, while others happen more slowly and depend on reactant concentrations and temperature.
● There is a relationship between the speed of a reaction and the collision frequency of particle collisions.
● Many chemical reactions occur through a series of elementary reactions. These elementary reactions when combined form a chemical equation.
● The speed at which a reaction occurs can be influenced by a catalyst.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Why are some reactions faster than other reactions?
● How long will a marble statue last?
● How can a sports drink cure a headache?
● Why does bread rise?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● The kinetics of a chemical reaction is defined as the rate at which an amount of reactants is converted to products per unit of time.
● Experimental methods can be used to monitor the amounts of reactants and/or products of a reaction and to determine the rate of the reaction.</td><td>Students will be skilled at…

● Providing reasoning to justify a claim using connections between particulate and macroscopic scales or levels.
● Explaining the relationship between variables within an equation when one variable changes.</td></tr>
</table>

products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events. ● **BIG IDEA 4:** ENERGY (ENE) Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.	● The order of a reaction can be inferred from a graph of concentration of reactant versus time. ● The rate law of an elementary reaction can be inferred from the stoichiometry of the molecules participating in a collision. ● For an elementary reaction to successfully produce products, reactants must successfully collide to initiate bond-breaking and bond making events. ● Elementary reactions typically involve the breaking of some bonds and the forming of new ones. ● A reaction mechanism consists of a series of elementary reactions, or steps, that occur in sequence. The components may include reactants, intermediates, products, and catalysts. ● For reaction mechanisms in which each elementary step is irreversible, or in which the first step is rate limiting, the rate law of the reaction is set by the molecularity of the slowest elementary step (i.e., the rate-limiting step). ● If the first elementary reaction is not rate limiting, approximations (such as steady state) must be made to determine a rate law expression. ● Knowledge of the energetics of each elementary reaction in a mechanism allows for the construction of an energy profile for a multistep reaction. ● In order for a catalyst to increase the rate of a reaction, the addition of the catalyst must increase the number of effective collisions and/ or provide a reaction path with a lower activation energy relative to the original reaction coordinate.	● Providing reasoning to justify a claim using connections between particulate and macroscopic scales or levels. ● Representing chemical substances or phenomena with appropriate diagrams or models (e.g., electron configuration). ● Describing the components of and quantitative information from models and representations that illustrate both particulate level and macroscopic-level properties.

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

Windham School District Curriculum
AP Chemistry: Thermodynamics

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** SCALE, PROPORTION, AND QUANTITY (SPQ) Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.
- **BIG IDEA 2:** STRUCTURE AND PROPERTIES (SAP) Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.
- **BIG IDEA 3:** TRANSFORMATIONS (TRA) At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both macroscopically and at the atomic level during the process. This reasoning can be as simple as monitoring amounts of products made or as complex as visualizing the

Transfer

Students will be able to independently use their learning to…

- Link atomic and particulate level phenomena and models to macroscopic phenomena.
- Develop justifications for claims made about the direction of thermal energy transfer of a system in relation to its surroundings when a temperature change, physical change, or a chemical reaction occurs.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Changes in a substance's properties or change into a different substance requires an exchange of energy.
- The energy exchanged in a chemical transformation is required to break and form bonds.

ESSENTIAL QUESTIONS
Students will be able to answer…

- Why is energy released when water becomes an ice cube?
- How are chemical transformations that require bonds to break and form influenced by energy?

Acquisition

Students will know…

- Temperature changes in a system indicate energy changes.
- A physical or chemical process can be described with an energy diagram that shows the endothermic or exothermic nature of that process.
- The particles in a warmer body have a greater average kinetic energy than those in a cooler body.

Students will be skilled at…

- Providing reasoning to justify a claim using chemical principles or laws, or using mathematical justification.
- Making observations or collecting data from representations of laboratory setups or results, while attending to precision where appropriate.
- Describing the components of and quantitative information from models and representations that illustrate both particulate-level and macroscopic level properties.

intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events. ● **BIG IDEA 4:** ENERGY (ENE) Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.	● The heating of a cool body by a warmer body is an important form of energy transfer between two systems. The amount of heat transferred between two bodies may be quantified by the heat transfer equation: EQN: $q = mc\Delta T$. ● Energy must be transferred to a system to cause a substance to melt (or boil). The energy of the system therefore increases as the system undergoes a solid-to-liquid (or liquid to-gas) phase transition. Likewise, a system releases energy when it freezes (or condenses). The energy of the system decreases as the system undergoes a liquid-to-solid (or gas-to-liquid) phase transition. The temperature of a pure substance remains constant during a phase change. ● The enthalpy change of a reaction gives the amount of heat energy released (for negative values) or absorbed (for positive values) by a chemical reaction at constant pressure. ● During a chemical reaction, bonds are broken and/or formed, and these events change the potential energy of the system. ● Tables of standard enthalpies of formation can be used to calculate the standard enthalpies of reactions.	● Calculating, estimate, or predict an unknown quantity from known quantities by selecting and following a logical computational pathway and attending to precision (e.g., performing dimensional analysis and attending to significant figures). ● Identifying quantities needed to solve a problem from given information (e.g., text, mathematical expressions, graphs, or tables).

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
AP Chemistry: Equilibrium

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

● BIG IDEA 1: SCALE, PROPORTION, AND QUANTITY (SPQ) Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.
● BIG IDEA 2: STRUCTURE AND PROPERTIES (SAP) Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.
● BIG IDEA 3: TRANSFORMATIONS (TRA) At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both macroscopically and at the atomic level</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Construct equilibrium expressions from reaction equations.
● Illustrate the dynamic nature of the chemical reaction through particulate level representations, portraying both the forward and reverse rates of the reaction equations.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● A system at equilibrium depends on the relationships between concentrations, partial pressures of chemical species, and equilibrium constant K.
● Some reactions can occur in both forward and reverse directions, sometimes proceeding in each direction simultaneously.
● Systems at equilibrium respond to external stresses to offset the effect of the stress.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Why is a waterfall considered a spontaneous reaction?
● How can reactions occur in more than one direction?
● How is caffeine removed from coffee?
● Why is food stored in a refrigerator?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Many observable processes are reversible. Examples include evaporation and condensation of water, absorption and desorption of a gas, or dissolution and precipitation of a salt. Some important reversible chemical processes include the transfer of protons in acid-base reactions and the transfer of electrons in redox reactions.
● If the rate of the forward reaction is greater than the reverse reaction, then there is a net conversion of reactants to products. If the rate of the reverse reaction is greater than</td><td>Students will be skilled at…

● Providing reasoning to justify a claim using chemical principles or laws, or using mathematical justification.
● Explaining the degree to which a model or representation describes the connection between particulate-level properties and macroscopic properties.</td></tr>
</table>

<table>
<tr>
<td>during the process. This reasoning can be as simple as monitoring amounts of products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events.
● BIG IDEA 4: ENERGY (ENE) Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.</td>
<td>that of the forward reaction, then there is a net conversion of products to reactants. An equilibrium state is reached when these rates are equal.
● The reaction quotient Q c c describes the relative concentrations of reaction species at any time. For gas phase reactions, the reaction quotient may instead be written in terms of pressures as Qp . The reaction quotient tends toward the equilibrium constant such that at equilibrium Kc = Qc and K p = Qp . As examples, for the reaction.
● Equilibrium constants can be determined from experimental measurements of the concentrations or partial pressures of the reactants and products at equilibrium.
● Some equilibrium reactions have very large K values and proceed essentially to completion. Others have very small K values and barely proceed at all.
● The concentrations or partial pressures of species at equilibrium can be predicted given the balanced reaction, initial concentrations, and the appropriate K.
● Particulate representations can be used to describe the relative numbers of reactant and product particles present prior to and at equilibrium, and the value of the equilibrium constant.
● Le Châtelier's principle can be used to predict the response of a system to stresses such as addition or removal of a chemical species, change in temperature, change in volume/ pressure of a gas-phase system, or dilution of a reaction system.
● A disturbance to a system at equilibrium causes Q to differ from K, thereby taking the system out of equilibrium. The system responds by bringing Q back into agreement with K, thereby establishing a new equilibrium state.</td>
<td>● Representing chemical phenomena using appropriate graphing techniques, including correct scale and units.
● Explaining the relationship between variables within an equation when one variable changes.
● Identify quantities needed to solve a problem from given information (e.g., text, mathematical expressions, graphs, or tables).
● Calculating, estimate, or predict an unknown quantity from known quantities by selecting and following a logical computational pathway and attending to precision (e.g., performing dimensional analysis and attending to significant figures).</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</td>
</tr>
</table>

Windham School District Curriculum
AP Chemistry: Acids and Bases

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

● BIG IDEA 1: SCALE, PROPORTION, AND QUANTITY (SPQ) Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.
● BIG IDEA 2: STRUCTURE AND PROPERTIES (SAP) Properties of substances observable at the macroscopic scale emerge from the structures of atoms and molecules and the interactions between them. Chemical reasoning moves in both directions across these scales. Properties are predicted from known aspects of the structures and interactions at the atomic scale. Observed properties are used to infer aspects of the structures and interactions.
● BIG IDEA 3: TRANSFORMATIONS (TRA) At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at many levels as one must quantify what is occurring both macroscopically and at the atomic level during the process. This reasoning can be</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Collect titration data and develop titration curves to represent a variety of acid-base systems.
● Analyze these titration curves to describe the similarities and differences between a strong acid strong base and a weak acid-strong base titration, identify the equivalence points and the half-equivalence points, and identify the buffering regions of the curves.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● The chemistry of acids and bases involves reversible proton-transfer reactions, with equilibrium concentrations being related to the strength of the acids and bases involved.
● A buffered solution resists changes to its pH when small amounts of acid or base are added.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How are reactions involving acids and bases related to pH?
● How does your body maintain pH balance?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Molecules of a strong acid (e.g., HCl, HBr, HI, HClO4 , H2SO4 , and HNO3) will completely ionize in aqueous solution to produce hydronium ions. As such, the concentration of H3O+ in a strong acid solution is equal to the initial concentration of the strong acid, and thus the pH of the strong acid solution is easily calculated.
● Weak acids react with water to produce hydronium ions. However, molecules of a weak acid will only partially ionize in this way. In other words, only a small percentage of the molecules of a weak acid are ionized</td><td>Students will be skilled at…

● Identifying an appropriate theory, definition, or mathematical relationship to solve a problem.
● Calculating, estimate, or predict an unknown quantity from known quantities by selecting and following a logical computational pathway and attending to precision (e.g., performing dimensional analysis and attending to significant figures).</td></tr>
</table>

as simple as monitoring amounts of products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events. ● **BIG IDEA 4:** ENERGY (ENE) Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.	in a solution. Thus, the concentration of H_3O^+ is much less than the initial concentration of the molecular acid, and the vast majority of the acid molecules remain un-ionized. ● When a strong acid and a strong base are mixed, they react quantitatively in a reaction represented by the equation: $H^+ (aq) + OH^- (aq) \rightarrow H_2O(l)$. ● An acid-base reaction can be carried out under controlled conditions in a titration. A titration curve, plotting pH against the volume of titrant added, is useful for summarizing results from a titration. ● The protons on a molecule that will participate in acid-base reactions, and the relative strength of these protons, can be inferred from the molecular structure. ● The protonation state of an acid or base (i.e., the relative concentrations of HA and A^-) can be predicted by comparing the pH of a solution to the pKa of the acid in that solution. When solution pH < acid pKa , the acid form has a higher concentration than the base form. When solution pH > acid pKa , the base form has a higher concentration than the acid form. ● A buffer solution contains a large concentration of both members in a conjugate acid-base pair. The conjugate acid reacts with added base and the conjugate base reacts with added acid. These reactions are responsible for the ability of a buffer to stabilize pH.	● Explaining the relationship between variables within an equation when one variable changes. ● Supporting a claim with evidence from representations or models at the particulate level, such as the structure of atoms and/or molecules. ● Making observations or collecting data from representations of laboratory setups or results, while attending to precision where appropriate. ● Explaining how potential sources of experimental error may affect the experimental results.

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
AP Chemistry: Applications of Thermodynamics

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1:** SCALE, PROPORTION, AND QUANTITY (SPQ) Quantities in chemistry are expressed at both the macroscopic and atomic scale. Explanations, predictions, and other forms of argumentation in chemistry require understanding the meaning of these quantities, and the relationship between quantities at the same scale and across scales.
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- **BIG IDEA 3:** TRANSFORMATIONS (TRA) At its heart, chemistry is about the rearrangement of matter. Understanding the details of these transformations requires reasoning at

Transfer

Students will be able to independently use their learning to…

- Connect principles and calculations across the areas of kinetics, thermodynamics, equilibrium, and electrochemistry to explain and support claims about what is happening in chemical systems.
- Use particulate representations and graphical distribution of kinetic energy to describe the increase in entropy with increasing temperature.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Some chemical or physical processes cannot occur without intervention.
- The relationship between $\Delta G°$ and K can be used to determine favorability of a chemical or physical transformation.
- Electrical energy can be generated by chemical reactions.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How does water flow uphill?
- How is the favorability of a chemical or physical transformation determined?
- How is electrical energy generated using chemical reactions?

