Windham School District

Science Curriculum

Approved by the Windham School Board on January, 2014

Science Curriculum

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WINDHAM SCHOOL DISTRICT SCIENCE TOPIC CHART

GRADE	EARTH SCIENCE	LIFE SCIENCE	PHYSICAL SCIENCE
Kindergarten	Weather and Climate	Independent Relationships in Ecosystems Animals, Plants and their Environments	Forces and Interactions Pushes and Pulls
1st Grade	Space Systems: Patterns and Cycles • Observations of the sun, moon, and stars • Seasonal Patterns of sunrise and sun set	• Structure, Function, and Information processing • Human, Animal, Plant needs for survival	Waves: light and sound • Wave properties-sound can make matter vibrate • Objects can be seen when illuminated • People use a variety of devices to communicate
2nd Grade	Rocks: types and properties Processes that shape the earth: wind, water	Plants, animals, ecosystems • How do they use their environment to survive? • How do they use each other • Different habitats for different living things	Matter: solid, liquid, gas Changes in matter: chemical reactions- freezing, melting
3rd Grade	Weather and Climate Natural Hazards Earth, Moon and Sun	Life cycles and traits (long ago vs. now) Surviving within a habitat	Force and Motion Electric/Magnetic interactions Electricity, Energy Use
4th Grade	Earth's systems Patterns in rock formations	Structure and Function, Information processing (Plants and Animals)	Energy: Heat, light and Sound Sound Waves
5th Grade	Earths Systems/Weather Space(Basic) History of Space Exploration	Ecology	Properties of Matter / Energy Transfer
6th Grade	Natural Resources The Universe and Stars Earth and the Solar System The Roles of Water Human Impacts on Earth Systems The Geological History of Planet Earth		

	Climate Change Earth's Materials and Systems Plate Technotics		
7th Grade		• Structure, Function, and Information processing • Matter and Energy in Organisms and Ecosystems • Interdependent Relationships in Ecosystems • Growth, Development, and Reproduction of Organisms • Natural Selection and Adaptations	
8th Grade			• Structure and Properties of Matter • Forces and Interactions • Chemical Reactions • Energy • Waves and Electromagnetic Radiation

Windham School District Science Curriculum
Kindergarten

Title of Core Map	Kindergarten
Title of Unit	Weather and Climate
Essential Questions	• How does weather impact our lives and our Earth?
Content	• **Conservation of Energy and Energy Transfer-** Sunlight warms Earth's surface. (K-PS3-1),(K-PS3-2) • **Weather and Climate**- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure and record weather to notice patterns over time. (K-ESS2-1) • **Natural Hazards**- Severe weather types are more likely in a given region, so weather scientists forecast severe weather to prepare communities to respond to weather events. (K-ESS3-2) • **Defining and Delimiting an Engineering Problem**- Asking questions, making observations, and gathering information are helpful in thinking about problems. (secondary to K-ESS3-2)
Skills	• Recognize the effects of the sun's light. (S:ESS2:2:2.1) • Recognize that weather conditions change frequently, and that weather patterns change over the seasons. (S:ESS:1:1:1/1) • Describe and compare weather using observations and measurements of local weather conditions. (S:ESS:1:2:1.2) • Identify severe types of weather and where they occur more frequently on Earth. • Understand the importance of asking questions, making observations, and gathering information to solve problems. • Recognize that some tools, such as magnifiers, balances and thermometers, have special uses and can help gather information and extend the senses. (S:LS5:2:2.1) (S:ESS:4:2.21) • Recognize that some jobs/careers require knowledge and use of Earth science content and/or skills. (S:ESS:4:2
Common Summative Assessments	
Standards	• **K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface.** [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water] [*Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.*] • **K-PS3-2. Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.*** [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.] • **K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.** [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month.

	Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*] • **K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*** [Clarification Statement: Emphasis is on local forms of severe weather.]

Title of Core Map	Kindergarten
Title of Unit	Forces and Interactions: Pushes and Pulls
Essential Questions	• How and why do objects move?
Content	• **Forces and Motion**- Pushes and pulls can have different strengths and directions. (KPS2-1),(K-PS2-2) Pushing or pulling on an object can change the speed or direction of its motion and start or stop it. (K-PS2-1),(K-PS2-2) • **Types of Interactions**- When objects touch or collide, they push one another and can change motion. (K-PS2-1) • **Relationship between Energy and Forces**- A bigger push or pull makes things go faster. (secondary to K-PS2-1) • **Defining Engineering Problems**- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (secondary to KPS2-2)
Skills	• Describe the many different ways things can move, such as in a straight line, zigzag or circular motion, back and forth, and fast and slow. (S:PS3:2:2.1) • Describe and demonstrate how the position and motion of an object can be changed by applying force, such as pushing and pulling; and explain that the greater the force, the greater the change. (S:PS3:2:2.2) • Describe the position of an object by referencing its location in relation to another object or background. • Identify problems and understand engineering as ways to create solutions. (S:PS3:2:2.3) • Identify tools and simple machines, such as a wheel, and explain how they work. (S:PS4:2:2.1) • Recognize that some jobs/careers require knowledge and use of physical science content and/or skills. (S:PS4:2:4.1)
Common Summative Assessments	
Standards	• **K-PS2-1.Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.** [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [*Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.*] • **K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*** [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [*Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.*]

Title of Core Map	Kindergarten
Title of Unit	Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment
Essential Questions	• How do living things depend upon each other and impact each other?
Content	• **Organization for Matter and Energy Flow in Organisms-** Animals need food, from plants or other animals, in order to live and grow. Plants need water and light to live and grow. (K-LS1-1) • **Biogeology**- Plants and animals can change their environment. (K-ESS2-2) • **Natural Resources-** Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. (K-ESS3-1) • **Human Impacts on Earth Systems**- People's choices, to live comfortably, can impact the world around them. Choices can reduce impacts on land, water, air, and other living things. (secondary to K-ESS2-2),(K-ESS3-3) • **Developing Possible Solutions-** Designs can be conveyed though sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (secondary to K-ESS3-3)
Skills	• Identify that animals need food, and plants need water and light, to live and grow. • Recognize that living things can change their environment, (squirrels dig holes to hide food, roots can break concrete). (S:L52:2:2.1) • Recognize that plants and animals have features that help them survive in different environments. (S:LS1:2:2.1) • Understand human impact on our environment (reusing paper and recycling cans and bottles). • Understand the importance of communicating solutions to problems using sketches, drawing, or physical models. • Recognize that new products can be made out of natural materials, such as paper from trees and cloth from various plants and animals. (S:LS5:2:1.1) • Describe actions that can help the environment, such as recycling and proper disposal of waste materials. S:ESS4:2:3.3) • Identify environments that are natural, such as a forest, meadow, or mountains and those that have been built or modified by people, including cities, roads, farms, and houses. (S:ESS4:2:3.2) • Recognize that some jobs/careers require knowledge and use of life science content and/or skills. (S:LS5:2:4.1)
Common Summative Assessments	
Standards	• **K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.** [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living

	things need water.] • **K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.** [Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.] • **K-ESS3-1. Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.** [Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.] • **K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*** [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]

Windham School District Science Curriculum
First Grade

Title of Core Map	First Grade
Title of Unit	Space Systems: Patterns and Cycles
Essential Questions	• What objects are in the sky and how do they seem to move and change?
Content	• **The Universe and its Stars** – Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1-ESS1-1) • **Earth and Solar System** – Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)
Skills	• Recognize that the Sun, Moon, and stars all appear to move slowly across the sky. (S:ESS2:2:4.1) • Recognize the basic patterns of the Sun, including its appearance during the daytime, and how its position in the sky changes through the seasons. (S:ESS:2:2:1.1) • Recognize the basic patterns of the Moon, including its appearance sometimes at night and sometimes during the day; and how it appears to change shape through the month. (S:ESS2:2:1.2) • Recognize that as the position of the Sun changes in relation to the Earth it creates shadows of varying length and direction. (S:ESS2:2:4.2) • Explain that people should not look directly at the Sun because it is dangerous and may cause injury to the eyes. (S:ESS2:2:4.3) • Recognize there are too many stars to count, and that they are unequal in their brightness. (S:ESS3:2:2.1)
Common Summative Assessments	
Standards	• **1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.** [Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.] • **1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.** [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in

	the spring or fall.] [Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.]

Title of Core Map	First Grade
Title of Unit	Waves: Light and Sound
Essential Questions	• How is sound produced? • What are the properties of light and how does it behave? • How is a light wave different from a sound wave?
Content	• **Wave Properties**- Sounds can make matter vibrate, and vibrating matter can make sound. (1-PS4-1) • **Electromagnetic Radiation**- Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1-PS4-3) • **Information Technologies and Instrumentation**- People also use a variety of devices to communicate over long distances. (1-PS4-4)
Skills	• Recognize some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. • Recognize darkness is the absence of light. • Recognize there are many kinds and sources of sound. • Recognize light travels from a source. • Recognize light is reflected from surfaces (mirrors, polished metals) • Recognize that sounds are made when objects vibrate. (S:PS2:2:3.1) • Recognize that people use a variety of devices to communicate over long distances.
Common Summative Assessments	
Standards	• **1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.** [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.] • **1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.** [Clarification Statement: Examples of observations could include those made in a completely dark room, a

	pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.] • **1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.** [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.] • **1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*** [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]

Title of Core Map	First Grade
Title of Unit	Structure, Function, and Information Processing
Essential Questions	• How can living things be so different yet be so alike? • What does it mean to be alive? • What is necessary for life?
Content	• **Structure and Function-** All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place**,** and seek, find, and taking in food, water and air. Plants have different parts that help them survive and grow. (1-LS1-1) • **Growth and Development of Organisms-** Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring survive. (1-LS1-2) • **Information processing-** Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1-LS1-1) • **Inheritance of Traits-** Young animals are very much, but not exactly, like their parents. Plants are also very much, but not exactly, like their parents. (1-LS3-1) • **Variation of Traits-** Individuals of the same kind of plant or animal are recognizable as similar, but can also vary in many ways. (1-LS3-1)
Skills	• Differentiate between living and nonliving things; and categorize objects in each group using the significant observable characteristics they share, such as color, shape, and size. (S:LS1:2:1.1) • Recognize plants and animals as living things and describe how they are alike and different.(S:LS1:2:1.2) • Recognize that plants and animals have features that help them survive in different environments. (S:LS1:2:1.2) • Recognize that parents and offspring of many species closely resemble one another; and describe the similarities in appearance of given plant and animal families. (S:LS1:2:3.1) • Recognize that living things have a life cycle, during which they are born, grow, and die.(S:LS1:2:3.2) • Recognize that animals, including humans, interact with their surroundings using their senses; and that different senses provide different kinds of information.(S:LS2:2:1.2) • Recognize and describe how living things respond when exposed to helpful and harmful situations. (S:LS4:2:1.1) • Recognize that humans learn from each other in many different ways, such as listening and speaking, watching and imitating. (S:LS4:2:1.2)

	• Recognize that humans can gather different kinds of information about an object by adjusting their proximity to it. (S:LS4:2:1.3) • Recognize that some of the things humans can do, such as playing games, reading, writing, must be learned. (S:LS4:2:1.4) • Recognize similarities and individual differences among people, and that children closely resemble their parents. (S:LS4:2:3.1) • Identify the sense organs, including eyes, ears, nose, mouth, and skin; and describe how each can warn an individual about danger. (S:LS4:2:3.2) • Recognize that two parents, both a father and mother, are required for human reproduction. (S:LS4:2:3.3) • Recognize and describe the human life cycle from birth to old age. (S:LS4:2:3.4) • Recognize that humans need food, water, air, waste removal and a particular range of temperatures in their environment, just as other animals do. (S:LS4:2:3.5)
Common Summative Assessments	
Standards	• **1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*** [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.] • **1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.** [Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).] • **1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.** [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.] [Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.]

Windham School District Science Curriculum
Second Grade

Title of Core Map	Second Grade
Title of Unit	Earth Systems: Processes that Shape the Earth
Essential Questions	• What causes change in our physical world? • How are parts of Earth (land, air and water) related?
Content	• **Rock Cycle** – Identify/categorize rocks and their physical properties. • **The History of the Planet** – Some events happen quickly or slowly over time. (2-ESS1-1) • **Earth Materials and Systems** - Wind and water can change the shape of the land. (2-ESS2-1) • **Plate Tectonics and Large Scale System Interactions** – Maps show where things are located. (one can map the shapes and kinds of land and water in an area). (2-ESS2-2) • **The Roles of Water in Earth's Surface Processes** – Water exists in solid and liquid forms. When located in ocean, rivers, lakes, ponds. (2-ESS2-3) • **Optimizing the Design Solution** – Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)
Skills	• Describe rocks and soils in terms of their physical properties. (S:ESS1:2:6.2) • Recognize that Earth materials have a variety of properties, including size, shape, color, and texture. (S:ESS1:2:2.3) • Use observable properties, such as color and texture to classify and organize rocks and minerals (S:ESS1:2:2.2) • Recognize that solid rocks, soils, and water in its liquid and solid states can be found on the Earth's surface. (S.ESSD1:2:2.1) • Explain that large rocks can be broken down into smaller rocks.(S:ESS1:2:6.1) • Recognize that some changes are too slow or too fast to be easily observed. Ex. Volcano/earthquakes happen quickly while erosion of rocks happens slowly. (S:ESS1:2:5.1) • Identify how wind and water can change the shape of land overtime. • Recognize and understand how to create a map to show where land and water are located • Recognize, and with assistance, safely demonstrate the use of tools to gather data and extend the sense such as thermometers, hand lenses, and balances. (S:ESS4:2:2.1) • Differentiate between natural and man-made materials. (S:ESS4:2:3.1) • Recognize that some jobs/careers require knowledge and use of Earth science content and/or skills. (S:ESS4:2:4.1)

	• Identify the 3 different types of rocks and how they are formed.
Common Summative Assessments	
Standards	• **2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.** [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.] • **2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*** [Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.] • **2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.** [Assessment Boundary: Assessment does not include quantitative scaling in models.] • **2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.**

Title of Core Map	Second Grade
Title of Unit	Structure and Properties of Matter
Essential Questions	• How does matter make up our world? • How does matter change?
Content	• **Structure and Properties of Matter** – Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1) Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3) A great variety of objects can be built up from a small set of pieces. (2-PS1-3) **Chemical Reactions-** Heating or cooling substances may cause changes that can be observed. Sometimes these changes are reversible and sometimes they are not. (2-PS1-4)
Skills	• Recognize that objects can be composed of different types of materials, such as wood, metal and paper. (S:PS1:2:1.1) • Recognize that objects can be made of one or more materials. (S:PS1:2:1.2) • Identify the observable properties of different objects, such as color, size, shape, weight and texture. (S:PS1:2:2.1) • Describe how the properties of certain materials can change when specific actions are applied to the, such as freezing, mixing, heating, cutting, dissolving and bending.(S:PS2:2:1.1) • Recognize that water can be a liquid or solid, and explain that it can be made to change from one state to the other but the amount of water always remains the same in either state. (S:ESS1:2:7.1) • Recognize that not all materials react the same way when an action is applied to them. (S:PS2:2:1.2) • Describe that heat can be produced in a variety of ways such as burning, rubbing, and mixing substances. (S:PS2:2:3.3) • Recognize that new objects can be made out of physical materials, such as cloth and paper. (S:PS4:2:1.1) • Demonstrate how to use tools, such as rulers, scales, balances, magnifiers and thermometers to measure properties of objects, such as size, weight, temperature. (S:PS4:2:2.2) • Recognize that some jobs/careers require knowledge and use of physical science content and/or skills. (S:PS4:2:4.1) • Use measures of weight (data) to demonstrate that the whole equals the sum of its parts. (S:PS1:4:1.2) • Make prediction about what might happen to the state of common materials when heated or cooled; or categorize materials as solid, liquid, or gas. (S:PS1:4:2.4) • Collect and organize data about physical properties in order to classify objects or draw conclusions about objects and their properties. (eg. Temperature, color, size, shape, weight, texture, flexibility. (S:PS1:4:2.5)

Common Summative Assessments	
Standards	• **2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.** [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.] • **2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.] • **2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.** [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.] • **2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.** [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

Title of Core Map	Second Grade
Title of Unit	Interdependent Relationships in Ecosystems
Essential Questions	• What does it mean to be alive? • How can living things be so different yet be so alike? • Why do plants and animals need different environments to survive? • How do plants and animals use their environments to survive?
Content	• **Interdependent Relationships in Ecosystems**- Plants depend on light and water to grow. Plants depend on animals for pollination or to move their seeds around. (2-LS2-2) • **Biodiversity and Humans** – There are many different kinds of living things in an area, and they exist in different places on land and in water. (2-LS4-1) • **Developing possible solutions** – Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (secondary to 2-LS2-2)
Skills	• Recognize that plants and animals have features that help them survive in different environments. (S:LS1:2:2.1) • Identify the resources plants and animals need for growth and energy, and describe how their habitat provides these basic needs.(S:LS2:2:2.1) • Understand how plants depend on water and light to grow. • Recognize that living things can be found almost any place in the world, and that specific types of environments are required to support the many different species of plants and animal life. (S:LS2:2:1.1) • Recognize and describe the similarities and differences in both behavior and appearance of plants and animals. (S:LS3:2:3.1) • Recognize that there are different species of living things in various places around the world. (S:LS3:2:3.2) • Recognize that there are different kinds of living things in an area and understand that they exist in different places on land and in water. • Understand how animals help seeds to travel. • Identify the diversity of living things in each of a variety of different habitats. • Recognize that some jobs/careers require knowledge and use of life science content and/or skills. (S:LS5:2:4.1)
Common Summative Assessments	

Standards	• **2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.** [Assessment Boundary: Assessment is limited to testing one variable at a time.] • **2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*** • **2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.** [Clarification Statement: Emphasis is on the diversity of living

Windham School District Science Curriculum
Third Grade

Title of Core Map	Third Grade
Title of Unit	Weather and Climate
Essential Questions	• How are the weather and climate different from where I live compared to other places in the world?
Content	• **Weather and Climate:** Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1) Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2) • **Natural Hazards:** A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3-ESS3-1) (Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)
Skills	• Explain how water exists in the atmosphere in different forms and describe how it changes from one form to another through various processes such as freezing, condensation, precipitation and evaporation. (S:ESS1:4:1.1) • Explain that air surrounds the Earth, it takes up space, and it moves around as wind. (S:ESS1:4:1.2) • Describe weather changes or weather patterns based on data collected from daily weather observations. (S:ESS1:4:1.3) • Explain how the use of scientific tools helps to extend senses and gather data about weather (i.e., weather/wind vane– direction; wind sock– wind intensity; anemometer– speed; thermometer– temperature; meter sticks/rulers– snow depth; rain gauges– rain amount in inches). (S:ESS1:4:1.4)
Common Summative Assessments	
Standards	• **3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.] • **3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.** • **3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*** [Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.]

Title of Core Map	Earth and Space Science
Title of Unit	Earth, Sun and Moon
Essential Questions	• How does the earth's position in the solar system affect my life? • How are the parts of the solar system related?
Content	• **Earth, Sun and Moon:** The Earth is a part of a solar system, made up of distinct parts, which have temporal and spatial interrelationships. The sun is the star in our solar system and the Earth revolves around the sun. One full orbit takes 365 ¼ days. The moon orbits the Earth in a 24 hour period. • **Energy:** The sun produces heat energy that is felt by the earth. This heat is different depending on the tilt of the earth. At the same time, the temperature varies on the moon depending on its position while in orbit of the Earth. • **Size and scale:** The stars in the galaxy appear smaller than our star, the Sun, due to its proximity with the Earth. • **Stars and galaxies:** The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time. • **Constellations:** Constellations, or pictures in the sky, can be seen and their names were created in long ago history.
Skills	• Explain that night and day are caused by the Earth's rotation on its axis, and that the Earth rotates approximately once, every 24 hours. (S:ESS2:4:1.1) • Describe the Sun as Star. (S:ESS2:4:1.2) • Recognize that the Sun provides the light and heat necessary to maintain the temperature of the Earth. (S:ESS2:4:2.1) • Recognize that the Moon orbits the Earth. (S:ESS2:4:3.1) • Recognize that the Earth is one of a number of planets that orbit the Sun. (S:ESS2:4:3.2) • Recognize that although star patterns seen in the sky appear to move slowly each night from east to west, they actually remain the same, and explain why different stars can be seen during different seasons. (S:ESS2:4:4.1) • Explain why the planets look like stars, and why, over a period of time, they appear to wander among the constellations. (S:ESS2:4:4.2) • Recognize that astronomical objects in space are massive in size and are separated from one another by vast distances. (S:ESS3:4:1.1) • Explain that telescopes magnify the size of distant objects and significantly increase the number of these objects that can be viewed from Earth. (S:ESS3:4:1.2) • Recognize and describe the stars, like the Sun, as spherical in nature.(S:ESS3:4:2.1) • Recognize that stars come in different colors, and that the Sun is a yellow Star. (S:ESS3:4:2.2)

Common Summative Assessments	
Standards	• **3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.] • **3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.** • **3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*** [Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.]

Title of Core Map	Third Grade
Title of Unit	Interdependent Relationships in Ecosystems
Essential Questions	• What relationships do living things have with their environment? • What do living things need to survive? • How does life change over time?
Content	• **Ecosystem Dynamics, Functioning, and Resilience:** Some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment and some die, when the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources. (secondary to 3-LS4-4) • **Social Interactions and Group Behavior:** Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. (Note: Moved from K–2) (3-LS2-1) • **Evidence of Common Ancestry and Diversity:** Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (Note: Moved from K–2) (3-LS4-1) Fossils provide evidence about types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1) • **Adaptation:** Some kinds of organisms survive well, some survive less well, and some cannot survive at all, for any particular environment. (3-LS4-3) • **Biodiversity and Humans:** Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)
Skills	• Recognize and identify the various ways in which living things can be grouped. (S:LS1:4:1.1) • Sort/classify different living things using similar and different characteristics; and describe why organisms belong to each group or cite evidence about how they are alike or not alike. (S:LS1:4:1.2) • Identify the basic needs of plants and animals in order to stay alive (i.e., water, air, food, space). (S:LS1:4:2.4) • Distinguish between plant and animal characteristics that are inherited, such as eye color in humans and the shape of leaves in plants, and those that are affected by their environment, such as grass turning brown due to lack of water. (S:LS1:4:3.1) • Recognize that living organisms have life cycles, which include birth, growth and development, reproduction, and death; and explain how these life cycles vary for different organisms. (S:LS1:4:3.2) • Describe the reproductive process of plants, explaining some plants grow from seed, while others grow from the parts of other plants. (S:LS1:4:3.3)

	• Predict, sequence, or compare the life stages of organisms (plants and animals): e.g., put images of life stages of an organism in order, predict the next stage in sequence, and compare two organisms. (S:LS1:4:3.4)
	• Recognize that some plants and animals go through changes in appearance when the seasons change. (S:LS2:2:1.3) • Describe how the nature of an organism's environment, such as the availability of a food source, the quantity and variety of other species present, and the physical characteristics of the environment affect the organism's patterns of behavior. (S:LS2:4:1.1) • Describe the interactions of living organisms with nonliving things. (S:LS2:4:1.2) • Recognize that the transfer of energy through food is necessary for all living organisms and describe the organization of food webs. (S:LS2:4:2.1)
	• Recognize that energy is needed for all organisms to stay alive and grow or identify where a plant or animal gets its energy. (S:LS2:4:2.2)
	• Describe ways plants and animals depend on each other. (S:LS2:4:3.2)
	• Recognize that plants and animals interact with one another in various ways besides providing food, such as seed dispersal or pollination. (S:LS2:4:3.1)

Standards	• **3-LS2-1. Construct an argument that some animals form groups that help members survive.** • **3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.** [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.] • **3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.** [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.] • **3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.*** [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

Title of Core Map	Third Grade
Title of Unit	Inheritance and Variations of Traits: Life Cycles and Traits
Essential Questions	• How are life cycles among all living things same or different? • Why are differences important for survival?
Content	• **Growth and Development of Organisms:** Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1) • **Inheritance of Traits:** Many characteristics of organisms are inherited from their parents. (3-LS3-1) Other characteristics result from individual's interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2) • **Variation of Traits:** Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1) The environment also affects the traits that an organism develops. (3-LS3-2) • **Natural Selection:** Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (3-LS4-2)
Skills	• Provide examples of how environmental changes can cause different effects on different organisms. (S:LS3:4:1.1) • Provide examples of how an organism's inherited characteristics can adapt and change over time in response to changes in the environment. (S:LS3:4:1.2) • Using information, explain how changes in the environment can cause organisms to respond (e.g. survive there and reproduce, move away, die.) (S:LS3:4:1.3) • Recognize that some plants and animals, which are alive today, are similar to living things which have become extinct, such as elephants and mammals. (S:LS3:2:2.1) • Compare information about fossils to living organisms and other fossils to determine any similarities and differences.(S:LS3:4:2.1) • Recognize that individuals of the same species differ in their characteristics; and explain that sometimes these differences give individuals an advantage in survival and reproduction. (S:LS3:4:3.1) • Recognize that for any particular environment, some kinds of animals and plants survive well, some less well, and some cannot survive at all. (S:LS3:4:3.2) • Distinguish between characteristics of humans that are inherited from parents (i.e., hair color, height, skin color, eye color) and others that are learned(e.g., riding a bike, singing a song, playing a game, reading). (S:LS4:4:3.2)

	• Recognize man uses various mechanical devices to record and describe living organisms. (S:LS5:4:1.1) • Demonstrate the use of appropriate tools and simple equipment, such as thermometers, magnifiers and microscopes to gather data and extend the senses. (S:LS4:4:2.1) (S:PS4:4:2.1) • Describe how some tools can be used to modify natural materials by processes such as separating, shaping, and joining, to produce materials. (S:PS4:4:2.2) • Identify some jobs/careers that require knowledge and use of life science content and/or skills. (S:LS5:4:4.1)
Common Summative Assessments	
Standards	• **3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.** [Clarification Statement: Changes organisms go through during their life form a pattern.] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.] • **3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.** [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.] • **3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.** [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.] • **3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.** [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]

Title of Core Map	Third Grade
Title of Unit	Forces and Interactions
Essential Questions	• How and why do objects move?
Content	• **Forces and Motion:** Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (3-PS2-1) Patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (3-PS2-2) • **Types of Interactions:** Objects in contact exert forces on each other. (3-PS2-1) Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3),(3-PS2-4)
Skills	• Recognize that magnets attract certain kinds of other materials; and classify objects by those magnets will attract and those they will not. (S:PS3:4:1.1) • Recognize that magnets attract and repel each other. (S:PS3:4:1.2) • Explain that electrically charged material pulls on all other materials and can attract or repel other charged materials. (S:PS3:4:1.3) • Recognize that the Earth's gravitational force pulls any object toward it. (S:PS3:4:1.4) • Use observations of magnets in relation to other objects to describe the properties of magnetism (i.e., attract or repel certain objects or has no effect). (S:PS3:4:1.5) • Use data to predict how a change in force (greater/lesser) might affect the position, direction of motion, or speed of an object (e.g., ramps and balls). (S:PS3:4:2.1)
Common Summative Assessments	
Standards	• **3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at

	all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.] • **3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.] • **3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.] • **3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.*** [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

Windham School District Science Curriculum
Fourth Grade

Title of Core Map	Fourth Grade
Title of Unit	Structure, Function, and Information Processing
Essential Questions	• How do the parts of living things help them to survive? • How do animals gather information?
Content	• **Electromagnetic Radiation-** An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2) • **Structure and Function-** Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1) • **Information Processing-** Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)
Skills	• Identify what the physical structures of humans do (e.g., sense organs– eyes, ears, skin, etc.) or compare physical structures of humans to similar structures of animals. (S:LS4:4:3.1) • Demonstrate the use of appropriate tools and simple equipment, such as thermometers, magnifiers and microscopes to gather data and extend the senses. (S:LS5:4:2.1) • Recognize that living organisms have certain structures and systems that perform specific functions, facilitating survival, growth and reproduction. (S:LS1:4:2.1) • Identify and explain how the physical structures of an organism (plants or animals) allow it to survive in its habitat/environment (e.g., roots for water; nose to smell fire). (S:LS1:4:2.3) • Identify and describe the function of the plant structures responsible for food production, water transport, support, reproduction, growth and protection. (S:LS1:4:2.2) • Recognize that an individual organism's behavior is affected by internal cues, such as hunger and thirst; and describe how an organism uses its senses to understand and respond to these cues. (S:LS4:4:1.1)

	• Recognize that an individual organism's behavior is influenced by external cues, such as seasonal change; and describe how an organism might react, such as migrating or hibernating. (S:LS4:4:1.2) • Recognize behaviors that may be unsafe or unhealthy for themselves and others. (S:LS4:4:1.3)
Common Summative Assessments	
Standards	• **4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction**. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [*Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.*] • **4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.** [Clarification Statement: Emphasis is on systems of information transfer.] [*Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.*]

Windham School District Science Curriculum
Fourth Grade

Title of Core Map	Fourth Grade
Title of Unit	Earth's Systems: Processes that Shape the Earth
Essential Questions	• How do we gather evidence about Earth's changes? • How has Earth changed over time?
Content	• **The History of Planet Earth-** Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1) • **Earth Materials and Systems-** Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1) • **Plate Tectonics and Large-Scale System Interactions-** The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2) • **Bio geology-** Living things affect the physical characteristics of their regions. (4-ESS2-1) • **Natural Hazards-** A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. . (4-ESS3-2)
Skills	• Explain how wind, water, or ice shape and reshape the Earth's surface. (S:ESS1:4:5.2) • Use results from an experiment to draw conclusions about how water interacts with earth materials (e.g., percolation, erosion, frost heaves). (S:ESS1:4:6.4) • Identify and describe processes that affect the features of the Earth's surface, including weathering, erosion, and deposition of sediment. (S:ESS1:4:5.1) • Explain that smaller rocks come from the breaking and weathering of larger rocks and bedrock. (S:ESS1:4:6.1)