Acquisition

Students will know…

- Entropy increases when matter becomes more dispersed. For example, the phase change from solid to liquid or from liquid to gas results in a dispersal of matter as the individual particles become freer to move and generally occupy a larger volume. Similarly, for a gas, the entropy increases when there is an increase in volume (at constant temperature), and the gas molecules are able to move within a larger space. For reactions involving gas-phase reactants or products, the entropy generally increases when the total number of moles of gas-phase

Students will be skilled at…

- Supporting a claim with evidence from representations or models at the particulate level, such as the structure of atoms and/or molecules.
- Calculating, estimate, or predict an unknown quantity from known quantities by selecting and following a logical computational pathway and attending to precision (e.g., performing dimensional analysis and attending to significant figures).

many levels as one must quantify what is occurring both macroscopically and at the atomic level during the process. This reasoning can be as simple as monitoring amounts of products made or as complex as visualizing the intermolecular forces among the species in a mixture. The rate of a transformation is also of interest, as particles must move and collide to initiate reaction events. ● **BIG IDEA 4:** ENERGY (ENE) Energy has two important roles in characterizing and controlling chemical systems. The first is accounting for the distribution of energy among the components of a system and the ways that heat exchanges, chemical reactions, and phase transitions redistribute this energy. The second is in considering the enthalpic and entropic driving forces for a chemical process. These are closely related to the dynamic equilibrium present in many chemical systems and the ways in which changes in experimental conditions alter the positions of these equilibria.	products is greater than the total number of moles of gas-phase reactants. ● The Gibbs free energy change for a chemical process in which all the reactants and products are present in a standard state (as pure substances, as solutions of 1.0 M concentration, or as gasses at a pressure of 1.0 atm (or 1.0 bar)) is given the symbol ΔGo . ● The phrase "thermodynamically favored" (ΔGo < 0) means that the products are favored at equilibrium (K > 1). ● Each component of an electrochemical cell (electrodes, solutions in the half-cells, salt bridge, voltage/current measuring device) plays a specific role in the overall functioning of the cell. The operational characteristics of the cell (galvanic vs. electrolytic, direction of electron flow, reactions occurring in each half-cell, change in electrode mass, evolution of a gas at an electrode, ion flow through the salt bridge) can be described at both the macroscopic and particulate levels. ● Electrochemistry encompasses the study of redox reactions that occur within electrochemical cells. The reactions are either thermodynamically favored (resulting in a positive voltage) or thermodynamically favored (resulting in a negative voltage and requiring an externally applied potential for the reaction to proceed). ● In a real system under nonstandard conditions, the cell potential will vary depending on the concentrations of the active species. The cell potential is a driving force toward equilibrium; the farther the reaction is from equilibrium, the greater the magnitude of the cell potential.	● Providing reasoning to justify a claim using connections between particulate and macroscopic scales or levels. ● Explaining the degree to which a model or representation describes the connection between particulate-level properties and macroscopic properties. ● Providing reasoning to justify a claim using chemical principles or laws, or using mathematical justification. ● Identifying an appropriate theory, definition, or mathematical relationship to solve a problem.

Used in Content Area Standards	***21st Century Skills***
not applicable	● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
CP Chemistry: Intro to Chemistry

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

● **HSN-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
● **HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</td><td colspan="2">***Transfer***</td></tr>
<tr><td colspan="2">***Students will be able to independently use their learning to…***

● Make realistic measurements by applying knowledge of limits to certainty in measurements.
● Use scientific tools appropriately in the laboratory.</td></tr>
<tr><td colspan="2">***Meaning***</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Confidence in scientific measurements will vary depending on the tool used and the method used.
● Measurements need to be based on a common unit and language to make meaning universal.
● Science is a practice as well as a body of knowledge.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do scientists record and report data to take into account the natural limits of the tools or methods they are using?
● What are commonly used units for distance, mass, volume, and density?
● How do scientists safely carry out laboratory procedures and collect data in an organized way?</td></tr>
<tr><td colspan="2">***Acquisition***</td></tr>
<tr><td>***Students will know…***

● Observations and data collected in the lab are used to make inferences or construct explanations about a phenomenon.
● Confidence in evidence, and therefore claims based on that evidence, is tied to the methodology and tool(s) of choice.
● The names of common metric units of measurements and prefixes.
● How to use dimensional analysis to convert between metric units.</td><td>***Students will be skilled at…***

● Gathering/Using evidence to support a claim with valid scientific reasoning.
● Communicating scientific ideas through written and spoken formats.</td></tr>
</table>

	• Laboratory tools and methods used to make measurements of mass, length, volume, and density. • How to interpret the interval marks on volumetric tools. • How to report a measurement in a way that matches and does not exceed the precision limits (appropriate place values). • Evaluate and compare the precision and accuracy of various volumetric tools.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Communication • Critical thinking • Creativity

Windham School District Curriculum
CP Chemistry: Matter and Its Changes

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

● HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Differentiate between the ways matter can be combined physically or chemically.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Matter is a complex, overarching term used to describe anything that has mass and takes up space.
● Physical and Chemical changes both describe rearrangements of atoms, but they differ in their disruption to the integrity of a substance.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do we further classify matter into meaningful categories?
● How do we gather evidence to differentiate between chemical and physical changes?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

● Atoms are the indivisible building blocks of all matter.
● Matter can be further classified into two bulk categories: mixtures and pure substances.
● Mixtures come in many forms (solutions, colloids, suspensions, homogeneous, heterogeneous) with variable qualities (consistency, phases, states of matter).
● Pure substances can be pure elements (one type of atom) or molecules/compounds</td><td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning.
● Communicating scientific ideas through written and spoken formats.</td></tr>
</table>

	(many different types of atom chemical bonded) . ● Mixtures can be separated back to their component parts by physical methods. ● Compounds and Molecules cannot be separated into their component parts by physical means. ● Chemical changes are chemical reactions in which the bonds between atoms are broken and remade to produce new substances. ● Chemical reactions involve the production of new substances and often involves the absorption or release of energy associated with altering chemical bonds.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
CP Chemistry: Thermochemistry

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

● HS-PS3-1: 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
● HS-PS3-2: 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).
● HS-PS3-4: 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).</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Understand and use the concept of specific heat capacity to calculate heat changes in chemical and physical processes.
● Differentiate between endothermic and exothermic processes and identify how they can be useful.
● Understand the heat changes involved in phase transitions such as melting and evaporation.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Energy cannot be created or destroyed; the amount of energy gained by one component of a system equals the amount of energy lost by the other component of the system.
● The amount of heat released or absorbed by a system is dependent on its mass, its specific heat capacity, and the temperature change within that system.
● Substances with high specific heat capacities, like water, heat up and cool down slowly.
● During phase transitions, the energy added or removed from the system is used entirely to change the phase of matter, and the temperature does not change.
● Heat energy is always spontaneously transferred from warmer objects to cooler ones until the two objects are in thermal equilibrium at the same temperature.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are the distinguishing features of exothermic and endothermic processes?
● How are temperature and heat related?
● What is happening to the particles in a substance when its temperature increases? What is happening to those particles during a phase change?
● How can we quantify the energy changes that occur during a multi-step process?</td></tr>
</table>

<table>
<tr><td rowspan="2"></td><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

● Energy can be transformed or converted between components of a system.
● According to the Law of Conservation of Energy, a closed system retains all energy and matter associated with its parts.
● An open system loses energy (usually in the form of thermal energy) to its surroundings.
● We can quantify the amount of heat energy transferred between components of a closed system if we know their masses, their specific heat capacities, and the amount that their temperature changes in the process.
● In a closed system, the energy gained by one substance is equal to the energy lost by another.
● Thermal energy (heat energy) is related to the motion of particles; they move faster as the temperature increases and move further apart or closer together during phase changes.
● Temperature is a measure of the average kinetic energy of the particles in a system.</td><td>Students will be skilled at…

● Calculating the amount of heat released or absorbed by a substance given its mass, temperature change, and specific heat capacity.
● Manipulating the standard specific heat equation ($q = mc\Delta T$) to solve for a variable on the right side of the equation.
● Differentiating between exothermic and endothermic reactions based on heat and/or temperature changes.
● Calculating the heat released or absorbed during phase transitions given the heat of fusion or vaporization, as applicable.
● Explaining the events that occur during each part of a heating curve, including the energy transitions that occur.</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
● Creativity</td></tr>
</table>

Windham School District Curriculum
CP Chemistry: Atomic Theory and Structure

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-PS1-1:** 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.

Transfer

Students will be able to independently use their learning to…

- Track how the accepted model of the atom has changed over time, leading to our current understanding of its structure.
- Understand how the three major subatomic particles contribute to the charge, reactivity and stability of the atom.
- Identify factors that lead to the formation of isotopes and ions among the elements.

Meaning

ENDURING UNDERSTANDINGS ***Students will understand that…***	ESSENTIAL QUESTIONS ***Students will be able to answer…***
• Scientists' understanding of the structure of the atom has been refined over the past few centuries as technology has improved. • The subatomic particles found in an atom help to determine its overall charge, reactivity with other atoms, and relative stability. • The location and movement of electrons in an atom can be determined with the use of complex mathematical models. • Some isotopes of certain atoms are unstable and therefore radioactive, releasing energy in the form of radiation. • The periodic table is a tool that can be used to determine the composition of an atom.	• How has our understanding of atomic structure changed over time? • How can we use the periodic table to help determine the number of protons, neutrons and electrons in an atom? • How did scientists calculate the average atomic masses of elements on the periodic table? • What makes an atom stable, and what makes an atom reactive?

Acquisition

Students will know…	***Students will be skilled at…***
• The atom is the fundamental unit of matter and consists of protons, neutrons, and electrons.	• Determining the number of protons, neutrons, and electrons in an atom given a periodic table and other identifying information.

	- John Dalton derived the first atomic theory, but this theory was changed and improved upon as new evidence was discovered. - JJ Thomson's use of the cathode ray allowed him to discover the electron, a negatively-charged particle 1840 times smaller than a hydrogen atom. - Ernest Rutherford's gold-foil experiment allowed him to discover the nucleus, a small, dense, positively-charged center of the atom where protons and neutrons can be found. - In the modern atomic model, electrons are found in three-dimensional areas called atomic orbitals. These orbitals vary in their shape and distance from the nucleus. - For the representative elements, we can use the position of an element on the periodic table to determine the number of valence electrons it will contain. - The stability of a nucleus is determined by the ratio of protons to neutrons. - Atoms can form ions when they gain or lose electrons.	- Identifying isotopes of a given element that have the same atomic number but different mass numbers. - Tracking the evolution of the atomic model over time as new subatomic particles were discovered. - Calculating the average atomic mass of an element using the masses and relative abundances of its isotopes.

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

Windham School District Curriculum
CP Chemistry: Periodic Table and Trends

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-PS1-1:** 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.
- **HS-PS1-2:** 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.

Transfer

Students will be able to independently use their learning to…

- Identify all the information that the periodic table can provide about the properties and behavior of elements.
- Describe how the properties of elements change in a predictable way according to their position on the periodic table.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- The periodic table is arranged in a way that allows us to find patterns in physical properties and reactivity among the various periods and groups.
- The trends in properties can help us to predict the behavior of elements and their ability to react with other elements.
- The number of valence electrons an atom of a representative element contains can be determined by its position on the periodic table.
- The number of valence electrons in an atom can determine its ability to form chemical bonds with other elements.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How can the periodic table help us to predict the properties and reactivity of the elements?
- How do the properties of elements change as we go across a period and down a group?
- What do the valence electrons in an atom tell us about their ability to react with other atoms?

Acquisition

Students will know…

- Elements in the same group on the periodic table share certain chemical properties, and their reactivity changes in predictable ways.
- Elements in the same period have predictable trends in their properties as we go from left to right.

Students will be skilled at…

- Identifying the important groups of elements on the periodic table (alkali metals, alkaline earth metals, halogens, and noble gasses) and predicting trends in their reactivity.

	● The number and location of electrons can help determine trends in the properties of atoms. ● Electronegativity measures the ability of an atom to attract electrons in a chemical bond; this quantity increases across a period and decreases down a group. ● First ionization energy measures the amount of energy required to remove the first electron from an atom to form an ion; this quantity increases across a period and decreases down a group. ● The atomic radius is a measure of the relative size of an atom; it generally decreases across a period and increases down a group. ● The group numbers of the representative elements help to determine the number of valence electrons their atoms will contain; each of these atoms will gain, lose or share electrons to attain a noble-gas electron configuration.	● Predicting how the properties of elements will change as we go across a period and down a group. ● Identifying which element in a pair has the lower or higher value for a given periodic property (eg. which of nitrogen and oxygen has the higher electronegativity). ● Predicting the number of valence electrons for a representative element and what ions it will form as a result.

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

Windham School District Curriculum
CP Chemistry: Chemical Equations

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-PS1-2:** 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.
- **HS-PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Transfer

Students will be able to independently use their learning to…

- Identify the type of bond that will occur between two elements and the type of compound they will form when they combine.
- Derive the names and formulas of ionic and molecular compounds.
- Write balanced chemical equations to represent simple chemical reactions.
- Recognize and identify the different types of chemical reactions.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- The periodic table can help us predict what types of bonds a given element will form.
- Ionic compounds generally form between metals and nonmetals, while molecular compounds are formed between two nonmetal atoms.
- Ionic compounds form in such a way that the net charge on the compound is zero.
- Balanced chemical equations obey the Law of Conservation of Mass; the number of atoms of each element is the same on both sides of an equation.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How can we predict what type of bond will form between any two atoms?
- What are the rules when finding the names and formulas of chemical compounds?
- How can equations be balanced, and why is it important to have a balanced equation?