	• Describe Earth materials such as gases found in the atmosphere, rocks, soils, and water in its liquid and solid states. (S:ESS1:4:2.1) • Describe rock as being composed of different combinations of minerals. (S:ESS1:4:2.2) • Given information about Earth materials, explain how their characteristics lend themselves to specific uses. (S:ESS1:4:2.3) • Given certain Earth materials (soils, rocks, or minerals) use physical properties to sort, classify, and/or describe them. (S:ESS1:4:2.4) • Recognize features of the Earth as viewed by astronauts in orbit and as transmitted by scientific instruments on satellites and spacecraft. (S:ESS1:4:4.1) • Recognize and describe the Earth's surface as mostly covered by water. (S:ESS1:4:7.1) • Explain that most of Earth's water is salt water, which is found in the oceans, and that fresh water is found in rivers, lakes, underground sources, and glaciers. (S:ESS1:4:7.2) • Distinguish between and provide examples of materials that can be recycled/reused and those that cannot. (S:ESS4:4:3.1) • Provide examples of technology that have changed the environment and explain whether the effect had a positive or negative impact. (S:ESS4:4:3.2) • Explain how to dispose of waste so that it does not harm the environment. (S:ESS4:4:3.3) • Identify some jobs/careers that require knowledge and use of Earth science content and/or skills. (S:ESS4:4:4.1) • Explain that manufactured products are designed to solve a problem or meet a need. (S:PS4:4:3.2) • Recognize and explain that fossils offer evidence of plants, animals and the nature of environments that existed long ago. (S:ESS1:4:3.1)
Common Summative Assessments	
Standards	• **4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers for changes in a landscape over time to support an explanation for changes in a landscape over time.** [Clarification

	Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [*Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.*] • **4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation**. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [*Assessment Boundary: Assessment is limited to a single form of weathering or erosion.*] • **4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.] • **4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [*Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.*]

Windham School District Science Curriculum
Fourth Grade

Title of Core Map	Fourth Grade
Title of Unit	Energy
Essential Questions	• How is energy transferred and transformed? • In what ways does the physical world affect our lives and our earth?
Content	• **Definitions of Energy-** The faster a given object is moving, the more energy it possesses. . (4-PS3-1) Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3) • **Conservation of Energy and Energy Transfer-** Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2),(4-PS3-3) Light also transfers energy from place to place. (4-PS3-2) Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4) • **Relationship Between Energy and Forces-** When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3) • **Energy in Chemical Processes and Everyday Life-** The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4) • **Natural Resources-** Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)
Skills	• Recognize that energy has the ability to create change. (S:PS2:4:1.1) • Identify the various forms of energy, such as electrical, light, heat, sound. (S:PS2:4:3.1) • Recognize that electricity in circuits can produce light, heat, sound, and magnetic effects. (S:PS2:4:3.2) • Identify and describe the organization of a simple circuit.(S:PS2:4:3.3) • Differentiate between objects and materials that conduct electricity and those that are insulators of electricity.

	(S:PS2:4:3.4) • Explain that light travels in a straight line until it strikes an object; and describe how it can be reflected by a mirror, bent by a lens, or absorbed by the object.(S:PS2:R:3.5) • Given a specific example or illustration (e.g., simple closed circuit, rubbing hands together) predict the observable effects of energy (i.e., the bulb lights, a bell rings, and hands warm up). A test item may ask, "What will happen when…?" (S:PS2:4:3.6) • Use observations of light in relation to other objects/substances to describe the properties of light (i.e., can be reflected, refracted, or absorbed). (S:PS2:4:3.7) • Experiment, observe, or predict how heat might move from one object to another. (S:PS2:4:3.8) • Understand that materials are used in certain products based on their properties, such as strength and flexibility. (S:PS4:4:1.1) • Recognize that products are made using a combination of technologies, such as how an escalator uses both a pulley system and an electrical motor. (S:PS4:4:1.2) • Give examples of transportation systems used in New Hampshire, such as buses, trains, cars, and bicycles; and describe the sources of energy they use. (S:PS4:4:3.1) • Recognize there are pros and cons to using different types of energy, such as solar energy and fossil fuels, and compare the differences. (S:ESS4:4:3.4) • Provide an example to illustrate that manufacturing involves changing natural materials into finished products; and explain that this results in the production of a large number of objects that look almost identical. (S:PS4:4:3.3)
Common Summative Assessments	
Standards	• **4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.** [*Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.* • **4-PS3-2.Make observations to provide evidence that energy can be transferred from place to place by**

	sound, light, heat, and electric currents. [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*] • **4-PS3-3.Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*] • **4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [*Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.*] • **4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move**. [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [*Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.*] • **4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.** [*Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.*] • **4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.*** [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.] • **4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment**. [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

Windham School District Curriculum
Fifth Grade

Title of Core Map	Fifth Grade
Title of Unit	Space Systems: Stars and the Solar Systems
Essential Questions	• What predictable, observable patterns occur as a result of the interaction between the Earth, Moon, and Sun? How are planets and other objects in the Solar System similar and different to Earth? • What role does intellectual curiosity play in the history of space exploration and the direction of space exploration today?
Content	• **Types of Interactions:** The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5-PS2-1) • **The Universe and its Stars:** The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1) • **Earth and the Solar System:** The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)
Skills	• Recognize and describe how the regular and predictable motions of the earth and moon explain certain Earth phenomena such as day and night, the seasons, the year, shadows and tide. (S:ESS2:6:1.1) • Explain the historical perspective of planetary exploration and man's achievements in space, beginning with Russia's Sputnik mission in 1957. (S:ESS2:6:4.1) • Describe man's perception of the constellations throughout history, and explain how he has used them to his advantage, including navigational purposes and to explain historical events. (S:ESS2:6:4.2) • Recognize that of all the known planets, Earth appears to be somewhat unique, and describe the conditions that exist on Earth to allow it to support life. (S:ESS2:6:1.2) • Compare and contrast planets based on data provided about size composition, location, orbital movement, atmosphere or surface features. (S:ESS2:8:3.4)

Common Summative Assessments	
Standards	• **5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.** [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [*Assessment Boundary: Assessment does not include mathematical representation of gravitational force.*] • **5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from the Earth.** [*Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).*] • **5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [*Assessment Boundary: Assessment does not include causes of seasons.*]

Title of Core Map	Fifth Grade
Title of Unit	Earth's Systems Weather
Essential Questions	• How does the interaction of Earth's major systems (geosphere, hydrosphere, and atmosphere) effect the Earth's surface materials and processes?
Content	• **Earth Materials and Systems:** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1) • **The Roles of Water in Earth's Surface Processes:** Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)
Skills	• Describe and make predictions about local and regional weather conditions using observation and data collection methods. (S:ESS1:6:1.1) • Identify weather patterns by tracking weather related events, such as hurricanes. (S:ESS1:6:1.2) • Explain the composition and structure of the Earth's atmosphere. (S:ESS1:6:1.3) • Describe weather in terms of temperature, wind speed and direction, precipitation, and cloud cover. (S:ESS1:6:1.4) • Describe how clouds affect weather and climate, including precipitation, reflecting light from the sun, and retaining heat energy emitted from the Earth's surface. (S:ESS1:6:1.5) • Explain that satellites can be used to view and track storms and Earth events, such as hurricanes and wild fires. (S:ESS1:6:4.2) • Recognize how the tilt of the Earth's axis and the Earth's revolution around the Sun affect seasons and weather patterns. (S:ESS2:6:2.1) • Identify and describe seasonal, daylight and weather patterns as they relate to energy. (S:ESS2:6:2.2) • Recognize that satellites and Doppler radar can be used to observe or predict the weather. (S:ESS4:6:2.1) • Employ knowledge of basic weather symbols to read and interpret weather and topographic maps. (S:ESS4:6:2.2)

	• Read and interpret data from barometers, sling psychrometers and anemometers. (S:ESS4:6:2.3) • Understand that some form of science is used in most jobs/careers and that some jobs/careers specifically require knowledge of Earth science. (S:ESS4:6:4.1) • Describe and define the different landforms on the Earth's surface, such as coastlines, rivers, mountains, deltas, canyons, etc. (S:ESS1:6:2.2) • Identify and distinguish between various landforms, using a map and/or digital images. (S:ESS1:6:2.3) • Recognize that images taken of the Earth from space can show its features and any changes in those features that appear over time. S:ESS1:6:4.1)
Common Summative Assessments	
Standards	• **5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [*Assessment Boundary: Assessment is limited to the interactions of two systems at a time.*] • **5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** [*Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.*] • **5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.**

Title of Core Map	Fifth Grade
Title of Unit	Structure and Properties of Matter
Essential Questions	• How do properties of materials determine their use? • What determines the type and extent of a chemical or physical reaction? • How can energy be transferred from one material to another?
Content	• **Structure and Property of Matter:** Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1) The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2) Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3) • **Chemical Reactions:** When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4) No matter what reaction or change in properties occurs, the total weight of the substances does not change. (5-PS1-2) • **Energy:** Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.
Skills	• Recognize that all matter is composed of minute particles called atoms, and explain that all substances are composed of atoms, each arranged into different groupings. (S:PS1:6:1.1) • Identify elements as substances that contain only one kind of atom and explain that elements do not break down by normal laboratory reactions, such as heating, exposure to electric current, and reaction to acid. (S:PS1:6:1.2) • Identify elements according to their common properties, such as highly reactive metals, less reactive metals, highly reactive non-metals, and almost non-reactive gasses.(S:PS1:6:2.1) • Recognize that over one hundred elements exist, and identify the periodic table as a tool for organizing them. (S:PS1:6:1.3)

	• Identify substances by their physical and chemical properties, such as magnetism, conductivity, density, solubility, boiling and melting points. (S:PS1:6:2.2) • Differentiate between weight and mass. (S:PS1:6:2.3) • Identify energy as a property of many substances. (S:PS1:6:2.4) • Differentiate between a physical change such as melting, and a chemical change, such as rusting. (S:PS2:6:1.1) • Describe how mass remains constant in a closed system and provide examples relating to both physical and chemical change. (S:PS2:6:2.1) • Explain that the pitch of a sound is dependent on the frequency of the vibration producing it. (S:PS2:6:3.1) • Explain that sound vibrations move at different speeds, have different wavelengths, and establish wave-like disturbances that emanate from the source. (S:PS2:6:3.1) • Recognize that energy, in the form of heat, is usually a by-product when one form of energy is changed to another, such as when machines convert stored energy to motion. (S:PS2:6:3.3) • Explain that heat energy moves from warmer materials or regions to cooler ones through conduction, convection, and radiation. (S:PS2:6:3.4) • Explain how electrical circuits can be used to transfer energy in order to produce heat, light, sound, and chemical changes. (S:PS2:6:3.5) • Understand that some form of science is used in most jobs/careers and that some jobs/careers specifically require knowledge of physical science. (S:PS4:6:4.1)
Common Summative Assessments	
Standards	• **5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [*Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.*]

	• **5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conservered.** [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [*Assessment Boundary: Assessment does not include distinguishing mass and weight.*] • **5-PS1-3. Make observations and measurements to identify materials based on their properties.** [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Asse*ssment Boundary: Assessment does not include density or distinguishing mass and weight.*] • **5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.**

Title of Core Map	Fifth Grade
Title of Unit	Matter and Energy in Organisms and Ecosystems
Essential Questions	• How is matter transformed, and energy transferred/transformed in living systems? • How do changes in one part of an Earth system affect other parts of the system? • How do humans impact the diversity and stability of ecosystems?
Content	• **Energy in Chemical Processes and Everyday Life:** The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter. (5-PS3-1) • **Organization for Matter and Energy Flow in Organisms:** Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1) Plants acquire their material for growth chiefly from air and water. (5-LS1-1) • **Interdependent Relationships in Ecosystems:** The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1) • **Cycles of Matter and Energy Transfer in Ecosystems:** Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1) • **Human Impacts on Earth's Systems:** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)
Skills	• Identify and describe the factors that influence the number and kinds of organisms an ecosystem can support, including the resources that are available, the differences in temperature, and the composition of the soil, any disease, the threat of predators, and competition from other organisms. (S:LS2:6:1.1)

	• Explain that most microorganisms do not cause disease and that many are beneficial to the environment. (S:LS2:6:1.2) • Describe how energy is transferred in an ecosystem through food webs; and explain the roles and relationships between producers, consumers and decomposers. (S:LS2:6:2.1) • Recognize that one of the most general distinctions among organisms is between plants, which use sunlight to make their own food, and animals, which consume energy-rich foods. (S:LS2:6:2.2) • Describe the process of photosynthesis and explain that plants can use the food they make immediately or store it for later use. (S:LS2:6:2.3) • Recognize that energy, in the form of heat, is usually a byproduct when one form of energy is converted to another, such as when living organisms transform stored energy to motion. (S:LS2:6:2.4) • Define a population as all individuals of a species that exist together at a given place and time; and explain that all populations living together in a community, along with the physical factors with which they interact, compose an ecosystem. (S:LS2:6:2.1) • Using food webs, identify and describe the ways in which organisms interact and depend on one another in an ecosystem. (S:LS2:6:3.2) • Explain how insects and various other organisms depend on dead plant and animal matter for food; and describe how this process contributes to the system. (S:LS2:6:3.3) • Explain how soil is formed from combinations of weathered rock and decomposed plant and animal remains, and that it contains living organisms. (S:ESS1:6:6.1) • Identify the components of soil and other factors, such as bacteria, fungi and worms, which influence its texture, fertility, and resistance to erosion. (S:ESS1:6:6.2) • Describe the properties of soil, such as color, texture, capacity to retain water, and its ability to support plant life. (S:ESS1:6:6.3) • Explain the properties that make water an essential component of the Earth's system, including solvency and its ability to maintain a liquid state at most temperatures. (S:ESS1:6:7.1) • Explain that water quality has a direct effect on Earth's life forms. (S:ESS1:6:7.2) • Differentiate between renewable and non-renewable resources. (S:ESS1:6:2.1)
Common Summative Assessments	

Standards	• **5-PS3-1. Use models to describe that that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.** [Clarification Statement: Examples of models could include diagrams, and flow charts.] • **5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.** [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.] • **5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.**[Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

Windham School District Science Curriculum
Sixth Grade

Title of Core Map	Sixth Grade
Title of Unit	**Space Systems**
Essential Questions	• What is the relationship between the movement of the Earth and the apparent movement of celestial objects? • What forces caused the formation of the solar system and determined its structure today?
Content	• **The Universe and Its Stars** -Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) • **Earth and the Solar System-**The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3) This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1) The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)
Skills	• Recognize and describe how the regular and predictable motions of the Earth and Moon explain certain Earth phenomena, such as day and night, the seasons, the year, shadows and the tides. (S:ESS2:6:1.1) • Recognize that of all the known planets, Earth appears to be somewhat unique; and describe the conditions that exist on Earth that allow it to support life. (S:ESS2:6:1.2) • Identify the characteristics of the Sun and its position in the universe. (S:ESS2:8:1.1) • Recognize and describe how the regular and predictable motions of the Earth and Moon account for phenomena, such as the phases of the Moon and eclipses. (S:ESS3:8:1.2) • Recognize the relationships between the tides and the phases of the moon; and use tide charts and NOAA information to describe them. (S:ESS2:8:1.3) • Identify the characteristics and movement patterns of the planets in our Solar System and differentiate between them. (S:ESS2:8:3.1) • Explain the effects of gravitational force on the planets and their moons. (S:ESS2:8:3.2) • Explain why Earth and our Solar System appear to be somewhat unique, while acknowledging recent evidence that suggests similar systems exist in the universe. (S:ESS2:8:3.3) • Define an astronomical unit as the distance from the Earth to the Sun. (S:ESS3:8:1.1) • Explain that special units of measure, such as light years and astronomical units, are used to calculate distances in space.

	(S:ESS3:8:1.2) • Describe objects such as asteroids, comets and meteors in terms of their characteristics and movement patterns.(S:ESS3:8:2.1) • Describe the universe as being comprised of billions of galaxies, each containing many billions of stars; and explain that there are vast distances separating these galaxies and stars from one another and from the Earth. (S:ESS3:8:3.1) • Compare and contrast planets based on data provided about size, composition, location, orbital movement, atmosphere, or surface features (includes moons). [ESS2(5-**8**)MAS-**6**] (S:ESS2:8:3.4) • Explain how gravitational force affects objects in the Solar System (e.g., moons, tides, orbits, satellites). [ESS2(5-**8**)SAE+POC-**8**] (S:ESS2:8:3.5) • Explain the temporal or positional relationships between or among the Earth, Sun and Moon (e.g., night/day, seasons, year, tide). [ESS2(5-**8**)SAE+POC-**8**] (S:ESS2:8:1.4) • Explain how technological advances have allowed scientists to re-evaluate or extend existing ideas about the Solar System. [ESS2(5-**8**)NOS-**7**] (S:ESS2:8:4.1)
Common Summative Assessments	
Standards	• **MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.** [Clarification Statement: Examples of models can be physical, graphical, or conceptual.] • **MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.** [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as their school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.] • **MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.** [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.]

Title of Core Map	Sixth Grade
Title of Unit	History of Earth
Essential Questions	• What forces wear down and build up Earth's surface? • How can conclusions about the Earth be drawn through the identification and classification of rocks and minerals? • How are Earth processes and change evidenced in rock formations?
Content	• **The History of Planet Earth** - The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4) Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (MS.ESS1.C GBE) (secondary to MS-ESS2-3) • **Earth's Materials and Systems-** The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2) • **Plate Tectonics and Large-Scale System Interactions** - Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3) • **The Roles of Water in Earth's Surface Processes-** Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)
Skills	• Recognize that fossils offer important evidence relating to changes in life forms and environmental conditions over geologic time. (S:ESS1:6:3.1) • Identify connections between fossil evidence and geological events, such as changes in atmospheric composition, movement of tectonic plates, and asteroid/comet impact; and develop a means of sequencing this evidence. (S:ESS1:6:3.2) • Explain how fossils found in sedimentary rock can be used to support the theories of Earth's evolution over geologic time; and describe how the folding, breaking, and uplifting of the layers affects the evidence. (S:ESS1:8:3.1) • Recognize that things change in steady, repetitive, or irregular ways, or sometimes in more than one way at the same time. (S:ESS1:6:5.1) • Explain how some changes to the Earth's surface happen abruptly, as a result of landslides, earthquakes and volcanic eruptions; while other changes happen very slowly as a result of weathering, erosions and deposition of sediment caused by waves, wind, water and ice. (S:ESS1:6:5.2) • Recognize that vibrations in materials set up wavelike disturbances that spread away from the source, as with earthquakes. (S:ESS1:6:5.3) • Explain that the Earth's crust is divided into plates, which move at extremely slow rates in response to movements in the

	mantle. (S:ESS1:8:5.1) • Describe how catastrophic changes that have taken place on the Earth's surface can be revealed by satellite images. (S:ESS1:8:4.1) • Describe the layers of the Earth, including the core, mantle, lithosphere, hydrosphere, and atmosphere. (S:ESS1:8:2.1) • Describe the processes of the rock cycle. (S:ESS1:8:6.1) • Explain that sedimentary, igneous, and metamorphic rocks contain evidence of the minerals, temperatures, and forces that created them. (S:ESS1:8:6.2) • Explain how sediments of sand and smaller particles, which may contain the remains of organisms, are gradually buried and cemented together by dissolved minerals to form solid rock. (S:ESS1:8:6.3) • Using data about a rock's physical characteristics make and support an inference about the rock's history and connection to the rock cycle. [ESS1(5-**8**)SAE+POC-**5**] (S:ESS1:8:6.4) • Use geological evidence provided to support the idea that Earth's crust/lithosphere is composed of plates that move. [ESS1(5-**8**)INQ+POC-**1**] (ESS1:8:2.2) • Explain how Earth events, abruptly and over time, can bring about changes on Earth's surface (e.g., landforms, ocean floor, rock features, climate). [ESS1(5-**8**)POC-**3**] (S:ESS1:8:5.2) • Explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate. [ESS1(5-**8**)SAE+POC-**4**] (S:ESS1:8:5.3)
Common Summative Assessments	
Standards	• **MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.** [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.] • **MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.** [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events.

	Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.] • **MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.** [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]

Title of Core Map	Sixth Grade
Title of Unit	Earth's Systems
Essential Questions	▪ What are renewable and non-renewable resources and how are the resources used and conserved in our daily lives? • What forces cause the distribution of Earth's resources? • What forces cause energy movement in Earth's systems?
Content	• **Earth's Materials and Systems** - All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles, produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1) • **The Roles of Water in Earth's Surface Processes** - Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) • **Natural Resources** - Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)
Skills	• Describe how water flows into and through a watershed, falling on the land, collecting in rivers and lakes, soil, and porous layers of rock, until much of it flows back into the ocean. (S:ESS1:8:7.1) • Identify the physical and chemical properties that make water an essential component of the Earth's system. (S:ESS1:8:7.2) • Describe the Sun as the principle energy source for phenomena on the Earth's surface. (S:ESS2:8:2.1) • Explain the processes that cause cycling of water into and out of the atmosphere and their connections to our planet's weather patterns. [ESS1(5-**8**)SAE-**2**] (S:ESS1:8:7.3)
Common Summative Assessments	
Standards	• **MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.** [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.] • **MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.** [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.]

	[Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.] • **MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.** [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

Title of Core Map	Sixth Grade
Title of Unit	Weather and Climate
Essential Questions	▪ What forces cause the movement of water within the Earth's Systems? • How do forces affected climate over time? • How does human activity effect climate change?
Content	• **The Roles of Water in Earth's Surface Processes** - The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5) Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) • **Weather and Climate** - Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6) • **Global Climate Change-** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)
Skills	• Identify and describe the processes of the water cycle and explain their effects on climatic patterns. (S:ESS1:8:1.1) • Identify and describe the impact certain factors have on the Earth's climate, including changes in the oceans' temperature, changes in the composition of the atmosphere, and geological shifts due to events such as volcanic eruptions and glacial movements. (S:ESS1:8:7.3) • Explain the processes that cause cycling of water into and out of the atmosphere and their connections to our planet's weather patterns. [ESS1(5-**8**)SAE-**2**] (S:ESS1:8:7.3)
Common Summative Assessments	
Standards	• **MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.** [Clarification Statement: Emphasis is on how air masses flow from

	regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.] • **MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.** [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.] • **MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.** [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

Title of Core Map	Sixth Grade
Title of Unit	Human Impacts
Essential Questions	• How can geological events be forecast using past events? • How do human activities affect Earth systems?
Content	• **Natural Hazards** - Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2) • **Human Impacts on Earth Systems** - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4)
Skills	• Describe how catastrophic changes that have taken place on the Earth's surface can be revealed by satellite images. (S:ESS1:8:4.1) • Describe the type of impact certain environmental changes, including deforestation, invasive species, increased erosion, and pollution containing toxic substances, could have on local environments. (S:LS3:8:1.1)
Common Summative Assessments	
Standards	• **MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.** [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).] • **MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.** [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that

	impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).] • **MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.** [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

Windham School District Curriculum
Seventh Grade

Title of Core Map	Seventh Grade
Title of Unit	Structure, Function and Information Processing
Essential Questions	• What is the (significance) importance of the characteristics that are common to all living things? • Why are cells important to an organism's ability to survive? • What is health and how do different biotic and abiotic factors affect it? • How does homeostasis occur in a single cell, and multicellular organism?
Content	• **Structure and Function** - All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1) Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2) In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3) • **Information Processing-** Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)
Skills	• Describe or compare how different organisms have mechanisms that work in a coordinated way to obtain energy, grow, move, respond, provide defense, enable reproduction, or maintain internal balance (e.g., cells, tissues, organs and systems). [LS1(5-8)SAE+FAF-2] (S:LS1:8:1.2) • Identify the functions of the human body's systems, including digestion, respiration, reproduction, circulation, excretion, movement, control and coordination and protection from disease; and describe how they interact with one another. (S:LS1:8:2.1) • Explain why it is beneficial for an organism to be able to regulate its internal environment while living in a constantly changing external environment. – homeostasis. (S:LS1:8:2.3) • Explain relationships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism. [LS1(5-8)FAF-4] (S:LS1:8:2.4) • Recognize that all living things are composed of cells, and explain that while many organisms are single celled, such as yeast, others, including humans, are multicellular. (S:LS1:6:2.1) • Explain that the way in which cells function is similar in all organisms. (S:LS1:6:2.2) • Recognize that cells use energy obtained from food, to conduct the functions necessary to sustain life, such as cell growth. (S:LS1:6:2.3)

- Recognize and describe the hierarchical organization of living systems, including cells, tissues, organs, organ systems, whole organisms, and ecosystems. (S:LS1:6:2.4)
- Explain that multicellular organisms have specialized cells, tissues, organs and organ systems that perform certain necessary functions, including digestion, respiration, reproduction, circulation, excretion, movement, control and coordination and protection from disease. (S:LS1:6:2.5)
- Recognize that the human cells found in tissues and organs are similar to those of other animals, but somewhat different from cells found in plants. (S:LS1:6:2.6)
- Recognize that learning requires more than just storage and retrieval of information and that prior knowledge needs to be tapped in order to make sense out of new experiences or information. (S:LS4:6:1.1)
- Explain that people can learn about others from direct experience, from the media, and from listening to others talk about their life and work. (S:LS4:6:1.2)
- Provide examples of how humans make judgments about new situations based on memories of past experiences. (S:LS4:6:1.3)
- Recognize that unlike human beings, behavior in insects and many other species is determined almost entirely by biological inheritance. (S:LS4:8:1.1)
- Explain that organism's behavioral response is a reaction to internal or and environmental stimuli, and that these responses may be determined by heredity or from past experience. (S:LS4:8:1.2)
- Explain how all behavior is affected by both inheritance and experience. (S:LS4:8:1.3)
- Explain that the human body has ways to defend itself against disease-causing organisms and describe how defenders, including tears, saliva, the skin, some blood cells and stomach secretions support the defense process. (S:LS4:6:2.1)
- Recognize that there are some diseases that human beings can only get once; and explain how many diseases can be prevented by vaccination. (S:LS4:6:2.2)
- Explain how vaccines induce the body to build immunity to a disease without actually causing the disease itself. (S:LS4:6:2.3)
- Recognize a healthy body cannot fight all germs that invade it; and explain how some germs interfere with the body's defenses. (S:LS4:6:2.4)
- Recognize that disease in organisms can be caused by intrinsic failures of the system or infection from other organisms. (S:LS4:8:2.1)
- Describe how viruses, bacteria, fungi, and parasites may affect the human body and provide examples of how they can interfere with normal body function. (S:LS4:8:2.2)
- Describe the function of white blood cells and explain how they support the body's defense system. (S:LS4:8:.23)
- Use data and observations to support the concept that environmental or biological factors affect human body systems (biotic and abiotic). [LS4(5-**8**)INQ-**10**] (S:LS4:8:2.4)

Common Summative Assessments	
Standards	• **MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.** [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living cells, and understanding that living things may be made of one cell or many and varied cells.] • **MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.** [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.] • **MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.** [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.] • **MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.** [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

Title of Core Map	Seventh Grade
Title of Unit	Matter and Energy in Organisms and Ecosystems
Essential Questions	• How does energy flow and matter recycle through an ecosystem?
Content	• **Organization for Matter and Energy Flow in Organisms-** Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6) Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7) • **Interdependent Relationships in Ecosystems-** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) • **Cycle of Matter and Energy Transfer in Ecosystems** - Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3) • **Ecosystem Dynamics, Functioning, and Resilience** - Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4) • **Energy in Chemical Processes and Everyday Life-** The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6) Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)
Skills	• Explain how changes in environmental conditions can affect the survival of individual organisms and an entire species. (S:LS2:8:1.1) • Explain that in all environments, organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter, and that in any particular environment the growth and survival of organisms depend on the physical conditions. (S:LS2:8:1.2)

	• Using data and observations, predict outcomes when abiotic/biotic factors are changed in an ecosystem. [LS2(5-8)INQ+SAE-5] (S:LS2:8:1.3) • Given a scenario, trace the flow of energy through an ecosystem, beginning with the sun, through organisms in the food web, and into the environment (includes photosynthesis and respiration). [LS2(5-8)SAE-6] (S:LS2:8:2.2) • Identify autotrophs as producers who may use photosynthesis, and describe this as the basis of the food web. (S:LS2:8:3.1) • Explain the process of respiration and differentiate between it and photosynthesis. (S:LS2:8:3.2) • Know that all organisms, including humans, are part of, and depend on, two main interconnected global food webs: one which includes microscopic ocean plants, and the other which includes land plants. (S:LS2:8:3.3) • Describe how matter is recycled within ecosystems and explain that the total amount of matter remains the same, though its form and location change. (S:LS2:8:3.4) • Identify carbon, hydrogen, oxygen, nitrogen and phosphorus as common elements of living matter. (S:LS2:8:3.5) • Given an ecosystem, trace how matter cycles among and between organisms and the physical environment (includes water, oxygen, food web, decomposition and recycling, but not carbon cycle nor nitrogen cycle). [LS2(5-8)SAE-7] (S:LS2:8:3.6) • Define a population and describe the factors that can affect it. (S:LS1:8:2.2) • Explain how food provides energy and materials for growth and repair of body parts. (S:LS2:8;2.1)
Common Summative Assessments	
Standards	• **MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.** [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.] • **MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.** [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.] • **MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