Acquisition

Students will know…

- Ionic bonds form by the transfer of electrons from (generally) a metal to a nonmetal; this

Students will be skilled at…

- Determining whether a given pair of elements will form ionic or covalent bonds.

	creates positive and negative charges that attract each other to form a bond. ● Covalent bonds form by the sharing of electrons between nonmetal atoms; the compounds formed in this way are called molecular compounds. ● The names and formulas of ionic compounds are derived by following a series of rules; the most important of these is that the net charge must be zero. ● Nonmetals can combine in different proportions to form molecular compounds; prefixes help us to determine the number of each element in the compound. ● Chemical reactions can be categorized as one (or sometimes two) of the following types: synthesis, decomposition, single replacement, double replacement, and combustion.	● Determining the correct chemical formula for a compound given its name or the ions that make it up. ● Determining the correct name for a compound given its formula. ● Balancing simple chemical equations, whether or not the formulas of the substances are provided. ● Identifying a given chemical reaction by its type: synthesis, decomposition, single replacement, double replacement, or combustion.

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

Windham School District Curriculum
CP Chemistry: The Mole Concept, Stoichiometry and Solution Chemistry

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Transfer

Students will be able to independently use their learning to…

- Understand the concept of the mole and use it to determine the mass and number of particles in a mole of a given element or compounds.
- Use the mole concept to make simple conversions involving the mass and composition of compounds.
- Determine the relative amounts of substances participating in a chemical reaction using the principles of stoichiometry.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Chemical quantities are measured with Moles.
- The Law of Conservation of Matter is demonstrated through the balancing of chemical equations.
- There are five different types of chemical reactions.
- Acids are electron donors while bases are electron acceptors.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How are chemical quantities measured?
- How do we use the equations to demonstrate the Law of Conservation of Matter?
- How can chemical reactions be classified?
- What is the difference between acids and bases?

Acquisition

Students will know…

- Avagoadro’s number explains that the number of molecules in a single mole is 6.02x10^23.
- A mole is a unit that can be converted into other units that specify mass, volume or count.

Students will be skilled at…

- Predicting the chemical name and compounds of products of a chemical reaction based on the reactants.
- Determining the amount (moles) of product that will be produced based on their reactants.
- Creating different concentrations of solutions based on moles of materials dissolved in water.

	- Mole ratios are the coefficients of a balanced equation. - The Law of Conservation of Matter states that matter can not be created nor destroyed and is distributed evenly throughout the system. - Particles move from areas of high concentration to areas of low concentration. “Like dissolves like.” - Combustion, synthesis, decomposition, single and double displacement are the five different types of solutions. - pH scale is based on the amount of hydronium ions present in a solution, a lower number implies a lower pH. - pH scale is logarithmic.	

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

Windham School District Curriculum
CP Chemistry: Gas Laws

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

● **HS-PS1-5:** 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.
● **HS-PS1-6:** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*
● **HS-ESS2-5:** Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</td>
<td colspan="2">***Transfer***</td>
</tr>
<tr>
<td colspan="2">***Students will be able to independently use their learning to…***
● Use mathematics to predict the properties of gasses.
● Explain real gasses in terms of ideal gasses.</td>
</tr>
<tr><td colspan="2">***Meaning***</td></tr>
<tr>
<td>ENDURING UNDERSTANDINGS
Students will understand that…

● The Ideal Gas Law is PV=NRT.
● Kinetic Molecular Theory of Gases dictates that gasses are composed of tiny particles that exert pressure and are mainly empty space.
● Pressure and temperature are related.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is the Ideal Gas Law and how do we use it?
● What are the three parts of the Kinetic Molecular Theory of Gasses?
● How are real gasses different from ideal gasses?
● How are pressure and temperature related?</td>
</tr>
<tr><td colspan="2">***Acquisition***</td></tr>
<tr>
<td>***Students will know…***

● The Ideal gas laws are Boyle’s Law, Charles’ Law, Gay Lusac’s, and combined.
● 0 Kelvin is absolute zero.
● P= pressure, V= volume, N= number of moles, R is constant and T is the temp in K.
● Pressure and temperature are created by collisions of particles.
● Size of particles determines the motion of the particles.</td>
<td>***Students will be skilled at…***

● Demonstrating the five different gas laws using pressure-volume, temperature, and moles.
● Identifying gas laws through simulations.</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 skills
● Creativity
● Collaboration</td>
</tr>
</table>

Windham School District Curriculum
CP Chemistry: Properties of Matter

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-PS1-1:** 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.
- **HS-PS1-8**: 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.

Transfer

Students will be able to independently use their learning 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.

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
Students will be able to answer…

- 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.
- 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.

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	● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
CP Chemistry: Electrical Forces in Chemistry

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

● HS-PS1-3: 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.
● HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● “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 structure, properties, and transformations of matter, as well as the contact forces between material objects.</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 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.</td></tr>
</table>

		● 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		● Collaboration ● Communication ● Critical thinking ● Creativity

Windham School District Curriculum
CP Chemistry: Chemical Reactions

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

● HS-PS1-2: 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.
● HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● 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.</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
Students will be able to answer…

● 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 the atom’s nucleus and places those with similar chemical properties in columns.
● The repeating patterns of this table reflect.</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>

	• 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.	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		• Collaboration • Communication • Critical thinking

Windham School District Curriculum
CP Chemistry: Energy

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

● HS-PS1-4: Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
● HS-PS1-5: 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.
● HS-PS1-6: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning 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
Students will be able to answer…

● 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 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</td><td>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 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</td></tr>
</table>

	in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	evidence, prioritized criteria, and trade off considerations.
Used in Content Area Standards		***21st Century Skills***
not applicable		● One to one technology ● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
Honors Chemistry: Measurements, Matter and Energy

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **MS-PS1-1:** Develop models to describe the atomic composition of simple molecules and extended structures.
- **MS-PS1- 2:** Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
- **MS-PS1-4:** 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.
- **HS-PS2-6:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*

Transfer

Students will be able to independently use their learning to…

- Matter: An understanding that the arrangement of particles determines properties of substances.
- Energy: is the ability to do work and change the arrangement of particles.
- Identify and apply the golden rule of measurement.
- Using the correct units with types of measurements.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Matter is always moving.
- Atomic history and the major players to the development of the atom.
- An atom is composed of subatomic particles.
- Students will communicate using mathematics with different forms of processes, i.e. Density, heat.
- Students will use dimensional analysis to solve problems and convert units.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How can laboratory observations be used to generate conclusions about the relationship between matter and energy?
- Who discovered the atom and how is it made?
- How do I use mathematics in chemistry?
- How do I use dimensional analysis to solve problems?

Acquisition

Students will know…

- 3 states of matter and phase changes between them (KMT).
- classification of matter as a pure substance (element of the compound) or mixture (hetero- or homogeneous).

Students will be skilled at…

- Performing calculations with specific heat. ($q = m \times C_p \times \Delta T$).
- Identifying the historic models of the atom.

	• Perform calculations with standard heats equations. • Understand the difference between potential and kinetic energy, with specific examples related to chemistry. • Know the common units and their conversions: Joule, kilojoule, calorie, and kilocalorie. • Define endothermic versus exothermic reactions. • Density is a unit that includes matter, volume and mass. • Significant figures are used to appropriately round calculations. • Dimensional Analysis is used to convert between metric units and conversions. • The prefixes for metric are: Kilo, Hecka, Decka, Base, deci, centi, mili.	• Solving mathematical problems using derived units. • Applying significant figures to lab equipment.
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Communication skills • Creativity • Collaboration

Windham School District Curriculum
Honors Chemistry: Structure and Periodic Table

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-PS1-1:** 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
- **HS-PS1-8:** 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.
- **HS-ESS1-3:** Communicate scientific ideas about the way stars, over their life cycle, produce elements.
- **HS-PS1-2:** 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.

Transfer

Students will be able to independently use their learning to…

- Use a Periodic Table to predict the properties of elements.
- Movement and arrangement of electrons to define a substance's properties and characteristics such as light.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Structure and function: the way an object is shaped or structured determines many of its properties and functions.
- The characteristics of elements determine the arrangement of the periodic table.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How is the Periodic Table arranged?
- How does structure inform properties?

Acquisition

Students will know…

- How to identify and describe elements and their arrangements in the periodic based on the quantum mechanical model.
- Differentiate from atom/ion/isotope in terms of protons, neutrons, and electrons.
- Determine the number of valence electrons for an atom or ion.
- Describe the electromagnetic spectrum in terms of wavelength, frequency, and energy.

Students will be skilled at…

- Writing electron configuration of elements.
- Calculating a photon of light.
- Predicting properties of elements based on its location on the periodic table.

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

Windham School District Curriculum
Honors Chemistry: Bonding

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-PS1-4:** Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

Transfer

Students will be able to independently use their learning to…

- Understand why different types of bonds are formed.
- Determine the shape of a compound based on its bonds.

Meaning

ENDURING UNDERSTANDINGS ***Students will understand that…***	ESSENTIAL QUESTIONS ***Students will be able to answer…***
• The strong electrostatic forces of attraction holding atoms together in a unit are called chemical bonds. • The geometry of molecular compounds determines the polarity of the compound. • The shape of a molecule is impacted by the arrangement of electron pairs.	• Why are the properties exhibited by ionic compounds different from those exhibited by covalent compounds? • What effect does electron pair repulsion have on the geometry of molecular compounds? • How does the geometry of molecular compounds determine the polarity of the compound?

Acquisition

Students will know…	***Students will be skilled at…***
• Compounds with covalent bonds exhibit different characteristics than compounds formed with ionic bonds. • The Lewis structure model, combined with valence shell electron pair repulsion (VSEPR), can be used to predict many structural features of covalently bonded molecules and ions.	• Drawing 2D and 3D shaped molecules using VESPR Theory. • Testing and determining the chemical nature of different substances.

	- Ionic bonding is the phrase used to describe the strong Coulombic interaction between ions in an ionic substance. - The bonding in metals is characterized by the delocalization of valence electrons. - There are 8 core shapes to molecules based on geometry i.e., pyramidal and tetrahedral. - Some examples of molecular forces are hydrogen bonds, Van Der Waals, dipole-dipole, and london dispersion.	
Used in Content Area Standards		***21st Century Skills***
not applicable		- Critical thinking - Communication skills - Creativity - Collaboration

Windham School District Curriculum
Honors Chemistry: Stoichiometry and Solutions

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

● HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
● MS-PS1-5: 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</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used.
● Determine the chemical composition in compounds and chemical reactions using the Mole.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Chemical quantities are measured with Moles.
● The Law of Conservation of Matter is demonstrated through the balancing of chemical equations.
● There are five different types of chemical reactions.
● Acids are electron donors while bases are electron acceptors.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How are chemical quantities measured?
● How do we use the equations to demonstrate the Law of Conservation of Matter?
● How can chemical reactions be classified?
● What is the difference between acids and bases?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Avagoadro's number explains that the number of molecules in a single mole is 6.02x10^23.
● A mole is a unit that can be converted into other units that specify mass, volume or count.</td><td>Students will be skilled at…

● Determining the pH of a solution based on titration.
● Determining the amount of product that will be produced based on their reactants.</td></tr>
</table>

	- Mole ratios are the coefficients of a balanced equation. - The Law of Conservation of Matter states that matter can not be created nor destroyed and is distributed evenly throughout the system. - Particles move from areas of high concentration to areas of low concentration. “Like dissolves like.” - Combustion, synthesis, decomposition, single and double displacement are the five different types of solutions. - pH scale is based on the amount of hydronium ions present in a solution, a lower number implies a lower pH. - pH scale is logarithmic.	Creating different concentrations of solutions based on moles of materials dissolved in water.

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

Windham School District Curriculum
Honors Chemistry: Gas Laws

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

● HS-PS1-5: 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.
● HS-PS1-6: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*
● HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Use mathematics to predict the properties of gasses.
● Explain real gasses in terms of ideal gasses.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● The Ideal Gas Law is PV=NRT.
● Kinetic Molecular Theory of Gases dictates that gasses are composed of tiny particles that exert pressure and are mainly empty space.
● Pressure and temperature are related.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is the Ideal Gas Law and how do we use it?
● What are the three parts of the Kinetic Molecular Theory of gasses?
● How are real gasses different from ideal gasses?
● How are pressure and temperature related?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● The Ideal gas laws are Boyle's Law, Charles' Law, Gay Lusac's, and combined.
● 0 Kelvin is absolute zero.
● P= pressure, V= volume, N= number of moles, R is constant and T is the temp in K.
● Pressure and temperature are created by collisions of particles.
● Size of particles determines the motion of the particles.
● Graham's law explains the dispersion of gasses.</td><td>Students will be skilled at…

● Demonstrating the five different gas laws using pressure-volume, temperature, and moles.
● Identifying gas laws through simulations.</td></tr>
</table>

	• Effusion is particle movement through an opening while diffusion is the mixing of gasses.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Communication skills • Creativity • Collaboration

Windham School District Curriculum
Honors Chemistry: Thermodynamics

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

● HS-PS3-1: 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. [
● HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*
● HS-PS3-4: 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).
● MS-PS1-6: Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*
● HS-PS1-4: Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Understanding the Laws of Thermodynamics and how to apply them to chemical reactions.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● The Law of Conservation of Energy states that energy cannot be created or destroyed but it can be converted from one form to another.
● The second Law of Thermodynamics states that disorder increases over time and this is called entropy.
● Hess's Law states that the amount of heat involved in producing one chemical from another no matter how many stages are taken.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are the first and second Laws of Thermodynamics?
● What is Hess's law and how do we apply it?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Delta H= change in Heat, Delta T is change in Temperature, Delta S is Entropy and G= Gibbs Free Energy.
● Calorimeters are used to measure the amount of energy stored in the bonds of a substance.
● Endothermic reactions have energy as a reactant while exothermic reactions have energy as a product.</td><td>Students will be skilled at…

● Tracking the energy of an entire reaction to determine the amount of energy in a compound.
● Determining the amount of energy in a system by using the rate of release.</td></tr>
</table>

	• The sum of all of the energy in the bonds is equal to the total energy of the substance. • Spontaneous reactions are exothermic and have very low activation energy. • Endothermic reactions have less energy than the reactants.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Communication skills • Creativity • Collaboration

Windham School District Curriculum
AP Biology: Chemistry of Life

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

BIG IDEA 2: ENERGETICS (ENE) Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.