	• **MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.] • **MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.** [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

Title of Core Map	Seventh Grade
Title of Unit	Interdependent Relationships in Ecosystems
Essential Questions	• How do biotic and abiotic factors in an ecosystem contribute to its health?
Content	• **Interdependent Relationships in Ecosystems-** Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2) • **Ecosystem Dynamics, Functioning, and Resilience** - Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5) • **Biodiversity and Humans** - Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5) • **Developing Possible Solutions** - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)
Skills	• Using data and observations about the biodiversity of an ecosystem make predictions or draw conclusions about how the diversity contributes to the stability of the ecosystem. (S:LS1:8:2.5) • Describe the type of impact certain environmental changes, including deforestation, invasive species, increased erosion, and pollution containing toxic substances, could have on local environments. (S:LS3:8:1.1) • Provide examples of how all organisms, including humans, impact their environment; and explain how some changes can be detrimental to other organisms. (S:LS3:6:1.1) • Explain how changes in environmental conditions can affect the survival of individual organisms and an entire species. (S:LS3:6:1.2) • Explain that in all environments, organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter, and that in any particular environment the growth and survival of organisms depend on the physical conditions. (S:LS2:8:1.2) • Recognize that the length and quality of human life are influenced by many factors, including sanitation, diet, medical care, gender, genes, environmental conditions, and personal health behaviors. (S:LS4:6:3.1)
Common Summative Assessments	

Standards	• **MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.** [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.] • **MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*** [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

Title of Core Map	Seventh Grade
Title of Unit	Growth, Development, and Reproduction of Organisms
Essential Questions	• How does sexual reproduction contribute to the diversity and continuity of life? • How does our modern understanding of DNA and genetics allow humans to shape the living world? • How do the environment and genetics interact to produce predictable phenotypic traits?
Content	• **Growth and Development of Organisms** - Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MS-LS3-2) Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4) Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4) Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5) • **Inheritance of Traits** - Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) • **Variation of Traits-** In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1) • **Natural Selection** - In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5)
Skills	• Differentiate between asexual and sexual reproduction, and explain that in some kinds of organisms, all the genes come from one parent, while in organisms requiring two sexes to reproduce; typically half the genes come from each parent. (S:LS12:8:3.1) • Explain that a species of sexually reproducing organisms is comprised of all the organisms that can mate to produce fertile offspring. (S:LS1:8:3.2) • Explain that in sexual reproduction, a single specialized cell from a female merges with a specialized cell from a male in a process called fertilization. (S:LS1:8:3.3) • Explain that the fertilized egg cell, carrying genetic information from each parent, multiplies to form the complete organism. (S:LS1:8:3.4)

	• Explain how the basic tissues of an embryo form. (S:LS1:8:3.5) • Compare and contrast sexual reproduction with asexual reproduction. (S:LS1:8:3.6) • Using data provided, select evidence that supports the concept that genetic information is passed on from both parents to offspring. (S:LS1:8:3.7) • Recognize that hereditary information is contained in genes, which are located in the chromosomes of each cell; and explain that inherited traits can be determined by either one or many genes, and that a single gene can influence more than one trait, such as eye and hair color. (S:LS3:8:3.1) • Explain how individual organisms with certain traits are more likely than others to survive and have offspring. (S:LS3:8:3.3) • Recognize that humans are able to control some characteristics of plants and animals through selective breeding; and explain how this results in small differences between the parents and offspring, which can accumulate in successive generations so that decedents are very different from their ancestors. (S:LS3:8:3.4) • Explain that cells repeatedly divide to make more cells for growth and repair. (S:LS1:6:3.1) • Explain that the same genetic information is copied in each cell of a new organism. (S:LS1:6:3.2) • Explain that all living things reproduce in order to continue their species. (S:LS1:6:3.3) • Recognize that the length and quality of human life are influenced by many factors, including sanitation, diet, medical care, gender, genes, environmental conditions, and personal health behaviors. (S:LS4:6l3.1) • Compare patterns of human development with those of other vertebrates. (S:LS4:8:3.1) • Recognize that an organism can be described in terms of a combination of traits; and differentiate between inherited traits and those that result from interactions with the environment. (S:LS4:8:3.2) • Describe the major changes that occur over time in human development from single cell through embryonic development to new born (i.e., group of cells during the first trimester, organs form during the second, organs mature during the third). (S:LS4:8:3.3) • Using data provided, select evidence that supports the concept that genetic information is passed on from both parents to offspring. (S:LS4:8:3.4)
Common Summative Assessments	

Standards	• **MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.** [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.] • **MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.** [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.] • **MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.** [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.] • **MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.** [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.] • **MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.** [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]

Title of Core Map	Seventh Grade
Title of Unit	Natural Selection and Adaptations
Essential Questions	• What is the value of a classification system in informing our knowledge of evolutionary relationships? • What characteristics do all living things share and how would changes in the environment affect species' ability to survive?
Content	• **Evidence of Common Ancestry and Diversity** - The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1) Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2) Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3) • **Natural Selection-** Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4) • **Adaptation-** Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)
Skills	• Recognize that similarities among organisms are found in anatomical features and patterns of development; and explain how these can be used to infer the degree of relatedness among organisms. (S:LS1:8:1.1) • Identify ways in which living things can be grouped and organized, such as taxonomic groups of plants, animals and fungi. (S:LS1:6:1.1) • Categorize organisms into kingdoms that are currently recognized, according to shared characteristics. (S:LS1:6:1.2) • Describe how the fossil record provides geologic evidence verifying the existence of now extinct life forms, and explains how this evidence provides documented proof of their appearance, diversification and extinction. (S:LS3:8;2.1) • Explain the concept of extinction and describes its importance in biological evolution. (S:LS3:8:2.2) • Use a model, classification system, or dichotomous key to illustrate, compare, or interpret possible relationships among groups of organisms (e.g., internal and external structures, anatomical features). [LS3(5-8)MAS+FAF-8] (S:LS3:8:2.3) • Recognize that there are genetic variations among individuals in groups of organisms and provide examples of how these variations affect the survival of an organism. (S:LS3:6:3.1) • Recognize that only organisms that are able to reproduce can pass on their genetic information to the next generation. (S:LS3:6:3.2) • Recognize that in any given environment the growth and survival of organisms depend on the physical conditions that exist; and explain that in all environments, organisms with similar needs may compete with one another for resources,

	including food, space, water, air, and shelter. (S:LS3:8:3.2) • Cite examples supporting the concept that certain traits of organisms may provide a survival advantage in a specific environment and therefore, an increased likelihood to produce offspring. [LS3(5-8)POC-9] (S:LS3:8:3.5) • Explain how changes in environmental conditions can affect the survival of individual organisms and the entire species.(S:LS3:6:1.2) • Describe the fundamental concepts related to biological evolution, such as biological adaptations and the diversity of species. (S:LS3:6:2.1)
Common Summative Assessments	
Standards	• **MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.** [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.] • **MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.** [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.] • **MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.** [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.] • **MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.** [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations • **MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.** [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]

Windham School District Science Curriculum
Eighth Grade

Title of Core Map	Eighth Grade
Title of Unit	Structure and Properties of Matter
Essential Questions	• How does the structure of matter affect the properties of materials and how materials are used? • How does knowledge of matter and its properties apply to our lives?
Content	• **Structure and Properties of Matter-** Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.) Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. • **Chemical Reactions-** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (Note: This Disciplinary Core Idea is also addressed by MS-PS1-2 and MS-PS1-5.) • **Definitions of Energy** - The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.
Skills	• Identify a molecule as the smallest part of a substance that retains its properties. (S:PS1:8:2.3) • Recognize that all matter is composed of minute particles called atoms; and explain that all substances are composed of atoms, each arranged into different groupings. (S:PS1:6:1.1) • Identify elements as substances that contain only one kind of atom; and explain that elements do not break down by normal laboratory reactions, such as heating, exposure to electric current, and reaction to acid. (S:PS1:6:1.2) • Recognize that over one hundred elements exist, and identify the periodic table as a tool for organizing the information about them. (S:PS1:6:1.3)

	• Explain that atoms often combine to form a molecule or formula unit (crystal). (S:PS1:8:1.1) • Recognize that elements can combine in a variety of ways to form compounds. (S:PS1:8:1.2) • Differentiate between an atom and a molecule. (S:PS1:8:1.3) • Differentiate between a mixture and a pure substance. (S:PS1:8:1.4) • Identify methods used to separate mixtures, such as boiling, filtering, chromatography and screening. (S:PS1:8:1.5) • Identify elements according to their common properties, such as highly reactive metals, less reactive metals, highly reactive non-metals and almost non-reactive gases. (S:PS1:6:2.1) • Identify substances by their physical and chemical properties, such as magnetism, conductivity, density, solubility, boiling and melting points. (S:PS1:6:2.2) • Differentiate between weight and mass. (S:PS1:6:2.3) • Identify energy as a property of many substances.(S:PS1:6:2.4) • Differentiate between volume and mass and define density. (S:PS1:8:2.1) • Explain how different substances of equal volume usually have different weights. (S:PS1:8:2.2) • Collect data or use data provided to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter). [PS1(5-8)INQ+SAE-3] (S:PS1:8:1.6) • Given graphic or written information, classify matter as atom/molecule or element/compound (not the structure of an atom). [PS1(5-8)MAS-5] (S:PS1:8:1.7) • Investigate the relationships among mass, volume and density. [PS1(5-8)INQ-1] (S:PS1:8:2.4) • Given data about characteristic properties of matter (e.g., melting and boiling points, density, solubility), identify, compare, or classify different substances. (S:PS1:8:2.5) • Represent or explain the relationship between or among energy, molecular motion, temperature, and states of matter. [PS1(5-8)SAE+MAS-4] (S:PS1:8;2.6)
Common Summative Assessments	
Standards	• **MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]

	• **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.** [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with HCl.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.] • **MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.] • **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.** [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.] • **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.** [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.] • **MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.** [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

Title of Core Map	Eighth Grade
Title of Unit	Waves & Electromagnetic Radiation
Essential Questions	• What are the characteristic properties of waves and how can they be used? • How do waves send digital information? • How do waves behave when they interact with matter?
Content	• **Wave Properties-** A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) A sound wave needs a medium through which it is transmitted. (MS-PS4-2) • **Electromagnetic Radiation-** When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2) The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2) A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2) • **Information Technologies and Instrumentation-** Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)
Skills	• Explain that the pitch of a sound is dependent on the frequency of the vibration producing it. (S:PS2:6:3.1) • Explain that sound vibrations move at different speeds, have different wavelengths; and establish wave-like disturbances that emanate from the source. (S:PS2:6:3.2) • Describe ways light can interact with matter, such as transmission (which includes refraction), absorption, and scattering (which includes reflection). (S:PS2:6:3.2) • Explain that the human eye can only detect wavelengths of electromagnetic radiation within a narrow range; and explain that the differences of wavelength within that range of visible light are perceived as differences in color.(S:PS2:8:3.4)
Common Summative Assessments	
Standards	• **MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.** [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.] • **MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.** [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

	• **MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.** [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]

Title of Core Map	Eighth Grade
Title of Unit	Forces and Interactions
Essential Questions	• How can one describe physical interactions between objects and within systems of objects? • How do Newton's Three Laws of Motion apply to the world around us? • How does Newton's Third Law relate forces to explain the motion of objects? • Why do some materials attract each other while other materials repel? • How do objects exert forces upon one another? • What happens to the force and motion of objects when they collide?
Content	• **Forces and Motion-** For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's Third Law). (MS-PS2-1) The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2) All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2) • **Types of Interactions-** Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4) Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)
Skills	• Recognize that just as electric currents can produce magnetic forces, magnets can cause electric currents. (S:PS3:6:1.1) • Explain that when a force is applied to an object, it reacts in one of three ways: the object either speeds up, slows down, or goes in a different direction. (S:PS3:6:1.2) • Describe the relationship between the strength of a force on an object and the resulting effect, such as the greater the force, the greater the change in motion. (S:PS3:6:1.3) • Explain the how balanced and unbalanced forces are related to an object's motion. (S:PS3:6:2.1) • Explain that an object's motion can be tracked and measured over time and that the data can be used to describe its position. (S:PS3:6:2.2) • Explain that the force of gravity gets stronger the closer one gets to an object and decreases the further away one gets from it. (S:PS3:8:1.1) • Recognize the general concepts related to gravitational force. (S:PS3:8:1.2) • Explain that an object in motion that is unaffected by a force will continue to move at a constant speed and in a straight

	line. (S:PS3:8:2.1) • Explain how the motion of an object can be described by its position, direction of motion, and speed; and illustrate how that motion can be measured and represented graphically. (S:PS3:8:2.2) • Use data to determine or predict the overall (net) effect of multiple forces (e.g., friction, gravitational, magnetic) on the position, speed, and direction of motion of objects. [PS3(5-**8**)INQ+POC-**8**] (S:PS3:8:1.3)
Common Summative Assessments	
Standards	• **MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.** [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.] • **MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.] • **MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.** [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.] • **MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.** [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.] • **MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and is limited to qualitative evidence for the existence of fields.]