BIG IDEA 3: INFORMATION STORAGE AND TRANSMISSION (IST) Living systems store, retrieve, transmit, and respond to information essential to life processes.

BIG IDEA 4: SYSTEMS INTERACTIONS (SYI) Biological systems interact, and these systems and their interactions exhibit complex properties.

NGSS Science Standards

● HS-LS1-1: 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.
● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Use data to evaluate a hypothesis (or prediction), including
  ○ Rejecting or failing to reject the null hypothesis.
  ○ Supporting or refuting the alternative hypothesis.
● Explain biological concepts, processes, and/or models in applied contexts.
● Explain the relationship between experimental results and larger biological concepts, processes, or theories.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Living systems are organized in a hierarchy of structural levels that interact.
● The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
● Heritable information provides for continuity of life.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is the role of energy in the making and breaking of polymers?
● How do living things transmit information in order to ensure their survival?
● How would living systems function without the polarity of the water molecule?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

● The subcomponents of biological molecules and their sequence determine the properties of that molecule.
● Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.</td><td>Students will be skilled at…

● Describing characteristics of a biological concept, process, or model represented visually.
● Describing biological concepts and/ or processes.
● Representing biological concepts.</td></tr>
</table>

	• Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers. • DNA and RNA molecules have structural similarities and differences related to their function. • DNA and RNA molecules have structural similarities and differences related to their function.	• Predicting the causes or effects of a change in, or disruption to, one or more components in a biological system based on a visual.
Used in Content Area Standards		***21st Century Skills***
not applicable		• Critical thinking • Communication skills • Creativity • Collaboration

Windham School District Curriculum
AP Biology: Cell Structure and Function

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

BIG IDEA 1: EVOLUTION (EVO) The process of evolution drives the diversity and unity of life

BIG IDEA 2: ENERGETICS (ENE) Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.

BIG IDEA 3: INFORMATION STORAGE AND TRANSMISSION (IST) Living systems store, retrieve, transmit, and respond to information essential to life processes.

BIG IDEA 4: SYSTEMS INTERACTIONS (SYI) Biological systems interact, and these systems and their interactions exhibit complex properties.

NGSS Science Standards
- **HS-LS1-3:** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- **HS-LS1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Transfer

Students will be able to independently use their learning to…

- The ability to describe biological processes, principles, and concepts is central to the study of biology.
- Making a claim, supporting it with evidence, and providing reasoning to support the claim

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Living systems are organized in a hierarchy of structural levels that interact.
- The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
- Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments.
- Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence.

ESSENTIAL QUESTIONS
Students will be able to answer…

- Defend the origin of eukaryotic cells.
- How do the mechanisms for transport across membranes support energy conservation?
- What are the advantages and disadvantages of cellular compartmentalization?
- How are living systems affected by the presence or absence of subcellular components?

Acquisition

Students will know…

- Organelles and subcellular structures, and the interactions among them, support cellular function.
- The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.

Students will be skilled at…

- Supporting a claim with evidence from biological principles, concepts, processes, and/or data.
- Predicting the causes or effects of a change in, or disruption to, one or more components

	• The surface area of the plasma membrane must be large enough to adequately exchange materials. • Mitochondria have a double membrane. The outer membrane is smooth, but the inner membrane is highly convoluted, forming folds. • The folding of the inner membrane increases the surface area, which allows for more ATP to be synthesized. • Eukaryotic cells underwent an evolutionary process that can be explained with Lynn Margulis' Endosymbiont Theory. • Molecules are transported both passively and actively through the membrane itself and membrane proteins. • Life Occurs in compartments with different environmental factors that allow for cellular processes to occur. • Surface area-to-volume ratios affect the ability of a biological system to obtain necessary resources, eliminate waste products, acquire or dissipate thermal energy, and otherwise exchange chemicals and energy with the environment. • Organisms have evolved highly efficient strategies to obtain nutrients and eliminate wastes. Cells and organisms use specialized exchange surfaces to obtain and release molecules from or into the surrounding environment.	in a biological system based on biological concepts or processes. • Explaining biological concepts and/or processes. • Using data to evaluate a hypothesis (or prediction), including supporting or refuting the alternative hypothesis.

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

Windham School District Curriculum

AP Biology: Cellular Energetics

Stage 1 Desired Results

ESTABLISHED GOALS:

College Board Big Ideas

BIG IDEA 1: EVOLUTION (EVO) The process of evolution drives the diversity and unity of life

BIG IDEA 2: ENERGETICS (ENE) Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.

BIG IDEA 3: INFORMATION STORAGE AND TRANSMISSION (IST) Living systems store, retrieve, transmit, and respond to information essential to life processes.

BIG IDEA 4: SYSTEMS INTERACTIONS (SYI) Biological systems interact, and these systems and their interactions exhibit complex properties.

NGSS Science Standards

- **HS-LS1-5:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- **HS-LS1-6:** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine

Transfer

Students will be able to independently use their learning to…

- Gaining proficiency in argumentation through supporting claims with evidence. The evidence can be from biological principles, concepts, processes, and/or data.

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
- Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

ESSENTIAL QUESTIONS

Students will be able to answer…

- How is energy captured and then used by a living system?
- How do organisms use energy or conserve energy to respond to environmental stimuli?

Acquisition

Students will know…

- The structure of enzymes includes the active site that specifically interacts with substrate molecules.
- The structure and function of enzymes contribute to the regulation of biological processes.
- Change to the molecular structure of a component in an enzymatic system may

Students will be skilled at…

- Predicting the causes or effects of a change in, or disruption to, one or more components in a biological system based on data.
- Explaining biological concepts and/ or processes.
- Providing reasoning to justify a claim by connecting evidence to biological theories.

with other elements to form amino acids and/or other large carbon-based molecules. ● **HS-LS1-7:** 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. ● **HS-LS2-3:** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● **HS-LS2-4:** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. ● **HS-LS2-5:** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	result in a change of the function or efficiency of the system. ● All living systems require constant input of energy. ● Organisms capture and store energy for use in biological processes. ● Fermentation and cellular respiration use energy from biological macromolecules to produce ATP. Respiration and fermentation are characteristic of all forms of life. ● The conversion of ATP to ADP releases energy, which is used to power many metabolic processes. ● Variation at the molecular level provides organisms with the ability to respond to a variety of environmental stimuli.	

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

Windham School District Curriculum
AP Biology: Cell Division

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

● BIG IDEA 1: EVOLUTION (EVO) The process of evolution drives the diversity and unity of life
● BIG IDEA 2: ENERGETICS (ENE) Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.
● BIG IDEA 3: INFORMATION STORAGE AND TRANSMISSION (IST) Living systems store, retrieve, transmit, and respond to information essential to life processes.
● BIG IDEA 4: SYSTEMS INTERACTIONS (SYI) Biological systems interact, and these systems and their interactions exhibit complex properties.

NGSS Science Standards
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
● HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
● HS-LS3-2:. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Students build on their abilities to describe and explain biological concepts and processes by describing the cell cycle regulation.
● By performing laboratory investigations focused on the concepts of cell cycle, students should develop an understanding of how to formulate and devise a plan to investigate the answer to a scientific question.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Cells Use energy to communicate with each other through signal transduction pathways.
● The cell uses the process of Mitosis to divide which conserves the integrity of the genetic message.
● Cells communicate in a variety of ways using both intracellular and extracellular processes.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● In what ways do cells use energy to communicate with one another?
● How does the cell cycle aid in the conservation of genetic information?
● Why and in what ways do cells communicate with one another?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Prophase, Metaphase, Anaphase and Telophase are the stages of Mitosis and Interphase is the stage that represents normal cell life.
● The cell cycle is the life cycle of the cell. It phases progress due to the types and chemical messages that are sent both intracellularly and extracellularly.</td>
<td>Students will be skilled at…

● Describing biological concepts and/or processes.
● Predicting the causes or effects of a change in, or disruption to, one or more components in a biological system based on a visual representation of a biological concept, process, or model.</td></tr>
</table>

through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. ● **HS-LS3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. ● **HS-LS1-2:** Develop and use a model to illustrate the hierarchical	● Signal Transduction Pathways are a form of cellular messaging that includes a number of different protein and lipid messengers. ● Cancer is a disease of the cell cycle where signals are sent incorrectly and cause uncontrolled cell division. ● Cells communicate over short distances by using local regulators that target cells in the vicinity of the signal-emitting cell. ● Signaling begins with the recognition of a chemical messenger—a ligand—by a receptor protein in a target cell. ● Signaling cascades relay signals from receptors to cell targets, often amplifying the incoming signals, resulting in the appropriate responses by the cell, which could include cell growth, secretion of molecules, or gene expression. ● Signal transduction may result in changes in gene expression and cell function, which may alter phenotype or result in programmed cell death (apoptosis).	● Describing data from a table or graph, including describing trends and/or patterns in the data.

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

Windham School District Curriculum
AP Biology: Heredity

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

● BIG IDEA 1: EVOLUTION (EVO) The process of evolution drives the diversity and unity of life
● BIG IDEA 2: ENERGETICS (ENE) Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.
● BIG IDEA 3: INFORMATION STORAGE AND TRANSMISSION (IST) Living systems store, retrieve, transmit, and respond to information essential to life processes.
● BIG IDEA 4: SYSTEMS INTERACTIONS (SYI) Biological systems interact, and these systems and their interactions exhibit complex properties.

NGSS Science Standards
● HS-LS1-1: 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.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Comparing patterns and trends in data, students will describe biological changes that occur over time, predict short-term and long-term changes, and draw conclusions about the causes and/or solutions to problems in biological systems .</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Heritable information provides for continuity of life.
● Heritable information provides for continuity of life.
● Heritable information provides for continuity of life.
● Organisms are linked by lines of descent from common ancestry.
● Heritable information provides for continuity of life.
● Naturally occurring diversity among and between components within biological systems affects interactions with the environment.
● Naturally occurring diversity among and between components within biological systems affects interactions with the environment.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How is our understanding of evolution influenced by our knowledge of genetics?
● Why is it important that not all inherited characteristics get expressed in the next generation?
● How would Mendel’s laws have been affected if he had studied a different type of plant?
● How does the diversity of a species affect inheritance?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Meiosis is a process that ensures the formation of haploid gamete cells in sexually reproducing diploid organisms.
● Mitosis and meiosis are similar in the way chromosomes segregate but differ in the number of cells produced and the genetic content of the daughter cells.</td><td>Students will be skilled at…

● Predicting the causes or effects of a change in, or disruption to, one or more components in a biological system based on a visual representation of a biological concept, process, or model.</td></tr>
</table>

• **HS-LS3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	• Separation of the homologous chromosomes in meiosis I ensures that each gamete receives a haploid (1n) set of chromosomes that comprises both maternal and paternal chromosomes. • DNA and RNA are carriers of genetic information. • Core metabolic pathways are conserved across all currently recognized domains. • Mendel's laws of segregation and independent assortment can be applied to genes that are on different chromosomes. • Fertilization involves the fusion of two haploid gametes, restoring the diploid number of chromosomes and increasing genetic variation in populations by creating new combinations of alleles in the zygote. • Patterns of inheritance of many traits do not follow ratios predicted by Mendel's laws and can be identified by quantitative analysis, where observed phenotypic ratios statistically differ from the predicted ratios. • Some traits are determined by genes on sex chromosomes and are known as sexlinked traits. The pattern of inheritance of sex-linked traits can often be predicted from data, including pedigree, indicating the parent genotype/phenotype and the offspring genotypes/phenotypes. • Some traits result from non-nuclear inheritance. • Environmental factors influence gene expression and can lead to phenotypic plasticity. Phenotypic plasticity occurs when individuals with the same genotype exhibit different phenotypes in different environments.	• Explaining biological concepts, processes, and/or models in applied contexts. • Selecting and performing appropriate statistical hypothesis testing. • Identify or pose a testable question based on an observation, data, or a model.

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

Windham School District Curriculum
AP Biology: Gene Expression and Regulation

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

● BIG IDEA 1: EVOLUTION (EVO) The process of evolution drives the diversity and unity of life
● BIG IDEA 2: ENERGETICS (ENE) Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.
● BIG IDEA 3: INFORMATION STORAGE AND TRANSMISSION (IST) Living systems store, retrieve, transmit, and respond to information essential to life processes.
● BIG IDEA 4: SYSTEMS INTERACTIONS (SYI) Biological systems interact, and these systems and their interactions exhibit complex properties.