Title of Core Map	Eighth Grade
Title of Unit	Energy
Essential Questions	• What is energy? • Where does energy come from? • How does energy get from one place to another? • How can it be determined if something has energy? • What is the difference between energy and temperature? • How is force related to energy? • What are the differences and similarities of potential and kinetic energy?
Content	• **Definitions of Energy-** Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1) A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) • **Conservation of Energy and Energy Transfer-** When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) • **Relationship between Energy and Forces-** When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)
Skills	• Recognize that energy, in the form of heat, is usually a by-product when one form of energy is changed to another, such as when machines convert stored energy to motion. (S:PS2:6:3.3) • Explain that heat energy moves from warmer materials or regions to cooler ones through conduction, convection, and radiation. (S:PS2:6:3.4) • Explain how electrical circuits can be used to transfer energy in order to produce heat, light, sound, and chemical changes. (S:PS2:6:3.5) • Differentiate between kinetic energy, which is the energy of motion and potential energy, which depends on relative position. (S:PS2:8:3.1) • Recognize the Sun is a major energy source for the Earth, and describes how it affects the planet's surface. (S:PS2:8:3.2) • Recognize that most chemical and nuclear reactions involve a transfer of energy. (S:PS2:8:3.5) • Use data to draw conclusions about how heat can be transferred (convection, conduction, radiation). [PS2(5-**8**) INQ+SAE+POC-**7**] (S:PS2:8:3.6) • Given a real world example, show that within a system, energy transforms from one form to another.(i.e., chemical, heat,

	electrical, gravatational, light, sound, mechanical) (S:PS2:8:1.5)
Common Summative Assessments	
Standards	• **MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.** [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.] • **MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.** [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.] • **MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.** [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] • **MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] • **MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

Title of Core Map	Eighth Grade
Title of Unit	Chemical Reactions
Essential Questions	• What happens when new materials are formed? • What stays the same and what changes?
Content	• **Structure and Properties of Matter-** Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) (Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.) • **Chemical Reactions-** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-5) (Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.) The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) Some chemical reactions release energy, others store energy. (MS-PS1-6)
Skills	• Differentiate between a physical change, such as melting, and a chemical change, such as rusting. (S:PS2:6:1.1) • Explain how substances react chemically with other substances to form new substances, known as compounds, and that in such recombinations, the properties of the new substances may be very different from those of the old. (S:PS2:8:1.1) • Identify factors that affect reaction rates, such as temperature, concentration and surface area; and explain that dissolving substances in liquids often accelerates reaction rates. (S:PS2:8:1.1) • Explain that oxidation involves combining oxygen with another substance, as in burning or rusting. (S:PS2:8:1.3) • Explain that states of matter depend on the arrangement of the molecules and their motion. (S:PS2:8:1.4) • Explain that atoms often combine to form a molecule or formula unit (crystal). (S:PS1:8:1.1) • Collect data or use data provided to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter). [PS1(5-**8**)INQ+SAE-3] (S:PS2:8:2.2) • Given graphic or written information, classify matter as atom/molecule or element/compound (not the structure of an atom). [PS1(5-**8**)MAS-**5]** (S:PS1:8:1.7) • Explain the law of conservation of energy. (S:PS2:8:2.1)
Common Summative Assessments	
Standards	• **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.** [Clarification Statement: Examples of reactions could include burning

	sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.] • **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.** [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.] • **MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.** [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium

Windham School District Science Curriculum
Integrated Science

Title of Core Map	Integrated Science
Title of Unit	Earth's Place in the Universe
Essential Questions	• How do scientists develop the model for our solar system? • Why do we observe various astronomical cycles? • How do we define a planet? • Why do stars shine? • How do we differentiate the various types of stars in the universe? • How do stars change over time? • How is the universe organized? • How do astronomers study the universe? • How do we know Earth's age? • How do scientists know Earth's history? • How do rocks change over time? • How does Earth's interior differ from its exterior? • How has the Earth changed over time? • How are rocks formed? • Why do earthquakes cause more earthquakes? • Why are some volcanic eruptions explosive and some gentle? • How can certain materials in the universe be used to provide energy?
Content	• **The Universe and Its Stars-**The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1) The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2), (HS-ESS1-3) The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2) Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2), (HS-ESS1-3)

	• **Earth and the Solar System-** 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. (HS-ESS1-4) • **The History of Planet Earth-** Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. (HS-ESS1-5) Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS-ESS1-6) • **Plate Tectonics and Large-Scale System Interactions-** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. (ESS2.B Grade 8 GBE) • **Nuclear Processes** - Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (Secondary to HS-ESS1-5),(secondary to HS-ESS1-6) • **Energy in Chemical Processes and Everyday Life-** Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (Secondary to HS-ESS1-1) • **Electromagnetic Radiation-** Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (Secondary to HS-ESS1-2)
Skills	• Explain how the Earth, Moon and Sun were formed. (S:ESS2:2:11:1.1) • Explain that current scientific evidence supports the Big Bang Theory as a probable explanation of the origin of the universe, and describe the theory. (S:ESS3:11:3.1) • Explain the evidence that suggests the universe is expanding.(S:ESS3:11:3.2) • Provide scientific evidence that supports or refutes the "Big Bang" theory of how the universe was formed. (S:ESS2:11:3.3) • Based on the nature of electromagnetic waves, explain the movement and location of objects in the universe or their composition (e.g., red shift, blue shift, line spectra). (S:ESS3:11:3.4) • Explain how scientific theories about the structure of the universe have been advanced through the use of sophisticated technology (e.g., space probes and visual, radio and x-ray telescopes). (S:ESS3:11:3.5) • Identify and describe the characteristics common to most stars in the universe. (S:ESS3:11:2.1)

	• Describe the ongoing processes involved in star formation, their lifecycles and their destruction. (S:ESS3:11:2.2) • Explain the relationships between or among the energy produced from nuclear reactions, the origin of elements, and the life cycles of stars. (S:ESS3:11:2.3) • Explain how gravitational force influenced the formations of the planets and their moons; and describe how these objects move in patterns under its continued influence. (S:ESS2:11:3.1) • Explain how the Solar System formed from a giant cloud of gas and debris about 5 billion years ago. (S:ESS2:11:3.2) • Describe ways in which technology has increased our understanding of the universe. (S:ESS4:11:1.1) • Understand that technology is designed with a particular function in mind; and principles of Earth Space science are useful in creating technology for the Earth space sciences. (S:ESS4:11:1.2) • Describe the use and benefits of land-based light telescopes, radio telescopes, spectrophotometers, satellites, manned exploration, probes, and robots to the study of Earth Space Science. (S:ESS4:11:2.1) • Explain how scientists study the Earth using computer-generated models and observations from both land-based sites and satellites; and describe the value of using these tools in unison.(S:ESS4:11:2.2) • Differentiate between and provide examples of renewable and nonrenewable sources of energy; and explain the advantages and limitations of each. (S:ESS4:11:3.1) • Describe the means for transforming a natural material, such as iron ore, into useful products during different historical periods, such as the Stone Age, Iron Age, Renaissance, the Industrial Period and the current Age of Information.(S:ESS4:11:3.2) • Explain how the use of technologies at a local level, such as burning of fossil fuels for transportation or power generation, may contribute to global environmental problems.(S:ESS4:11:3.3) • Explain the kinds of applications of knowledge and skills necessary for jobs/careers specific to Earth or space sciences. (S:ESS4:11:4.1) • Identify the Earth's major external source of energy as solar energy. (S:ESS2:11:2.1) • Explain how the inclination of incoming solar radiation can impact the amount of energy Earth receives on any given surface area. (S:ESS2:11:2.3) • Explain how internal and external sources of heat (energy) fuel geologic processes (e.g., rock cycle, plate tectonics, sea floor spreading). (S:ESS1:11:5.6 and S:ESS2:11:2.3) • Explain the theory of plate tectonics. (S:ESS1:11:5.6) • Describe the movement of crustal plates and explain how the effects have altered the Earth's features. (S:ESS1:11:2.3) • Provide supporting geologic/geographic evidence that supports the validity of the theory of plate tectonics. (S:ESS1:11:5.4)

	• Trace the development of the theory of plate tectonics.(S:ESS1:11:5.5) • Recognize electromagnetic waves can be used to locate objects in the universe, and track their movement. (S:ESS4:11:1.1) • Define a light year. (S:ESS4:11:1.2)
Common Summative Assessments	
Standards	• **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. [Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).] • **HS-ESS1-3.**Communicate scientific ideas about the way stars, over their life cycle, produce elements. [Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.] [*Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.*] • **HS-ESS1-4**Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. [Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [*Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.*] • **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. [Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust increasing with distance away from a central ancient core (a result of past plate interactions).] • **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. [Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system

	objects, and the impact cratering record of planetary surfaces.]

Title of Core Map	Integrated Science
Title of Unit	Earth's Systems
Essential Questions	• How do scientists know Earth's age and history? • What is the driving force behind earthquakes and volcanic eruptions? • How do interactions between water, earth, and atmosphere help shape the planet?
Content	• **Earth and the Solar System-** Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary to HS-ESS2-4) • **Earth Materials and Systems-** Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS- ESS2-1),(HS-ESS2-2) Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3) The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4) □ • **Plate Tectonics and Large-Scale System Interactions-** The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. (HS-ESS2-3) Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. (ESS2.B Grade 8 GBE) (HS-ESS2-1) • **The Roles of Water in Earth's Surface Processes-** The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5) • **Weather and Climate-** The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2),(HS-ESS2-4) Gradual atmospheric changes were due to plants and other

	organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6),(HS-ESS2-7) Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2- 6),(HS-ESS2-4) • **Bio-geology-** The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7) • **Wave Properties-** Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. (secondary to HS-ESS2-3)
Skills	• Explain that the Earth is composed of interactive layers, which have distinct compositions, physical properties and processes. (S:ESS1:11:5.1) • Relate plate movement to earthquakes and volcanic activity, and explain how it results in tectonic uplift and mountain building. (S:ESS1:11:5.2) • Identify and describe the major external and internal sources of energy on Earth.(S:ESS1:11:5.3) • Provide supporting geologic/geographic evidence that supports the validity of the theory of plate tectonics. (S:ESS1:11:5.4) • Trace the development of the theory of plate tectonics. (S:ESS1:11:5.5) • Explain how internal and external sources of heat (energy) fuel geologic processes (e.g., rock cycle, plate tectonics, sea floor spreading). (S:ESS1:11:5.6) • Explain that throughout the rock cycle, the total amount of the material remains the same.(S:ESS1:11:6.1) • Explain that water quality can be affected positively or negatively by outside sources.(S:ESS1:11:7.1) • Describe the conditions that enable the Earth to support life, such as the availability of water, the gravitational force, the electromagnetic field and the intensity of radiation from the Sun.(S:ESS1:11:2.2) • Compare the strength of nuclear, electromagnetic and gravitational forces; and explain that the strength of nuclear forces account for the great amounts of energy released from the nuclear reactions in atomic or hydrogen bombs, and in the Sun and other stars.(S:PS3:11:1.4) • Recognize that elements exist in fixed amounts and describe how they move through the solid Earth, oceans, atmosphere, and living things as part of geochemical cycles, such as the water, carbon and nitrogen cycles. (S:ESS1:11:2.1) • Explain how Earth's features can affect wind and weather patterns by causing air to rise and increasing precipitation.(S:ESS1:11:1.4) • Identify and describe the methods used to measure geologic time, such as fossil identification, radioactive dating, and rock sequences. (S:ESS1:11:3.1)

	• Relate how geologic time is determined using various dating methods (e.g., radioactive decay, rock sequences, fossil records). (S:ESS1:11:3.2) • Provided with geologic data (including movement of plates) on a given locale, predict the likelihood for an earth event (e.g. volcanoes mountain ranges, islands, earthquakes, tides, tsunamis). (S:ESS1:11:4.1) • Describe how Earth's atmospheric composition has changed from the formation of the Earth through current time. (S:ESS1:11:1.3) • Explain how heat and energy transfer in and out of the atmosphere; and provide examples of how it is related to weather and climate. (S:ESS1:11:1.2) • Explain how winds and ocean currents are created on the Earth's surface.(S:ESS1:11:1.1)
Common Summative Assessments	
Standards	• **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. [Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).] [*Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.*] • **HS-ESS2-2.**Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.] • **HS-ESS2-3.**Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. [Clarification Statement: Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves,

	records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments.] • **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. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [*Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.*] • **HS-ESS2-5.**Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).] • **HS-ESS2-6.**Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.] • **HS-ESS2-7.**Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. [Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples of include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [*Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.*]

Title of Core Map	Integrated Science
Title of Unit	Matter and Its Interactions
Essential Questions	• What can the periodic table tell us about the elements? • How is matter changed and conserved in a chemical reaction? • How do you show what happens during a chemical reaction? • How are nuclear and chemical reactions similar and different? • How are atoms changed during nuclear reactions? • How do electrons affect the chemical properties of atoms? • How do elements combine to form compounds?
Content	• **Structure and Properties of Matter-** Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) The periodic table orders elements horizontally by the number of protons in the atom's nucleus and place those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2) The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6) 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. (HS-PS1-4) • **Chemical Reactions-** Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HSPS1-4),(HS-PS1-5) In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6) 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. (HS-PS1-2),(HS-PS1-7) • **Nuclear Processes-** 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. (HSPS1-8) • **Optimizing the Design Solution-** Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)

Skills	• Recognize and describe the structure of an atom and explain how the major components interact with one another. (S:PS1:11:1.1) • Determine whether an atom is either electrically neutral or an ion by referring to its number of electrons. (S:PS1:11:2.2) • Recognize how elements are arranged in the periodic table; and explain how this arrangement illustrates the repeating patterns among elements with similar properties, such as the relationship between atomic number and atomic mass.(S:PS1:11:1.2) • Explain that neutrons and protons are made up of even smaller constituents.(S:PS1:11:1.3) • Explain that the physical properties of a compound are determined by its molecular structure and the interactions among the molecules.(S:PS1:11:2.1) • Explain that states of matter rely on the arrangement and motion of molecules; and differentiate between the structures of solids, liquids, and gases. S:PS1:11:2.5) • Explain how the chemical properties of an element are governed by the electron configuration of atoms, and describe how atoms interact with one another by transferring or sharing the outermost electrons. (S:PS1:11:2.3) • Use physical and chemical properties as determined through an investigation to identify a substance. (S:PS1:11:2.6) • Recognize and explain that atoms may be bonded together into molecules or formula units (crystalline solids).(S:PS2:11:11.1) • Recognize that atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus; and explain that the outer electrons govern the chemical properties of an element.(S:PS2:11:1.2) • Explain that compounds are formed through both ionic and covalent bonding. (S:PS2:11:1.3) • Recognize that the rates of chemical reactions can vary greatly; and identify the factors that influence these reaction rates, such as how often the reacting atoms and molecules encounter one another, the temperature, and the properties of the reacting species, including shape. (S:PS1:11:1.4) • Recognize that a large number of important reactions involve the transfer of either electrons or hydrogen ions between reacting ions, molecules, or atoms. (S:PS2:11:2.3) • Define isotopes; recognize that most elements have two or more isotopes; and explain that although the number of neutrons has little effect on how the atom interacts with others, they do affect the mass and stability of the nucleus.(S:PS1:11:1.4) • Explain that radioactive materials are unstable and undergo spontaneous nuclear reactions, which emit particles and/or wavelike radiation. (S:PS1:11:2.4) • Model and explain the structure of an atom or explain how an atom's electron configuration, particularly the outermost electron(s), determines how that atom can interact with other atoms. (S:PS1:11:1.6)

	• Explain how properties of elements and the location of elements on the periodic table are related. (S:PS1:11:2.7)
Common Summative Assessments	
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. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [*Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.*] • **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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [*Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.*] • **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. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [*Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.*] • **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. [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [*Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.*] • **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. [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [*Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate*

	data; and qualitative relationships between rate and temperature.] • **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.* [Clarification Statement: Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.] [*Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.*] • **HS-PS1-7.**Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [*Assessment Boundary: Assessment does not include complex chemical reactions.*] • **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. [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [*Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.*]

Title of Core Map	Integrated Science
Title of Unit	Motion and Stability: Forces and Interactions
Essential Questions	• How are force and motion connected? • How do forces affect the motion of an object? • How are magnetism and electrical fields connected? • How is electricity produced, transmitted and stored?
Content	• **Forces and Motion-** Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1) Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2) If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3) • **Types of Interactions**- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4) Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5) 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. (HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3) • **Definitions of Energy-** "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5) • **Defining and Delimiting Engineering Problems-** 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. (secondary to HS-PS2-3) • **Optimizing the Design Solution-** Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS2-3)
Skills	• Explain relationships between and among electric charges, magnetic fields, electromagnetic forces, and atomic particles. (S:PS2:11:1.5) • Explain that magnetic forces are related to the action of electrons and can be thought of as different aspects of a single electromagnetic force; and describe how the interplay of these forces is the basis for electric motors, generators, radio, television, and many other modern technologies. (S:PS3:11:1.1)