NGSS Science Standards
● HS-LS1-1: 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.
● HS-LS3-1: Ask questions to clarify relationships about the role of DNA and</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● To create or use a representation/model to communicate biological phenomena, use the model to solve a problem, and refine the model or representation to analyze situations or solve problems.
● Argumentation by predicting the causes or effects of a change in, or disruption to, one or more components in a biological system.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Heritable information provides for continuity of life.
● Differences in the expression of genes account for some of the phenotypic differences between organisms.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How is a species' genetic information diversified from generation to generation?
● How does gene regulation relate to the continuity of life?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● DNA, and in some cases RNA, is the primary source of heritable information.
● DNA, and sometimes RNA, exhibits specific nucleotide base pairing that is conserved through evolution: adenine pairs with thymine or uracil (A-T or A-U) and cytosine pairs with guanine (C-G).
● DNA replication ensures continuity of hereditary information.
● The sequence of the RNA bases, together with the structure of the RNA molecule, determines RNA function.</td><td>Students will be skilled at…

● Explaining relationships between different characteristics of biological concepts, processes, or models represented visually in applied contexts.
● Representing relationships within biological models, including diagrams.
● Support a claim with evidence from biological principles, concepts, processes, and/or data.
● Explaining biological concepts, processes, and/or models in applied contexts.</td></tr>
</table>

chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	● Translation of the mRNA to generate a polypeptide occurs on ribosomes that are present in the cytoplasm of both prokaryotic and eukaryotic cells and on the rough endoplasmic reticulum of eukaryotic cells. ● Regulatory sequences are stretches of DNA that interact with regulatory proteins to control transcription. ● Promoters are DNA sequences upstream of the transcription start site where RNA polymerase and transcription factors bind to initiate transcription. ● Errors in DNA replication or DNA repair mechanisms, and external factors, including radiation and reactive chemicals, can cause random mutations in the DNA.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Critical thinking ● Communication skills ● Creativity ● Collaboration

Windham School District Curriculum
AP Biology: Natural Selection

Stage 1 Desired Results

ESTABLISHED GOALS:
College Board Big Ideas

- **BIG IDEA 1**: EVOLUTION (EVO) The process of evolution drives the diversity and unity of life
- **BIG IDEA 2:** ENERGETICS (ENE) Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.
- **BIG IDEA 3:** INFORMATION STORAGE AND TRANSMISSION (IST) Living systems store, retrieve, transmit, and respond to information essential to life processes.
- **BIG IDEA 4:** SYSTEMS INTERACTIONS (SYI) Biological systems interact, and these systems and their interactions exhibit complex properties.

NGSS Science Standards
- **HS-LS4-1:** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- **HS-LS4-2**: 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

Transfer

Students will be able to independently use their learning to…

- Students can create or use models such as cladograms and phylogenetic trees to communicate biological phenomena, analyze situations, or solve new problems.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence.
- Organisms are linked by lines of descent from common ancestry.
- Life continues to evolve within a changing environment.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What conditions in a population make it more or less likely to evolve?
- Scientifically defend the theory of evolution.
- How does species interaction encourage or slow changes in species?

Acquisition

Students will know…

- Natural selection is a major mechanism of evolution.
- Evolutionary fitness is measured by reproductive success.
- Natural selection acts on phenotypic variations in populations.
- Through artificial selection, humans affect variation in other species.
- Evolution is also driven by random occurrences.
- Hardy-Weinberg is a model for describing and predicting allele frequencies in a non evolving population. Conditions for a population or an allele

Students will be skilled at…

- Describing data from a table or graph, including identifying specific data points.
- Explaining biological concepts, processes, and/ or models in applied contexts.
- Describing characteristics of a biological concept, process, or model represented visually.
- Predicting the causes or effects of a change in, or disruption to, one or

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 . ● **HS-LS4-3:** 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. ● **HS-LS4-4:** Construct an explanation based on evidence for how natural selection leads to adaptation of populations. ● **HS-LS4-5:** 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.	to be in Hardy-Weinberg equilibrium are—(1) a large population size, (2) absence of migration, (3) no net mutations, (4) random mating, and (5) absence of selection. These conditions are seldom met, but they provide a valuable null hypothesis. ● Evolution is supported by scientific evidence from many disciplines (geographical, geological, physical, biochemical, and mathematical data). ● Structural evidence indicates common ancestry of all eukaryotes. ● Populations of organisms continue to evolve. ● Phylogenetic trees and cladograms show evolutionary relationships among lineages. ● Speciation may occur when two populations become reproductively isolated from each other. ● Extinctions have occurred throughout Earth's history. ● The level of variation in a population affects population dynamics. ● Several hypotheses about the origin of life on Earth are supported with scientific evidence.	more components in a biological system based on a visual representation of a biological concept, process, or model.

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

Windham School District Curriculum
AP Biology: Ecology

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

● BIG IDEA 1: EVOLUTION (EVO) The process of evolution drives the diversity and unity of life
● BIG IDEA 2: ENERGETICS (ENE) Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.
● BIG IDEA 4: SYSTEMS INTERACTIONS (SYI) Biological systems interact, and these systems and their interactions exhibit complex properties.

NGSS Science Standards
● 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-LS2-6: 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 to independently use their learning to…
● Designing research to test biological systems is at the heart of this course. Students should be able to understand and evaluate experimental plans designed and conducted by others.
● Planning and implementing data collection strategies that test biological systems, in order to understand and develop solutions to problems within biological systems.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence.
● Transmission of information results in changes within and between biological systems.
● The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
● Living systems are organized in a hierarchy of structural levels that interact.
● Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.
● Naturally occurring diversity among and between components within biological systems affects interactions with the environment.
● Evolution is characterized by change in the genetic make-up of a population over time and is supported by multiple lines of evidence.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How does diversity among and between species in a biological system affect the evolution of species within the system?
● How does the acquisition of energy relate to the health of a biological system?
● How do communities and ecosystems change, for better or worse, due to biological disruption?
● How does a disruption of a biological system affect genetic information storage and transmission?
● How do species interactions affect the survival of an ecosystem?</td></tr>
</table>

<table>
<tr><td rowspan="2">

- **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">Acquisition</td></tr>
<tr><td>

Students will know…

- Organisms respond to changes in their environment through behavioral and physiological mechanisms.
- Individuals can act on information and communicate it to others.
- Organisms use energy to maintain organization, grow, and reproduce.
- Changes in energy availability can result in changes in population size.
- Populations comprise individual organisms that interact with one another and with the environment in complex ways.
- A population can produce a density of individuals that exceeds the system's resource availability.
- The structure of a community is measured and described in terms of species composition and species diversity.
- Natural and artificial ecosystems with fewer component parts and with little diversity among the parts are often less resilient to changes in the environment.

</td><td>

Students will be skilled at…

- Identifying experimental procedures that are aligned to the question, including identifying dependent and independent variables.
- Constructing a graph, plot, or chart.
- Performing mathematical calculations, including rates.
- Using confidence intervals and/or error bars (both determined using standard errors) to determine whether sample means are statistically different.
- Using data to evaluate a hypothesis (or prediction), including rejecting or failing to reject the null hypothesis.

</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 skills
- Creativity
- Collaboration

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

Windham School District Curriculum
CP Biology: The Nature of Life

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS4-1:** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

Transfer

Students will be able to independently use their learning to…

- Use appropriate criteria to identify something as living or nonliving.
- Demonstrate effective and safe scientific practices.

Meaning

ENDURING UNDERSTANDINGS ***Students will understand that…***	ESSENTIAL QUESTIONS ***Students will be able to answer…***
• Life is defined by specific characteristics. • These defining characteristics may change. over time due to scientific discoveries.	• How do scientists currently define life? • Should a virus be considered alive?

Acquisition

Students will know…	***Students will be skilled at…***
• There are currently 8 characteristics of life which are used to define all living things. • The differences between asexual and sexual reproduction. • Living organisms respond to their environment, are organized by cells, contain genetic information, grow/develop, reproduce, maintain homeostasis, and adapt/evolve.	• Gathering/Using evidence to support a claim with valid scientific reasoning. • Communicating scientific ideas through written and spoken formats.

Used in Content Area Standards	***21st Century Skills***
not applicable	• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
CP Biology: Biochemistry

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

● 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-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Compare the four macromolecules by form and function.
● Connect the food items they consume to the macromolecules utilized by their cells.
● Form connections between energy and matter.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Energy is stored within the bonds of molecules.
● Carbohydrates, lipids, proteins, and nucleic acids have varying forms and varying functions.
● The shape or form of a molecule relates to its function.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How is energy stored and released in molecules?
● What is the primary function of each macromolecule?
● How does the shape/form of a molecule relate to its function?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● The importance of a varied and nutritional diet to get the materials and energy we need to function.
● Energy from food comes from breaking down chemical bonds between atoms.
● The 4 major categories of organic molecules and their respective functions within cells.
● Examples of how molecular structure relates to function (ex. Long chain carbs and lipids are large molecules with lots of bonds and therefore they store long-term energy; proteins can be cylinder-shaped and provide channels through membranes; enzymes and substrates fit like a lock and key).</td><td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning.
● Communicating scientific ideas through written and spoken formats.</td></tr>
</table>

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

Windham School District Curriculum
CP Biology: Cell Structure and Function

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

● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Explain and give examples of how a cell is a system of working parts that are interdependent.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Cells vary in their complexity but need to perform the same functions.
● Organelles within the cell work together to perform cell functions (take in food, process and extract energy and materials, build new things etc.) to maintain homeostasis.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How are plant and animal cells different and alike?
● What evidence do we have that complex cells arose from endosymbiosis of simple cells?
● How do organelles collaborate to carry out complex functions within a cell?</td></tr>
<tr><td colspan="2">Acquisition
<table><tr><td>Students will know…

● The differences and similarities of plant and animal cells in structure and function.
● The current scientific theory that complex cells arose from simple cells and the lines of evidence that support this theory.
● The function and structure of major organelles within a cell.
● How the structure of an organelle relates to its function.
● An example of a complex process (e.g. food/molecule intake and processing) and the organelles that are involved.</td><td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning.
● Communicating scientific ideas through written and spoken formats.
● Constructing explanations and designing solutions.</td></tr></table></td></tr>
</table>

	• Diffusion is the passive movement of materials across a cell membrane. • Osmosis is the diffusion of water across a cell membrane.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
CP Biology: Cell Processes

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

● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis
● HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
● HS-LS1-7: 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.
● HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
● HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Explain how energy is captured and used by living organisms.
● Explain why cells need to divide.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Chemical energy is harvested by cells in different ways depending on the environment.
● Multicellular organisms are composed of many cells which divide to allow for growth and to meet demands for energy and materials.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do cells process energy in different environments (aerobic vs. anaerobic)?
● Why do cells need to divide?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Differences between lactic acid fermentation and cell respiration,
● ATP is useful as an energy currency.
● ATP is recharged in oxygen-rich and oxygen-low environments.
● How cell respiration and photosynthesis are related.
● Matter (atoms) is rearranged in a series of small steps within living organisms.</td><td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning
● Communicating scientific ideas through written and spoken formats
● Analyze diagrams (models of glycolysis, cell respiration, and photosynthesis) and chemical equations
● Collaborate with peers to carry out a set of instructions and collect data
● Demonstrating lab safety procedures</td></tr>
</table>

● **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-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.	● Energy is released when chemical bonds are broken and stored when new chemical bonds are made. ● Cells size remains small to increase the surface area to volume ratio. ● Cells divide in the process of mitosis. ● Uncontrolled cell division can lead to cancer.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Critical Thinking ● Communication

Windham School District Curriculum
CP Biology: Genetics Part 1 (Meiosis)

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

● HS-LS1 -4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
● HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Explain how heredity is transmitted from one generation to the next.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Reproduction in a species can occur both sexually and asexually.
● DNA is packaged in reproductive cells to be passed on to the next generation through sexual reproduction.
● Variation within a species and population is attained through mitosis and sexual reproduction.
● Errors during mitosis can lead to chromosomal disorders.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do organisms reproduce?
● How is heredity passed down through generations?
● What causes variation in a population?
● What happens when meiosis goes wrong?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Advantages of sexual reproduction.
● The process of meiosis begins with one diploid cell and concludes with 4 haploid cells.
● Meiosis occurs in 2 stages.</td><td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning.
● Communicating scientific ideas through written and spoken formats.
● Analyze diagrams and graphical data (e.g. karyotypes).</td></tr>
</table>

	● There are three ways in which variation is introduced during sexual reproduction and meiosis: ○ Random fertilization ○ Crossing over ○ Independent assortment ● When chromosomes fail to separate correctly, it can result in a trisomy or cell death. ● Down syndrome is an example of a trisomy in which the 21st chromosome fails to split correctly.	● Drawing and interpreting diagrams to model a complex cellular process (e.g. steps of meiosis).
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Critical Thinking ● Communication

Windham School District Curriculum
CP Biology: Genetics Part 2 (Mendelian)

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS3-1:** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- **HS-LS3-2:** 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.
- **HS-LS3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Transfer

Students will be able to independently use their learning to…

- Explain how heredity is transmitted from one generation to the next.

Meaning

ENDURING UNDERSTANDINGS ***Students will understand that…***	ESSENTIAL QUESTIONS ***Students will be able to answer…***
• Traits are inherited in a probabilistic manner through sexual reproduction. • The traits you show or possess are the result of combinations of alleles and the principles of dominance (or other principles: codominance, sex-linked traits).	• Compared to their parents, why do organisms that are a result of sexual reproduction vary in their genes and traits? • How can we predict the probability of genes and traits of offspring using the genetic information of the parent generation?

Acquisition

Students will know…	***Students will be skilled at…***
• DNA is organized into chromosomes which contain many genes. • Genes are sets of nucleotide sequences that code for a protein. • An allele is a version of a gene. • A genotype is a combination of alleles (one inherited from each parent). • A phenotype is a trait that shows based on the genotype. • How to draw and interpret a punnett square. • The principle of dominance states that one allele will be dominant over the other and this determines an organism's phenotype.	• Gathering/Using evidence to support a claim with valid scientific reasoning. • Communicating scientific ideas through written and spoken formats. • Drawing and interpreting diagrams (punnett squares) to model a complex cellular process.

	• Other patterns of inheritance can create different phenotypes (codominance, sex-linked, incomplete dominance, polyploidy). • Pedigrees are useful tools that trace patterns of inheritance through generations.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
CP Biology: Genetics Part 3 (Central Dogma)

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

● HS-LS1-1: 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.
● HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
● HS-LS3-2: 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.
● HS-LS3-1: Ask questions to clarify relationships about
● the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</td>
<td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Students will be able to explain the transfer of information from DNA to RNA and finally, to proteins.
● Students will understand how and why mutations in the genetic code occur and how the expression of these mutations can impact a living organism.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● The structure and function of DNA and how it is expressed.
● DNA is copied and the information is passed on to the next generation of cells.
● Errors in mutations occur. Many mutations are expressed, however most are silent.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What is the structure of DNA and how does it dictate its function?
● How is genetic information passed on?
● What are mutations and how do they impact an organism?</td></tr>
<tr><td colspan="2">Acquisition
<table><tr><td>Students will know…

● Amino acids are the building blocks of proteins
● Nucleotides are the building blocks of nucleic acids.
● DNA is a double-stranded molecule that needs to be unpackaged and unwound in order for the code to be copied or read.
● RNA is a single-stranded molecule that is a copy of the DNA strand.
● One form of RNA is messenger RNA, which relays the DNA code to a ribosome.
● Ribosomes are the sites of translation (RNA to protein).</td><td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning.
● Communicating scientific ideas through written and spoken formats.</td></tr></table></td></tr>
</table>

	• Enzymes (proteins) play key roles in transcription and translation. • The code or language of DNA is in the sequence of triplicate bases. • How to use a codon wheel to interpret a DNA code and translate that to an amino acid sequence.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
CP Biology: Evolution and The Classification of Life

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards
HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
HS-LS4-2: 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
HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations
HS-LS4-5: 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</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Explain how life on Earth is organized into different groups based on phylogeny, morphologies and genetics sequences.
Explain how all of life on Earth is related and provide evidence to support this claim.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Life is organized into categories based on similarities and heredity.
Prokaryotic cells evolved into eukaryotic cells and the Endosymbiotic Theory describes that evolution.
Artificial and Natural Selection are two of the guiding forces that direct the change on life over time.
The scientific theory of Evolution is backed by many, many tested hypotheses and can be explained clearly and logically.
Changes in populations are predictable and able to be calculated by using equations like Hardy-Weinberg.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
What are the three domains and what information is used to describe them?
What is the endosymbiotic theory?
How are artificial and natural selection similar? How are they different?
What evidence do we use to prove that all of life on Earth is related?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…
Life is divided into 3 domains, Prokarya, Eukarya and Archaea. There are many subcategories used to organize life.</td><td>Students will be skilled at…
Gathering/Using evidence to support a claim with valid scientific reasoning.</td></tr>
</table>

species over time, and (3) the extinction of other species	● The most specific taxa for an organism is "species." ● The endosymbiotic theory describes the evolution of prokaryotic cells into eukaryotic cells by using evidence to describe a sequence of host cells engulfing smaller cells and then incorporating them into their own system. ● Artificial selection is the process where humans select how another species will change over time whereas natural selection is the process where nature impacts that change. ● The evidence used to support evolution is transition fossils, analogous and homologous structures, vestigial structures, geographical distribution.	● Communicating scientific ideas through written and spoken formats.
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Critical Thinking ● Communication

Windham School District Curriculum
CP Biology: Anatomy

Stage 1 Desired Results

ESTABLISHED GOALS:

NGSS Science Standards

- **HS-LS1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms

Transfer

Students will be able to independently use their learning to…

- Identify the structure and function of organ systems within an organism.
- Gain an understanding of how their body works so they can ask informed questions about their health.

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- Food is broken down during digestion and travels through a number of different organs which aid in the digestion process.
- The reproductive organs in males and females are related in structure, but change through development to serve different purposes.
- The respiratory system exists in the thoracic cavity and functions as a major entry and exit point for materials.

ESSENTIAL QUESTIONS

Students will be able to answer…

- How do the organs of the digestive system work together to maximize nutrient absorption for an organism?
- How are the respiratory and cardiovascular systems related and how do they work together to deliver materials to and from cells?
- How are the female and male reproductive organs structurally similar and different?

Acquisition

Students will know…

- The basic layout of the central body cavity of mammals.
- The hierarchical organization of living things (tissues are organized into organs, which are organized into organ systems within an organism).
- The function of major respiratory organs (lungs, heart, vessels, trachea).

Students will be skilled at…

- Gathering/Using evidence to support a claim with valid scientific reasoning.
- Communicating scientific ideas through written and spoken formats.
- Identifying organs and defining their structure.

	• The function of major digestive organs (esophagus, stomach, intestines, pancreas, liver). • The function of major reproductive organs (penis, vulva, nipples, ovaries, testicles).	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
CP Biology: Ecology

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS1-5:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy
- **HS-LS1-7:** 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.
- **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-LS2-6:** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively

Transfer

Students will be able to independently use their learning to…

- Describe how living and nonliving factors are interdependent.
- Explain how organisms in the environment interact with each other.
- Explain how energy and matter move through the biosphere.

Meaning

ENDURING UNDERSTANDINGS
Students will understand…

- Both living and nonliving things play a role in the function of a healthy ecosystem.
- Organisms fill unique roles in an ecosystem and can cooperate or compete to maintain survival.
- Matter and Energy describe different things and they move/are transferred in different ways.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What are some examples, within an ecosystem, of how living things depend on non-living things? (and vice versa)
- What are the ways that organisms build relationships with each other in a community?
- How do these relationships relate to survival and changes in populations over time?
- How does energy move through producers and a series of consumers?
- How does matter cycle through the biosphere (living and non-living things)?

Acquisition

Students will know…

- The differences between Autotrophs and Heterotrophs.
- The three different ways species interact with one another.
- What a symbiotic relationship is and the three different types.

Students will be skilled at…

- Creating graphs from data tables.
- Analyzing graphical data for patterns and trends
- Making inferences about relationships between organisms based on graphical evidence (emphasis on changes in populations).
- Referencing scientific vocabulary in written/oral expression.

<table>
<tr>
<td>consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
● HS-LS4-5: 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.
● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</td>
<td>● The difference between a food web and food chain.
● The difference between a Niche and a Habitat.
● How energy is transferred through the trophic pyramid.
● How to explain the differences of Matter and Energy.
● Explain what the arrows in food chains and food webs represent.
● Explain why the pyramid-shape is an appropriate choice to model the transfer of matter and energy.</td>
<td>● Collaborate with peers to carry out a set of instructions and collect data.
● Demonstrating lab safety procedures.
● Analyze diagrams (food chains, food webs, and ecological pyramids).
● Gathering/Using evidence to support a claim with valid scientific reasoning.
● Communicating scientific ideas through written and spoken formats.</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
● Creativity
● Critical Thinking</td>
</tr>
</table>

Windham School District Curriculum
Life Science: The Nature of Life

Stage 1 Desired Results

<table>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards

● HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Use appropriate criteria to identify something as living or nonliving.
● Demonstrate effective and safe scientific practices.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Life is defined by specific characteristics.
● These defining characteristics may change over time due to scientific discoveries.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do scientists currently define life?
● Should a virus be considered alive?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● There are currently 8 characteristics of life which are used to define all living things.
● The differences between asexual and sexual reproduction.
● Living organisms respond to their environment, are organized by cells, contain genetic information, grow/develop, reproduce, maintain homeostasis, and adapt/evolve.</td><td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning.
● Communicating scientific ideas through written and spoken formats.</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
● Critical Thinking
● Communication</td></tr>
</table>

Windham School District Curriculum
Life Science: Biochemistry

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

● 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-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Compare the four macromolecules by form and function.
● Connect the food items they consume to the macromolecules utilized by their cells.
● Form connections between energy and matter.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Energy is stored within the bonds of molecules.
● Carbohydrates, lipids, proteins, and nucleic acids have varying forms and varying functions.
● The shape or form of a molecule relates to its function.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How is energy stored and released in molecules?
● What is the primary function of each macromolecule?
● How does the shape/form of a molecule relate to its function?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● The importance of a varied and nutritional diet to get the materials and energy we need to function.
● Energy from food comes from breaking down chemical bonds between atoms.
● The 4 major categories of organic molecules and their respective functions within cells.
● Examples of how molecular structure relates to function (ex. Long chain carbs and lipids are large molecules with lots of bonds and therefore they store long-term energy; proteins can be</td><td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning.
● Communicating scientific ideas through written and spoken formats.</td></tr>
</table>

	cylinder-shaped and provide channels through membranes; enzymes and substrates fit like a lock and key).	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Critical Thinking ● Communication

Windham School District Curriculum
Life Science: Cell Structure and Function

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- **HS-LS1-3:** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Transfer

Students will be able to independently use their learning to…

- Explain and give examples of how a cell is a system of working parts that are interdependent.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Cells vary in their complexity but need to perform the same functions.
- Organelles within the cell work together to perform cell functions (take in food, process and extract energy and materials, build new things etc.) to maintain homeostasis.

ESSENTIAL QUESTIONS
Students will be able to answer…

- How are plant and animal cells different and alike?
- What evidence do we have that complex cells arose from endosymbiosis of simple cells?
- How do organelles collaborate to carry out complex functions within a cell?

Acquisition

Students will know…

- The differences and similarities of plant and animal cells in structure and function.
- The current scientific theory that complex cells arose from simple cells and the lines of evidence that support this theory.
- The function of major organelles within a cell.
- The structure of major organelles within a cell.
- How the structure of an organelle relates to its function.

Students will be skilled at…

- Gathering/Using evidence to support a claim with valid scientific reasoning.
- Communicating scientific ideas through written and spoken formats.
- Constructing Explanations and Designing Solutions.

	• An example of a complex process (e.g. food/molecule intake and processing) and the organelles that are involved. • Diffusion is the passive movement of materials across a cell membrane. • Osmosis is the diffusion of water across a cell membrane. • Factors like salt concentration determine the direction of a concentration gradient and the flow of materials.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
Life Science: Cell Processes

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

● HS-LS1-1: 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.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis
● HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
● HS-LS1-7: 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.
● HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
● HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Explain how energy is captured and used by living organisms.
● Explain why cells need to divide.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Chemical energy is harvested by cells in different ways depending on the environment.
● Multicellular organisms are composed of many cells which divide to allow for growth and to meet demands for energy and materials.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How do cells process energy in different environments (aerobic vs. anaerobic)?
● Why do cells need to divide?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Differences between lactic acid fermentation and cell respiration.
● ATP is useful as an energy currency.
● ATP is recharged in oxygen-rich and oxygen-low environments.
● How cell respiration and photosynthesis are related.
● Matter (atoms) is rearranged in a series of small steps within living organisms.</td><td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning.
● Communicating scientific ideas through written and spoken formats.
● Analyze diagrams (models of glycolysis, cell respiration, and photosynthesis) and chemical equations.
● Collaborate with peers to carry out a set of instructions and collect data.
● Demonstrating lab safety procedures.</td></tr>
</table>

differentiation in producing and maintaining complex organisms.	• Energy is released when chemical bonds are broken and stored when new chemical bonds are made. • Cells size remains small to increase the surface area to volume ratio. • Cells divide in the process of mitosis. • Uncontrolled cell division can lead to cancer.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
Life Science: Genetics Part 1 (Meiosis)

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS1 -4:** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- **HS-LS3-1:** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Transfer

Students will be able to independently use their learning to…

- Explain how heredity is transmitted from one generation to the next.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Reproduction in a species can occur both sexually and asexually
- DNA is packaged in reproductive cells to be passed on to the next generation through sexual reproduction.
- Variation within a species and population is attained through mitosis and sexual reproduction.
- Errors during mitosis can lead to chromosomal disorders

ESSENTIAL QUESTIONS
Students will be able to answer…

- How do organisms reproduce?
- How is heredity passed down through generations?
- What causes variation in a population?
- What happens when meiosis goes wrong?