	• Recognize that the strength of the gravitational force between two masses is proportional to the masses and inversely proportional to the square of the distance between them. (S:PS3:11:1.3) • Recognize that electromagnetic forces exist within and between atoms. (S:PS3:11:1.5) • Interpret and apply the laws of motion to determine the effects of forces on the motion of objects. (S:PS3:11:2.1) • Recognize that different kinds of materials respond to electric forces in various ways; and differentiate between insulators, semiconductors, conductors and superconductors. (S:PS3:11:1.6) • Describe the difference between materials that contain equal proportions of positive and negative charges and those that have a very small excess or deficit of negative charges. (S:PS3:11:1.7) • Given information (e.g., graphs, data, diagrams), use the relationships between or among force, mass, velocity, momentum, and acceleration to predict and explain the motion of objects. (S:PS3:11:1.8) • Apply the concepts of inertia, motion, and momentum to predict and explain situations involving forces and motion, including stationary objects and collisions. (S:PS3:11:2.3)
Common Summative Assessments	
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. [Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force.] [*Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.*] • **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. [Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.] [*Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.*] • **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.* [Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.] [*Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.*]

	• **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. [Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [*Assessment Boundary: Assessment is limited to systems with two 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. [*Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.*] • **HS-PS2-6.**Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [*Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.*]

Title of Core Map	Integrated Science
Title of Unit	Energy
Essential Questions	• What happens when electrons in atoms absorb or release energy? • What happens when matter is heated and cooled? • How is energy conserved? • How is energy related to chemical reaction? • How does energy take on different forms?
Content	• **Definitions of Energy-** Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HSPS3-1),(HS-PS3-2) At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. .(HSPS3-2)(HS-PS3-3) These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2) • **Conservation of Energy and Energy Transfer**- 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. (HS-PS3-1) Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4) 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. (HS-PS3-1) The availability of energy limits what can occur in any system. (HS-PS3-1) Uncontrolled systems always evolve toward more stable states— that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4) • **Relationship Between Energy and Forces-** When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5) • **Energy in Chemical Processes-** Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3),(HS-PS3-4) • **Defining and Delimiting Engineering Problems-** 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. (HS-PS3-3),(HS-PS3-4)
Skills	• Explain that all energy can be considered to be either, kinetic energy, potential energy, or energy contained by a field. (S:PS2:11:3.1) • Provide examples of how kinetic and potential energy can be transformed from one to the other. (S:PS2:11:3.1) • Describe how the energy associated with individual atoms and molecules can be used to identify the substances they comprise; and explain that each kind of atom or molecule can gain or lose energy only in particular discrete amounts, absorbing and emitting light only at wavelengths corresponding to these amounts. (S:PS2:11:3.3) • Explain the range of the electromagnetic spectrum as it relates to both wavelength and energy; and provide examples of practical applications of the different wavelengths in the spectrum. (S:PS2:11:3.4) • Explain that waves, such as light, seismic, sound waves, have energy and can transfer energy when they interact with matter. (S:PS2:11:3.7) • Recognize that the basic principles of energy, work and power are related to design technology. (S:PS4:11:1.1) • Identify tools, such as thermostats and thermal sensors, and explain their use in environmental control systems. (S:PS4:11:2.1) • Demonstrate how transformations of energy produce some energy in the form of heat and therefore the efficiency of the system is reduced (chemical, biological, and physical systems). (S:PS2:11:2.5)
Common Summative Assessments	
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. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.] [*Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.*] • **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). [Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the

	earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.] • **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.* [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.] [*Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.*] • **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). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [*Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.*] • **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. [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] [*Assessment Boundary: Assessment is limited to systems containing two objects.*]

Title of Core Map	Integrated Science
Title of Unit	Waves and Their Application in Technology for Information Transfer
Essential Questions	• What is the relationship between wavelength and frequency? • If all waves travel at the same speed (the speed of light) how can we explain the difference in energy across the electromagnetic spectrum? • How do you know that waves carry energy? • Explain how knowledge of waves helps us understand our world better and improve the quality of our lives? • How do the properties of EM waves determine their use in society and science? • What determines the colors you see in nature? • Why has the world "gone digital" (compared to analog)?
Content	• **Energy in Chemical Processes-** Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary to HS-PS4-5) • **Wave Properties-** 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. (HS-PS4-1) Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HSPS4-5) Waves can add or cancel one another as they cross, depending on their relative phase but they emerge unaffected by each other.) (HS-PS4-3) • **Electromagnetic Radiation-** Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3) 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. (HS-PS4-4) Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5) • **Information Technologies and Instrumentation-** Multiple technologies based on the understanding of waves and their interactions with matter are part of every day 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. (HS-PS4-5)

Skills	• Recognize that apparent changes in wavelength can provide information about changes in motion; explain that the observed wavelength of a wave depends upon the relative motion of the source and the observer; and relate these to the differences between shorter and longer wavelengths. (S:PS2:11:2.2) • Explain the effects on wavelength and frequency as electromagnetic waves interact with matter (e.g., light diffraction, blue sky) (S:PS2:11:2.4) • Describe how the energy associated with individual atoms and molecules can be used to identify the substances they comprise; and explain that each kind of atom or molecule can gain or lose energy only in particular discrete amounts, absorbing and emitting light only at wavelengths corresponding to these amounts. (S:PS2:11:3.3) • Explain the range of the electromagnetic spectrum as it relates to both wavelength and energy; and provide examples of practical applications of the different wavelengths in the spectrum. (S:PS2:11:3.4) • Recognize that the human eye can only see a narrow range of wavelengths within the electromagnetic spectrum; and explain how the variations of wavelength within that range of visible light are perceived as differences in color. (S:PS2:11:3.5) • Describe the relationship between heat and temperature, explaining that heat energy consists of the random motion and vibrations of atoms, molecules, and ions; and that the higher the temperature, the greater the atomic or molecular motion. (S:PS2:11:3.6) • Explain that waves, such as light, seismic, sound waves, have energy and can transfer energy when they interact with matter. (S:PS2:11:3.7) • Explain that nuclear reactions convert a fraction of the mass of interacting particles into energy and release much greater amounts of energy than atomic interactions. (S:PS2:11:3.8) • Describe how electrons flow easily in some materials, such as metals, whereas in insulating materials, such as glass, they can hardly flow at all. (S:PS2:11:3.9) • Using information provided about chemical changes, draw conclusions about the energy flow in a given chemical reaction. [PS2(9-11)INQ+SAE-67](S:PS2:11:3.10)
Common Summative Assessments	
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. [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic

	waves traveling through the Earth.] [*Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.*] • **HS-PS4-2.**Evaluate questions about the advantages of using a digital transmission and storage of information. [Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.] • **HS-PS4-3.**Evaluate the claims, evidence, and reasoning behind 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. [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [*Assessment Boundary: Assessment does not include using quantum theory.*] • **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. [Clarification Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [*Assessment Boundary: Assessment is limited to qualitative descriptions.*] • **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.* [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [*Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.*]

Title of Core Map	Integrated Science
Title of Unit	Earth and Human Activity
Essential Questions	• How do human activities affect the ability of living things to survive? • How have humans impacted the planet? • How have humans used Earth's resources? • How does technology help us understand the universe? • How does science affect society, and how does society affect science? • How is the greenhouse effect related to global climate change?
Content	• **Weather and Climate** - Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6) • **Natural Resources-** Resource availability has guided the development of human society. (HS-ESS3-1) All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2) • **Natural Hazards-** Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1) • **Human Impacts on Earth Systems-** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3) Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4) • **Global Climate Change** - Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5) Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) • **Developing Possible Solutions-** 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.
Skills	• Differentiate between and provide examples of renewable and nonrenewable sources of energy; and explain the advantages and limitations of each. (S:ESS4:11:3.1)

	• Describe the means for transforming a natural material, such as iron ore, into useful products during different historical periods, such as the Stone Age, Iron Age, Renaissance, the Industrial Period and the current Age of Information. (S:ESS4:11:3.2) • Explain how the use of technologies at a local level, such as burning of fossil fuels for transportation or power generation, may contribute to global environmental problems. (S:ESS4:11:3.3) • Explain the environmental effects of using both renewable and nonrenewable resources; and provide examples of how man is addressing these effects on the environment. (S:ESS4:12:3.1) • Provide examples of how man's use of Earth materials has changed over time; and use those examples to explain how the relationship between science and technology has gradually grown closer in the past century. (S:ESS4:12:3.2) • Research and evaluate a current environmental issue within the State of New Hampshire, such as a dispute regarding the conversion of a natural environment to human use; and construct a defense that supports environmental protection. (S:ESS4:12:3.3) • Describe ways in which technology has increased our understanding of the universe. (S:ESS4:11:1.1) • Understand that technology is designed with a particular function in mind; and principles of Earth Space science are useful in creating technology for the Earth space sciences. (S:ESS4:11:1.2) • Describe the use and benefits of land-based light telescopes, radio telescopes, spectrophotometers, satellites, manned exploration, probes, and robots to the study of Earth Space Science. (S:ESS4:11:2.1) • Explain how scientists study the Earth using computer-generated models and observations from both land-based sites and satellites; and describe the value of using these tools in unison.(S:ESS4:11:2.2) • Explain the kinds of applications of knowledge and skills necessary for jobs/careers specific to Earth or space sciences. (S:ESS4:11:2.2)
Common Summative Assessments	
Standards	• **HS-ESS3-1.**Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate

	that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.] • **HS-ESS3-2.**Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* [Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.] • **HS-ESS3-3.**Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [*Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.*] • **HS-ESS3-4.**Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).] • **HS-ESS3-5.**Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [*Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.*] • **HS-ESS3-6.**Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. [Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [*Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.*]

Windham School District Science Curriculum

Title of Core Map	Biology
Title of Unit	From Molecules to Organisms: Structures and Processes
Essential Questions	• What characteristics do all living things share and how does variation upon these characteristics create the diversity of life on the planet? • How does the process of science helps biologists investigate how nature works at all levels, from the molecules in cells to the biosphere and follows a logical sequence of events? • How do emergent properties at each level of life contribute to the complexity of the subsequent level. For example the properties of an atom dictate the types of bonds it can form to make a molecule. • What is the relationship between structure and function in molecules, organs, and living systems? • What characteristics do all cells share in common and what makes each type of cell unique? • How do cellular process provide the energy and basic structure organisms need to survive? • What happens when communication, on a cellular level, breaks down or is incorrect? • How do cellular organelles harness and transform potential and kinetic energy to fuel life processes?
Content	• **Structure and Function-** Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3- 1.) 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. (HS-LS1-2) Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3) □ • **Growth and Development of Organisms**-□ In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4) • **Organization for Matter and Energy Flow in Organisms-** The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5) The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino

	acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6) As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6),(HS-LS1-7) As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)
Skills	• Identify plants and animals according to binomial nomenclature. (S:LS1:11:1.3) • Differentiate between prokaryotic and eukaryotic cells according to general structure and degrees of complexity.(S:LS1:11:1.4) • Identify the structures of different types of cell parts/organelles and explain the functions they perform. (S:LS1:11:2.1) • Recognize how cell functions are regulated through changes in the activity of the functions performed by proteins, and through the selective expression of individual genes; and explain how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division. (S:LS1:11:2.2) • Recognize how an organism's organization and complexity accommodate its need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain it. (S:LS1:11:2.3) • Recognize that because all matter tends toward more disorganized states, living systems need a continuous input of energy to maintain their chemical and physical organizations. (S:LS1:11:2.7) • Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells; and explain why other changes in an organism cannot be passed on. (S:LS1:11:3.2) • Describe how organisms are classified into a hierarchy of groups and subgroups, which are based on similarities that reflect their evolutionary relationships. (S:LS1:11:1.1) • Explain that organisms that possess similar DNA code are more closely related than those in which DNA varies greatly. (S:LS1:11:1.2) • Explain how the processes of photosynthesis and cellular respiration are interrelated and contribute to biogeochemical cycles. (S:LS1:11:2.4) • Describe the structures of proteins and their role in cell function. (S:LS1:11:2.5) • Describe the chemical reactions involved in cell functions using examples from the nervous, immune and endocrine systems in multicellular animals. (S:LS1:11:2.6) • Use data and observation to make connections between, to explain, or to justify how specific cell organelles produce/regulate what the cell needs or what a unicellular or multi-cellular organism needs for survival (e.g., protein

	synthesis, DNA transport, nerve cells). [LS1(9-**11**)INQ+SAE+FAF-**1**] (S:LS1:11:2.8) • Describe the chemical and structural properties of DNA and explain its role in identifying the characteristics of an organism. (S:LS1:11:3.1) • Explain that disease in organisms can be caused by intrinsic failures of the system or infection by other organisms, and describe as well as provide examples of how some diseases are caused by: the breakdown in cellular function, congenital conditions, genetic disorders, malnutrition, and emotional health, including stress. (S:LS4:11:2.1) • Explain that vaccines were developed to reduce or eliminate diseases; and provide examples of how these medical advances have proven to be successful. (S:LS4:11:2.2) • Describe and provide examples of how new medical techniques, efficient health care delivery systems, improved sanitation, and a more complete understanding of the nature of disease provides today's humans a better chance of staying healthier than their forebears. (S:LS4:11:2.3) • Describe how some drugs mimic or block the molecules involved in transmitting nerve or hormone signals and explain how this disturbs the normal operations of the brain and body.(S:LS4:11:2.4) • Explain that gene mutation in a cell can result in uncontrolled division, which is called cancer; and describe how exposure of cells to certain chemicals and radiation increase mutation, and thus the chance for cancer. (S:LS4:11:2.5) • Recognize that the immune system, endocrine system, and nervous system can affect the homeostasis of an organism. (S:LS4:11:1.1) • Describe how the functions of all the human body systems are interrelated at a chemical level and how they maintain homeostasis. (S:LS4:11:1.2) • Explain how the immune system functions to prevent and fight disease. (S:LS4:11:3.2) • Explain how the immune system, endocrine system, or nervous system works and draw conclusions about how systems interact to maintain homeostasis in the human body. [LS4(9-**11**)SAE+FAF-**10**](S:LS4:11:3.3)
Common Summative Assessments	• Chapter end summative tests • Chapter specific labs, research papers, projects
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. [*Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.*] • **HS-LS1-2.**Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism

	system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [*Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.*] • **HS-LS1-3.**Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [*Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.*] • **HS-LS1-4.**Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. [*Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.*] • **HS-LS1-5.**Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [*Assessment Boundary: Assessment does not include specific biochemical steps.*] • **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 the details of the specific chemical reactions or identification of macromolecules.*] • **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. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [*Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.*]