Acquisition

Students will know…

- Advantages of sexual reproduction
- The process of meiosis begins with one diploid cell and concludes with 4 haploid cells.
- Meiosis occurs in 2 stages.
- There are three ways in which variation is introduced during sexual reproduction and meiosis:
    - Random fertilization
    - Crossing over
    - Independent assortment

Students will be skilled at…

- Gathering/Using evidence to support a claim with valid scientific reasoning
- Communicating scientific ideas through written and spoken formats
- Analyze diagrams and graphical data (e.g. karyotypes)
- Drawing and interpreting diagrams to model a complex cellular process (e.g. steps of meiosis)

	• When chromosomes fail to separate correctly, it can result in a trisomy or cell death. • Down syndrome is an example of a trisomy in which the 21st chromosome fails to split correctly.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
Life Science: Genetics Part 2 (Mendelian)

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

● HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
● HS-LS3-2: 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.
● HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Explain how heredity is transmitted from one generation to the next</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Traits are inherited in a probabilistic manner through sexual reproduction
● The traits you show or possess are the result of combinations of alleles and the principles of dominance (or other principles: codominance, sex-linked traits)</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● Compared to their parents, why do organisms that are a result of sexual reproduction vary in their genes and traits?
● How can we predict the probability of genes and traits of offspring using the genetic information of the parent generation?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● DNA is organized into chromosomes which contain many genes
● Genes are sets of nucleotide sequences that code for a protein
● An allele is a version of a gene
● A genotype is a combination of alleles (one inherited from each parent)
● A phenotype is a trait that shows based on the genotype
● How to draw and interpret a punnett square</td><td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning
● Communicating scientific ideas through written and spoken formats
● Drawing and interpreting diagrams (punnett squares) to model a complex cellular process</td></tr>
</table>

	• The principle of dominance states that one allele will be dominant over the other and this determines an organism's phenotype • Other patterns of inheritance can create different phenotypes (codominance, sex-linked, incomplete dominance, polyploidy) • Pedigrees are useful tools that trace patterns of inheritance through generations	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
Life Science: Genetics Part 3 (Central Dogma)

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS1-1:** 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.
- **HS-LS3-1:** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- **HS-LS3-2:** 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.
- **HS-LS3-1:** Ask questions to clarify relationships about
- the role of DNA and chromosomes in coding the instructions for

Transfer

Students will be able to independently use their learning to…

- Students will be able to explain the transfer of information from DNA to RNA and finally, to proteins.
- Students will understand how and why mutations in the genetic code occur and how the expression of these mutations can impact a living organism.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- The structure and function of DNA and how it is expressed.
- DNA is copied and the information is passed on to the next generation of cells.
- Errors in mutations occur. Many mutations are expressed, however most are silent.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What is the structure of DNA and how does it dictate its function?
- How is genetic information passed on?
- What are mutations and how do they impact an organism?

Acquisition

Students will know…

- Amino acids are the building blocks of proteins
- Nucleotides are the building blocks of nucleic acids
- DNA is a double-stranded molecule that needs to be unpackaged and unwound in order for the code to be copied or read
- RNA is a single-stranded molecule that is a copy of the DNA strand

Students will be skilled at…

- Gathering/Using evidence to support a claim with valid scientific reasoning
- Communicating scientific ideas through written and spoken formats

characteristic traits passed from parents to offspring.	• One form of RNA is messenger RNA, which relays the DNA code to a ribosome • Ribosomes are the sites of translation (RNA to protein) • Enzymes (proteins) play key roles in transcription and translation • The code or language of DNA is in the sequence of triplicate bases • How to use a codon wheel to interpret a DNA code and translate that to an amino acid sequence	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
Life Science: Evolution and The Classification and History of Life

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

● HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
● HS-LS4-2: 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
● HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations
● HS-LS4-5: 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>
<th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Explain how life on Earth is organized into different groups based on phylogeny, morphologies and genetics sequences.
● Explain how all of life on Earth is related and provide evidence to support this claim.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Life is organized into categories based on similarities and heredity.
● Prokaryotic cells evolved into eukaryotic cells and the Endosymbiotic Theory describes that evolution.
● Artificial and Natural Selection are two of the guiding forces that direct the change on life over time.
● The scientific theory of Evolution is backed by many, many tested hypotheses and can be explained clearly and logically.</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are the three domains and what information is used to describe them?
● What is the endosymbiotic theory?
● How are artificial and natural selection similar? How are they different?
● What evidence do we use to prove that all of life on Earth is related?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

● Life is divided into 3 domains, Prokarya, Eukarya and Archaea. There are many subcategories used to organize life.
● The most specific taxa for an organism is "species."</td>
<td>Students will be skilled at…

● Gathering/Using evidence to support a claim with valid scientific reasoning
● Communicating scientific ideas through written and spoken formats</td></tr>
</table>

	- The endosymbiotic theory describes the evolution of prokaryotic cells into eukaryotic cells by using evidence to describe a sequence of host cells engulfing smaller cells and then incorporating them into their own system. - Artificial selection is the process where humans select how another species will change over time whereas natural selection is the process where nature impacts that change. - The evidence used to prove evolution is transition fossils, analogous and homologous structures, vestigial structures, geographical distribution.	
Used in Content Area Standards		***21st Century Skills***
not applicable		- Collaboration - Critical Thinking - Communication

Windham School District Curriculum
Life Science: Anatomy

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards
HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Identify the structure and function of organ systems within an organism
Gain an understanding of how their body works so they can ask informed questions about their health.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Food is broken down during digestion and travels through a number of different organs which aid in the digestion process.
The reproductive organs in males and females are related in structure, but change through development to serve different purposes
The respiratory system exists in the thoracic cavity and functions as a major entry and exit point for materials</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
How do the organs of the digestive system work together to maximize nutrient absorption for an organism?
How are the respiratory and cardiovascular systems related and how do they work together to deliver materials to and from cells?
How are the female and male reproductive organs structurally similar and different?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
The basic layout of the central body cavity of mammals
The hierarchical organization of living things (tissues are organized into organs, which are organized into organ systems within an organism)</td><td>Students will be skilled at…
Gathering/Using evidence to support a claim with valid scientific reasoning
Communicating scientific ideas through written and spoken formats
Identifying organs and defining their structure.</td></tr>
</table>

	• The function of major respiratory organs (lungs, heart, vessels, trachea) • The function of major digestive organs (esophagus, stomach, intestines, pancreas, liver) • The function of major reproductive organs (penis, vulva, nipples, ovaries, testicles)	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Critical Thinking • Communication

Windham School District Curriculum
Life Science: Ecology

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

● HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy
● HS-LS1-7: 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.
● 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-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Describe how living and nonliving factors are interdependent
● Explain how organisms in the environment interact with each other
● Explain how energy and matter move through the biosphere</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand…

● Both living and nonliving things play a role in the function of a healthy ecosystem
● Organisms fill unique roles in an ecosystem and can cooperate or compete to maintain survival
● Matter and Energy describe different things and they move/are transferred in different ways</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are some examples, within an ecosystem, of how living things depend on non-living things? (and vice versa)
● What are the ways that organisms build relationships with each other in a community?
● How do these relationships relate to survival and changes in populations over time?
● How does energy move through producers and a series of consumers?
● How does matter cycle through the biosphere (living and non-living things)?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● The differences between Autotrophs and Heterotrophs
● The three different ways species interact with one another
● What a symbiotic relationship is and the three different types</td><td>Students will be skilled at…

● Creating graphs from data tables
● Analyzing graphical data for patterns and trends
● Making inferences about relationships between organisms based on graphical evidence (emphasis on changes in populations)</td></tr>
</table>

ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. ● **HS-LS4-5:** 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. ● **HS-LS1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	● The difference between a food web and food chain ● The difference between a Niche and a Habitat ● How energy is transferred through Trophic Pyramid ● How to explain the differences of Matter and Energy ● Explain what the arrows in food chains and food webs represent ● Explain why the pyramid-shape is an appropriate choice to model the transfer of matter and energy	● Referencing scientific vocabulary in written/oral expression ● Collaborate with peers to carry out a set of instructions and collect data ● Demonstrating lab safety procedures ● Analyze diagrams (food chains, food webs, and ecological pyramids) ● Gathering/Using evidence to support a claim with valid scientific reasoning ● Communicating scientific ideas through written and spoken formats
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Creativity ● Critical Thinking

Windham School District Curriculum
Honors Biology: Exploring Life

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
NGSS Science Standards
HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td><td colspan="2">Transfer: Performance Expectations</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Use the characteristics of life as a criteria for classifying items as living or nonliving.
Discuss the unity of life based on DNA and a common genetic code
Develop and execute a controlled experiment</td></tr>
<tr><td colspan="2">Meaning: Crosscutting</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Scientists use a common criteria to define life
All organisms share a common genetic code
A controlled experiment is testable and falsifiable</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
What are the characteristics of life?
What evidence supports the concept of the “unit of life”?
What evidence supports the Last Universal Common Ancestor (LUCA)?
What are the elements of a controlled experiment?</td></tr>
<tr><td colspan="2">Acquisition: DCI/SEP</td></tr>
<tr><td>Students will know…
All forms of life share common properties
Evolution explains the unity and diversity of life
Scientists make observations and form hypotheses to be tested
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.
All cells contain genetic information in the form of DNA molecules.</td><td>Students will be skilled at…
Communicating scientific ideas through written and spoken formats
Engaging in Argument from Evidence
Planning and Carrying Out Investigations</td></tr>
</table>

	• The parts of an experiment include: Independent variable, dependent variable, control, hypothesis, and constants. • Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA .	

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

Windham School District Curriculum
Honors Biology: The Chemical Basis of Life

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

● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
● 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. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Use trends in the periodic table to discuss an atom’s chemical properties
● Use trends in the periodic table to predict properties of elements</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Organisms are composed of matter/atoms
● An atom’s distribution of electrons will determine its chemical properties
● Interactions between atoms form chemical bonds
● Water has life supporting properties</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What components make up an atom?
● What is “matter”?
● How does an element’s position on the periodic table predict/inform its properties?
● How do the atomic interactions of ionic, covalent, and hydrogen bonds differ?
● How does water’s polarity impact its properties?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Atoms consist of Protons, Neutrons, and Electrons
● An element’s valence electrons will determine how it interacts with other elements
● Water is considered the universal solvent due to its polar covalent bonds
● The distinction between polar covalent, covalent and ionic bonds is determined by the atom’s electronegativity.</td><td>Students will be skilled at…

● Analyzing and Interpreting Data via the periodic table
● Collect and analyze data through various laboratory exercises
● Obtaining, Evaluating, and Communicating Information
● Utilizing the periodic table as a useful tool</td></tr>
</table>

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

Windham School District Curriculum
Honors Biology: Molecules of the Cells

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **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-LS1-3:** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- **HS-LS1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- **HS-LS1-3:** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- **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. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include

Transfer

Students will be able to independently use their learning to…

- Communicate the importance of Carbon and why it is essential to Organic Compounds
- Compare the macromolecules: Carbohydrates, Lipids, Proteins, and Nucleic Acids
- Relate Structure and Function of these macromolecules
- Identify the macromolecule polymers and their monomer building blocks

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Carbon-containing compounds are the chemical building blocks of life
- Carbohydrates serves as a cell's fuel and building material
- Lipids are hydrophobic molecules with diverse functions
- Proteins are essential to the structure and function of life
- Nucleic acids store, transmit, and help express hereditary information.

ESSENTIAL QUESTIONS
Students will be able to answer…

- Why is carbon able to form large complex molecules?
- How are short chain and long chain carbohydrates used by cells?
- How does the structure of a phospholipid inform its function/use in cell membranes?
- How are polypeptide bonds formed?
- What are the nucleotides that compose DNA and RNA?

Acquisition

Students will know…

- Carbon is so abundant in life because of its ability to form 4 bonds with many different types of elements.
- Trace elements are elements that are necessary for life but only necessary in very small quantities.
- Dehydration synthesis and hydrolysis are involved in the building up and breaking down of macromolecules.

Students will be skilled at…

- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Developing and Using Models

	• Carbohydrates tend to form molecules with a chemical formula of CH2O • There are monomers and polymers of Carbohydrate • Phospholipids are a major component of the lipid bilayer. • Proteins are composed of amino acids and perform many different jobs within the cell. • DNA is one form of nucleic acid which is composed of many different types of nucleotides.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Communication • Critical thinking • Analyzing

Windham School District Curriculum
Honors Biology: A Tour of the Cell

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

● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Differentiate between Prokaryotic and Eukaryotic organisms
● Discuss the various roles of organelles within eukaryotic cells
● Make connections between organelles and how they contribute to a working cellular system</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Cell Theory evolved alongside the discovery of the Microscope
● Cells are small to allow for the efficient exchange of materials
● Various organelles are part of different cellular systems that contribute to a cell’s ability to function</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How did the advancements in microscope technology contribute to Cell Theory?
● What role do ribosomes play within the cell?
● Explain why we say, “the Endoplasmic Reticulum is a biosynthetic workshop?”
● Explain which organelles directly contribute to energy processing for a plant cell?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>Students will know…

● Nucleus and Ribosomes work in tandem for the proper functioning of the cells using genetic information
● The Endomembrane System involves various organelles interacting to synthesize, distribute, store, and export molecules
● The Energy Processing organelles are the Mitochondria and Chloroplast
● How cellular surfaces interact with their surroundings</td><td>Students will be skilled at…

● Developing and using models to communicate their ideas
● Presenting and communicating ideas to classmates through presentations and written format
● Developing models to illustrate how cells are systems and work to recycle matter and convert energy.</td></tr>
</table>

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

Windham School District Curriculum
Honors Biology: The Working Cell

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

● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-1: 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.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Discuss how a membrane’s structure enables its many functions
● Discuss energy transformations within the cell
● Discuss how enzymes function within a cell</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● A cell membrane’s structure enables its many functions
● A cell’s metabolic reactions transform energy
● Enzymes speed up a cell’s chemical reactions</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How does a cell regulate molecular movement across a membrane?
● What is osmosis?
● How do passive and active transport compare?
● How is ATP used by cells?
● How does an enzyme impact the activation energy required for a reaction?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

● Cells regulate their internal environment with a combination of passive and active transport through the cell membrane.
● Chemical reactions either store or release energy.
● Cells transform energy as they work
● Enzymes lower the activation energy needed to drive chemical reactions.
● How energy transformations within the cell, connect to thermodynamics</td><td>Students will be skilled at…

● Connecting big ideas from lab exercises to a cell’s ability to maintain homeostasis
● Obtaining, Evaluating, and Communicating Information</td></tr>
</table>

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

Windham School District Curriculum
Honors Biology: Cell Respiration

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS1-3:** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis
- **HS-LS1-7:** 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.
- **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-LS2-3:** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- **HS-LS2-3:** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- **HS-LS1-6:** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other

Transfer

Students will be able to independently use their learning to…

- Compare anaerobic and aerobic respiration
- Track the movement of the matter within and between the different stages of cellular respiration
- Discuss the importance of energy for the cell
- Interpret diagrams

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Cell respiration generates ATP for cellular activities
- Cell respiration has multiple stages
- Cell respiration occurs in different organelles/locations
- The presence/absence of oxygen may impact a respiration pathway

ESSENTIAL QUESTIONS
Students will be able to answer…

- What are the reactants/products of aerobic cellular respiration?
- How is ATP generated by the cell?
- What are the stages of Aerobic Cell Respiration?
- Where does the Electron Transport Chain occur in the cell?
- Why does fermentation occur?
- When/Why is CO_2 produced by a cell?
- Which cell respiration pathway produces more ATP per glucose molecule?

Acquisition

Students will know…

- The difference between aerobic and anaerobic respiration
- Under what conditions fermentation occurs
- Why oxygen is necessary for aerobic respiration
- How ATP is generated within the cell

Students will be skilled at…

- Predicting respiration pathways when given different criteria.
- Collecting, Analyzing, and Interpreting Data
- Communicating information through diagrams with limited use of vocabulary terms

elements to form amino acids and/or other large carbon-based molecules.	● How facilitated diffusion is utilized to produce large amounts of ATP for a cell in aerobic conditions	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Analyzing ● Communication ● Critical thinking

Windham School District Curriculum
Honors Biology: Photosynthesis

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

● HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis
● HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
● HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
● 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-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.</td>
<th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Communicate the importance of H_2O in the production of Glucose
● Compare the process of Photosynthesis to Cellular Respiration
● Discuss how light energy is transformed throughout photosynthesis
● Identify how photosynthesis connects to larger global issues</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Plants and other autotrophs use sunlight to convert matter during photosynthesis
● Energy is transformed during the process of photosynthesis
● Photosynthesis has impacts on global systems
● Photosynthesis takes place in the Chloroplast of a plant cell</td>
<td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How is H_2O utilized by the chloroplast during photosynthesis?
● During which stage(s) is CO_2 utilized during photosynthesis?
● What are the products of photosynthesis?
● Where do the light reactions take place?
● Where does the Calvin Cycle take place?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

● Photosynthetic pigments absorb energy that drive reactions
● The carbon atoms found in glucose originate from carbon dioxide molecules
● Oxygen produced during photosynthesis originates from water molecules
● Light reactions produce high energy molecules that are used in the Calvin Cycle
● The Calvin Cycle produces glucose molecules</td>
<td>Students will be skilled at…

● Proposing testable hypotheses
● Collecting, Analyzing, and Interpreting Data
● Communicating information through diagrams with limited use of vocabulary terms</td></tr>
</table>

	• Glucose molecules can be used for various purposes within a cell/organism	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Communication • Critical thinking • Interpreting

Windham School District Curriculum
Honors Biology: Cell Cycle (Mitosis/Meiosis)

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS1 -4:** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- **HS-LS3-1:** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- **HS-LS1-1.** 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.
- **HS-LS1-3:** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis
- **HS-LS1-5:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- **HS-LS1-7:** 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.

Transfer

Students will be able to independently use their learning to…

- Communicate the importance of duplicating a genome prior to cell division
- Provide real world connections for mitosis and meiosis
- Predict how disruptions to the cell division process may impact daughter cells/organisms
- Make direct connections between mutations and cancer
- Understand how stem cells differentiate into other types of cells

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Cell division underlies many of life's important processes
- Cells produce genetically identical copies through the process of mitosis
- Meiosis produces genetically varied gametes used for sexual reproduction
- Errors in the cell division process can impact daughter cells produced
- Cancer results from mutations in genes that control cell division
- Stem cells differentiate into other types of cells

ESSENTIAL QUESTIONS
Students will be able to answer…

- What are chromosomes?
- What type of cells does Mitosis produce?
- What is asexual reproduction?
- Where does meiosis occur within a human male/female?
- How does Meiosis lead to genetically distinct offspring?
- What is nondisjunction and how may it impact a daughter cell/organism?
- What has occurred if a tumor has metastasized?
- Where do cells come from?

Acquisition

Students will know…

- The Mitosis stages: Interphase, Prophase, Metaphase, Anaphase, Telophase, Cytokinesis
- The many stages of Meiosis
- There are genes that promote and inhibit cell division
- How malignant and benign tumors differ

Students will be skilled at…

- Predicting cell cycle pathways when given different criteria.
- Communicating information through diagrams with limited use of vocabulary terms

● **HS-LS2-3:** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. ● **HS-LS1-4:** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	● When stem cells divide, one daughter cell becomes specialized, while the other remains a stem cell	● Presenting and communicating ideas to classmates through small group informal presentations
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
Honors Biology: Patterns of Inheritance

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="6">ESTABLISHED GOALS:
Content Standards:
HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
Understand how they are related to all other living things
Know what disorders are genetically related and know how to ask questions related to these disorders</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…
Monohybrid and dihybrid crosses are a tool that are used to predict the traits of offspring
The passing on of traits can be statistically predictable if specific previous knowledge is known and tools such as pedigree charts are used
Genes are small segments of DNA and can be passed on to the next generation separate or linked to other genes.</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…
How do we use monohybrid and dihybrid crosses to predict the probability of our children's phenotypes?
What is the probability that a specific trait will be passed on?
How can you tell if two genes are linked or if they are passed on separately?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
Genotypes are traits described in the genetic code whereas phenotypes are the traits that are expressed by the genetic code.
There is a 50% chance of a human producing a male and a 50% chance of a female
Some traits do not follow the Mendelian rules outlined by Mendel. Some traits are described by many genes and some genes can be turned off.
Some alleles expressed are recessive while others are dominant</td><td>Students will be skilled at…
Calculating the probability of a specific phenotype to be expressed.
Analyzing pedigree charts to predict the occurrence of specific types of traits.
Applying concepts of statistics and probability
Determining if genes are linked or assorted independently</td></tr>
</table>

	• Disorders that are expressed dominantly require the genes of only a single parent while recessive disorders require the expression from both parents. • Genes are small segments of DNA that code for proteins which do many different jobs in the body.	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Communication • Critical thinking

Windham School District Curriculum
Honors Biology: Molecular Biology

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

● HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
● HS-LS1-1: 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.
● HS-LS3-2: 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.</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Understand and explain how genetic information is passed on DNA to RNA and finally to proteins.
● Explain mutations in DNA causes changes in how the gene is expressed.</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● The Central Dogma of biology is DNA-> RNA -> Protein
● Transcription is the communication of the genetic code from DNA to RNA
● Translation is the communication of the genetic code from RNA to proteins
● Mutations arise when there are errors during transcription and translation</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● What are the three parts of the central dogma of biology?
● What is the goal of Transcription?
● What is the goal of Translation?
● What causes a mutation?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…

● There are three types of RNA used in the process of protein synthesis
● A triplet code can be found on the DNA strand where as a codon is found on an RNA strand
● There are many different types of mutations. Some are expressed and some are silent.
● If Mutations that are expressed benefit the individual or population it is considered an adaptation and is more likely to be passed on.</td><td>Students will be skilled at…

● Constructing explanations and designing solutions
● Creating models to explain phenomena existing in the natural world
● Applying concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</td></tr>
</table>

	• There are tens of thousands of genes and there are hundreds of thousands of proteins which are used to express the traits of an organism • The genetic code is universal to all of life	
Used in Content Area Standards		***21st Century Skills***
not applicable		• Collaboration • Communication • Critical thinking

Windham School District Curriculum
Honors Biology: Evolution

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS4-1:** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- **HS-LS4-2:** 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
- **HS-LS4-4:** Construct an explanation based on evidence for how natural selection leads to adaptation of populations
- **HS-LS4-5:** 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

Transfer

Students will be able to independently use their learning to…

- Explain how life on Earth is organized into different groups based on phylogeny, morphologies and genetics sequences.
- Explain how all of life on Earth is related and provide evidence to support this claim.

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Life is organized into categories based on similarities and heredity.
- Prokaryotic cells evolved into eukaryotic cells and the Endosymbiotic Theory describes that evolution.
- Artificial and Natural Selection are two of the guiding forces that direct the change on life over time.
- The scientific theory of Evolution is backed by many, many tested hypotheses and can be explained clearly and logically.
- Changes in populations over time are predictable and can be calculated using equations like the Hardy-Weinberg Principle.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What are the three domains and what information is used to describe them?
- What is the endosymbiotic theory?
- How are artificial and natural selection similar? How are they different?
- What evidence do we use to prove that all of life on Earth is related?
- How do we predict changes in populations over time?

Acquisition

Students will know…

- Life is divided into 3 domains, Prokarya, Eukarya and Archaea. There are many subcategories used to organize life.
- The most specific taxa for an organism is "species."
- The endosymbiotic theory describes the evolution of prokaryotic cells into eukaryotic cells by using evidence to describe a sequence of host cells engulfing smaller cells and then incorporating them into their own system.

Students will be skilled at…

- Gathering/Using evidence to support a claim with valid scientific reasoning
- Communicating scientific ideas through written and spoken formats.
- Calculating predictable changes in a population based on existing population dynamics

new species over time, and (3) the extinction of other species	● Artificial selection is the process where humans select how another species will change over time whereas natural selection is the process where nature impacts that change. ● The evidence used to support evolution is transition fossils, analogous and homologous structures, vestigial structures, geographical distribution. ● Evolution acts on phenotypes and impacts the genotypes of individuals in a population.	
Used in Content Area Standards		***21st Century Skills***
not applicable		● Collaboration ● Communication ● Critical thinking

Windham School District Curriculum
Honors Biology: Anatomy

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

● HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms</td><th colspan="2">Transfer</th></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Identify the structure and function of multiple organs within the Digestive System
● Identify the structure and function of multiple organs within the Respiratory and Circulatory Systems
● Identify the structure and function of multiple organs within the Urogenital System
● Compare anatomical features of animals of different species</td></tr>
<tr><th colspan="2">Meaning</th></tr>
<tr><td>ENDURING UNDERSTANDINGS
Students will understand that…

● Organs are part of organ systems
● Multiple organs work together to perform essential processes for an organism
● Humans have similar anatomical features to that of other animals</td><td>ESSENTIAL QUESTIONS
Students will be able to answer…

● How does the body stop food from entering the trachea?
● What is the function of the Liver?
● What is filtered out of the blood in the kidney?
● What are the organs involved in the urinary system?
● What is the job of the heart?
● How does the human digestive system compare to the animal being dissected?</td></tr>
<tr><th colspan="2">Acquisition</th></tr>
<tr><td>Students will know…
● The function of the many organs that compose the Digestive System
● The function of the many organs that compose the Respiratory/Circulatory Systems
● The function of the many organs that compose the Urogenital System</td><td>Students will be skilled at…

● Performing dissections in small groups
● Using Lab equipment and technology to document their dissection
● Researching the structure and function of applicable organ systems to inform their dissection</td></tr>
</table>

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

Windham School District Curriculum
Honors Biology: Ecology

Stage 1 Desired Results

ESTABLISHED GOALS:
NGSS Science Standards

- **HS-LS1-5:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy
- **HS-LS1-7:** 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.
- **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-LS2-6:** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively

Transfer

Students will be able to independently use their learning to…

- Describe how living and nonliving factors are interdependent
- Explain how organisms in the environment interact with each other
- Explain how energy and matter move through the biosphere

Meaning

ENDURING UNDERSTANDINGS
Students will understand that…

- Both living and nonliving things play a role in the function of a healthy ecosystem
- Organisms fill unique roles in an ecosystem and can cooperate or compete to maintain survival
- Matter and Energy describe different things and they move/are transferred in different ways.
- Factors like population size impact the carrying capacity of an ecosystem.

ESSENTIAL QUESTIONS
Students will be able to answer…

- What are some examples, within an ecosystem, of how living things depend on non-living things? (and vice versa)
- What are the ways that organisms build relationships with each other in a community?
- How do these relationships relate to survival and changes in populations over time?
- How does energy move through producers and a series of consumers?
- How does matter cycle through the biosphere (living and non-living things)?

Acquisition

Students will know…

- The differences between Autotrophs and Heterotrophs
- The three different ways species interact with one another
- What a symbiotic relationship is and the three different types
- The difference between a food web and food chain
- The difference between a Niche and a Habitat

Students will be skilled at…

- Creating graphs from data tables
- Analyzing graphical data for patterns and trends
- Making inferences about relationships between organisms based on graphical

consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. ● **HS-LS4-5:** 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. ● **HS-LS1-2:** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	● How energy is transferred through Trophic Pyramid ● How to explain the differences of Matter and Energy ● Explain what the arrows in food chains and food webs represent ● Explain why the pyramid-shape is an appropriate choice to model the transfer of matter and energy ● Populations will grow until they reach their biotic potential then they will hover around the (K) carrying capacity increasing and decreasing only slightly unless abiotic forces act upon it.	evidence (emphasis on changes in populations) ● Referencing scientific vocabulary in written/oral expression ● Collaborate with peers to carry out a set of instructions and collect data ● Demonstrating lab safety procedures ● Analyze diagrams (food chains, food webs, and ecological pyramids) ● Gathering/Using evidence to support a claim with valid scientific reasoning ● Communicating scientific ideas through written and spoken formats

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