Title of Core Map	Biology
Title of Unit	Ecosystems: Interactions, Energy, and Dynamics
Essential Questions	• How does the process of science helps biologists investigate how nature works at all levels, from the molecules in cells to the biosphere and follows a logical sequence of events? • How and why does energy flow but matter recycle through an ecosystem? • How do humans shape the planet on a global scale to better meet their needs? • How do the relationships between components of an ecosystem shape it? What roles do each of the components in an ecosystem play? • How do environmental and cellular changes affect humans?
Content	• **Interdependent Relationships in Ecosystems-** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1),(HS-LS2-2) • **Cycles of Matter and Energy Transfer in Ecosystems-** Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3) Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4) Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5) • **Ecosystem Dynamics, Functioning, and Resilience-** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6) Moreover, anthropogenic changes (induced by human activity) in the environment—including

	habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7) • **Social Interactions and Group Behavior-** Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HS- LS2-8) • **Biodiversity and Humans-** Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS- LS2-7) Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.) • **Energy in Chemical Processes-** The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (secondary to HS-LS2-5) • **Developing Possible Solutions-** 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. (secondary to HS-LS2-7)
Skills	• Identify the factors in an ecosystem that can affect its carrying capacity. (S:LS2:11:1.3) • Trace the cycling of matter (e.g., carbon cycle) and the flow of energy in a living system from its source through its transformation in cellular, biochemical processes (e.g., photosynthesis, cellular respiration, fermentation). [LS2(9-**11**)POC+SAE-**4**] (S:LS2:11:3.2) • Explain how the amount of life an environment can sustain is restricted by the availability of matter and energy, and the ability of the ecosystem to recycle materials. (S:LS2:11:1.1) • Describe how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years. (S;LS2:11:1.2) • Analyze and describe how environmental disturbances, such as climate changes, natural events, human activity and the introduction of invasive species, can affect the flow of energy or matter in an ecosystem. (S:LS2:11:1.4) • Using data from a specific ecosystem, explain relationships or make predictions about how environmental disturbance (human impact or natural events) affects the flow of energy or cycling of matter in an ecosystem. [LS2(9-**11**)INQ+SAE-**3**] (S:LS2:11:1.5) • Explain or evaluate potential bias in how evidence is interpreted in reports concerning a particular environmental factor that impacts the biology of humans. [LS2(9-**11**)NOS-**5**] (S:LS2:11:1.6)

	• Use examples from local ecosystems to describe the relationships among organisms at the different trophic levels. (S:LS2:11:2.1) • Explain that as matter and energy flow through different levels of organization in living systems and between living systems and the environment, elements, such as carbon and nitrogen, are recombined in different ways. (S:LS2:11:3.1) • Describe how the length and quality of human life are influenced by many factors, including sanitation, diet, medical care, gender, genes, and environmental conditions and personal health behaviors. (S:LS4:11:3.1) • Explain how the processes of photosynthesis and cellular respiration are interrelated and contribute to biogeochemical cycles. (S:LS1:11:2.4)
Common Summative Assessments	• Chapter end summative tests • Chapter specific labs, research papers, projects
Standards	• **HS-LS2-1.**Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [*Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.*] • **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. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [*Assessment Boundary: Assessment is limited to provided data.*] • **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. [Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.] [*Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.*] • **HS-LS2-4.**Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.] [*Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow 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. [Clarification Statement: Examples of models could include simulations and mathematical models.] [*Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.*] • **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. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.] • **HS-LS2-7.**Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.] • **HS-LS2-8.**Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. [Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.] •

Title of Core Map	Biology
Title of Unit	Heredity: Inheritance and Variation of Traits
Essential Questions	• How does DNA control heredity? • How does an organisms DNA along with the environment determine an organisms characteristics? • How does the study of Mendallian Genetics allow us to determine and predict patterns of inheritance? • How does the manipulation of genetics, reproduction, development and evolution affect the quality of human life?
Content	• **Structure and Function-** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.) • **Inheritance of Traits-** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA all cells in an organism have the same genetic content but the genes used (expressed) but the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as yet known function. (HS-LS3-1) • **Variation of Traits-** Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. In sexual reproduction, chromosomes can sometimes swap sections, during the process of meiosis (cell division), thereby creating new genetic combinations and this more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations and inherited. (HS-LS3-2) Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2),(HS-LS3-3)
Skills	• Recognize how cell functions are regulated through changes in the activity of the functions performed by proteins, and through the selective expression of individual genes; and explain how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division. (S:LS1:11:2.1) • Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells; and explain why other changes in an organism cannot be passed on. (S:LS1:11:3.2) • Describe the chemical and structural properties of DNA and explain its role in identifying the characteristics of an organism. (S:LS1:11:3.1)

	• Describe the alternation of generations, life cycles with haploid and diploid phases in living organisms, such as bacteria, plants and animals. (S:LS1:11:3.3) • Explain or justify with evidence how the alteration of the DNA sequence may produce new gene combinations that make little difference, enhance capabilities, or can be harmful to the organism (e.g., selective breeding, genetic engineering, mutations). (S:LS1:11:3.4) • Describe how the length and quality of human life are influenced by many factors, including sanitation, diet, medical care, gender, genes, and environmental conditions and personal health behaviors. (S:LS4:11:3.1) • Identify and describe ways genes may be changed and combined to create genetic variation within a species. (S:LS3:11:3.5) • Use evidence to make and support conclusions about the ways that humans or other organisms are affected by environmental factors or heredity (e.g., pathogens, diseases, medical advances, pollution, and mutations). [LS4(9-**11)**INQ+NOS-**9**] (S:LS4:11:2.6) • Explain that gene mutations and new combinations may have a variety of effects on the organism, including positive and negative ones, or none at all. (S:LS3:11:3.6) • Explain the concepts of Mendelian genetics. (S:LS3:11:3.7) • Use pedigree charts and Punnet Squares to determine patterns of inheritance. (S:LS3:11:3.8)
Common Summative Assessments	
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. [*Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.*] • **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. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

	• **HS-LS3-3.**Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [*Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.*]

Title of Core Map	Biology
Title of Unit	Biological Evolution: Unity and Diversity
Essential Questions	• How has the diversity of life has been shaped by ongoing evolutionary change and our understanding of the relatedness of organisms has been a direct result of observation and technology. • How does the process of science helps biologists investigate how nature works at all levels, from the molecules in cells to the biosphere and follows a logical sequence of events? • How does DNA provide the raw material upon which Natural Selection can act? • What evidence demonstrates that groups of organisms have changed over time? • What characteristics do all living things share and how does variation upon these characteristics create the diversity of life on the planet? • How does homeostasis coordinate the diverse and complex functions of the human body? • How are humans similar to all life on the planet and how are they different?
Content	• **Evidence of Common Ancestry and Diversity**- Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. HS-LS4-1) • **Natural Selection** - Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2),(HS-LS4-3) The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (H S -LS 4-3) • **Adaptation-** Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2) Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally , and physiologically w ell suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3),(HS-LS4-4) Adaptation also means that the distribution of traits in a population can change w hen conditions change. (H S -LS 4-3) Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (H S -LS 4-5),(H S -LS 4-6)

	Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5) • **Biodiversity and Humans-** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (H S -LS 4-6) • **Developing Possible Solutions** - 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. secondary to HS-LS4-6) Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. secondary to HS-LS4-6)
Skills	• Identify ways humans can impact and alter the stability of ecosystems, such as habitat destruction, pollution, and consumption of resources; and describe the potentially irreversible effects these changes can cause. (S:LS3:11:1.1) • Identify ways of detecting, and limiting or reversing environmental damage. (S:LS3:11:1.2) • Recognize that the abilities and behaviors an organism has, and likelihood of its survival strongly depend on its heritable characteristics, which can be biochemical and anatomical. (S:LS3:11:2.2) • Recognize how a species' chance of survival increases with each variation of an organism within the species; and explain how, in the event of a major global change, the greater the diversity of species on Earth, the greater the chance for survival of life. (S:LS3:11:3.3) • Analyze the aspects of environmental protection, such as ecosystem protection, habitat management, species conservation and environmental agencies and regulations; and evaluate and justify the need for public policy in guiding the use and management of the environment. (S:LS3:11:1.3) • Explain the currently accepted theory for the development of life on Earth, including the history of its origin and the evolutionary process. (S:LS3:11:2.1) • Explain the contributions of Darwin, Malthus, Wallace and Russell to the advancement of life science. (S:LS3:11:2.3) • Explain evolution in terms of how the Earth's present-day life forms evolved from earlier, distinctly different species as a consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection. (S:LS3:11:2.4)

	• Explain how evidence from technological advances supports or refutes the genetic relationships among groups of organisms (e.g., DNA analysis, protein analysis). [LS3(9-**11**)NOS-**6**] (S:LS3:11:2.5) • Given information about living or extinct organisms, cite evidence to explain the frequency of inherited characteristics of organisms in a population; or explain the evolution of varied structures (with defined functions) that affected the organisms' survival in a specific environment (e.g., giraffe, wind pollination of flowers). [LS3(9-**11**)INQ+FAF+POC-**8**](S:LS3:11:2.6) • Explain the concept of natural selection. (S:LS3:11:3.1) • Explain the diversity and unity of past and present life forms on Earth using currently accepted theories. (S:LS3:11:3.2) • Analyze present day data and research in areas, including antibiotic resistance in bacteria, changes in viral genomes, such as bird flu, and DNA sequencing; and relate it to the concepts of natural selection. (S:LS3:11:3.4) • Given a scenario, provide evidence that demonstrates how sexual reproduction results in a great variety of possible gene combinations and contributes to natural selection (e.g., Darwin's finches, isolation of a species, Tay Sach's disease). [LS3(9-**11**)INQ+POC-**7** (S:LS3:11:3.9)
Common Summative Assessments	• Chapter end summative tests • Chapter specific labs, research papers, projects
Standards	• **HS-LS4-1.**Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.] • **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. [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [*Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.*] • **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. [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [*Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.*] • **HS-LS4-4.**Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading 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. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.] • **HS-LS4-6.**Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

Windham School District Science Curriculum
Chemistry

Title of Core Map	Chemistry
Title of Unit	Matter and its interactions
Essential Questions	• How can the physical and chemical properties of different types of matter be used to define it and predict its behavior? • What is the importance of the Law of Conservation of Mass? • How have experimentation and technology contributed to our understanding of the atomic world? • How does our understanding of the atom allow us to predict and model the behavior of elements and compounds on a macroscopic scale? • How can the periodic table help us understand and predict the behavior of elements? • How do the particles in an atom interact during physical and chemical changes?
Content	• **Structure and Properties of Matter-** Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) 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. (HS-PS1-1),(HS-PS1-2) The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3) 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. (HS-PS1-4) • **Chemical Reactions**- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS- PS1-4),(HS-PS1-5) In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6) 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. (HS-PS1-2),(HS-PS1-7) • **Nuclear Processes**- 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. (HS-PS1-8)

Skills	• Recognize and describe the structure of an atom and explain how the major components interact with one another. S:PS1:11:1.1 • Recognize how elements are arranged in the periodic table; and explain how this arrangement illustrates the repeating patterns among elements with similar properties, such as the relationship between atomic number and atomic mass. S:PS1:11:1.2 • Explain that neutrons and protons are made up of even smaller constituents. S:PS1:11:1.3 • Define isotopes; recognize that most elements have two or more isotopes; and explain that although the number of neutrons has little effect on how the atom interacts with others, they do affect the mass and stability of the nucleus. S:PS1:11:1.4 • Scientific thought about atoms has changed over time. Using information (narratives or models of atoms) provided, cite evidence that changed our understanding of the atom and the development of atomic theory. S:PS1:11:1.5 • Model and explain the structure of an atom or explain how an atom's electron configuration, particularly the outermost electron(s), determines how that atom can interact with other atoms. S:PS1:11:1.6 • Explain that the physical properties of a compound are determined by its molecular structure and the interactions among the molecules. S:PS1:11:2.1 • Determine whether an atom is either electrically neutral or an ion by referring to its number of electrons. S:PS1:11:2.2 • Explain how the chemical properties of an element are governed by the electron configuration of atoms, and describe how atoms interact with one another by transferring or sharing the outermost electrons. S:PS1:11:2.3 • Explain that radioactive materials are unstable and undergo spontaneous nuclear reactions, which emit particles and/or wavelike radiation. S:PS1:11:2.4 • Explain that states of matter rely on the arrangement and motion of molecules; and differentiate between the structures of solids, liquids, and gases. S:PS1:11:2.5 • Use physical and chemical properties as determined through an investigation to identify a substance. S:PS1:11:2.6 • Explain how properties of elements and the location of elements on the periodic table are related. S:PS1:11:2.7 • Recognize and explain that atoms may be bonded together into molecules or formula units (crystalline solids). S:PS2:11:1.1 • Recognize that atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus; and explain that the outer electrons govern the chemical properties of an element. S:PS2:11:1.2 • Explain that compounds are formed through both ionic and covalent bonding. S:PS2:11:1.3 • Recognize that the rates of chemical reactions can vary greatly; and identify the factors that influence these reaction rates, such as how often the reacting atoms and molecules encounter one another, the temperature, and the properties of the reacting species, including shape. S:PS2:11:1.4

	• Explain relationships between and among electric charges, magnetic fields, electromagnetic forces, and atomic particles. S:PS2:11:1.5
Common Summative Assessments	
Standards	• **S-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.** [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.] • **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.** [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.] • **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.** [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.] • **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.** [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products. • **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.** [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from

	temperature, concentration, and rate data; and qualitative relationships between rate and temperature.] • **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.*** [Clarification Statement: Emphasis is on the application of Le Chatlier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.] [Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.] • **HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.** [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem- solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.] • **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.** [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.] • **HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*** [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.

Title of Core Map	Chemistry
Title of Unit	Energy
Essential Questions	• How does energy transform during a chemical reaction? • Why do atoms form different types of bonds? • What is occurring in a chemical reaction on an atomic, molecular, and macroscopic scale? • How can we use the Law of Conservation of Mass/Energy to predict the behaviors and outcomes of chemical reactions? • What are the driving forces of chemical reactions and how can they be used in practical applications? • What is the relationship between heat, entropy, and energy in exothermic and endothermic reactions?
Content	• **Definitions of Energy**- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, □ within the system, energy is continually transferred from one object to another and between its various possible forms. (HS- PS3-1),(HS-PS3-2) At the macroscopic scale, energy manifests itself in multiple ways such as in motion, sound, light, and thermal energy.(HS- PS3-2)(HS-PS3-3) These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2) • **Conservation of Energy and Energy Transfer-** 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. (HS-PS3-1) Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4) 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. (HS-PS3-1) The availability of energy limits what can occur in any system. (HS-PS3-1) Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flow s downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4) • **Relationship Between Energy and Forces-** When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5) • **Energy in Chemical Processes-** Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3),(HS-PS3-4)

Skills	• Explain that chemical reactions either release or consume energy. S:PS2:11:2.1 • Explain that chemical reactions can be accelerated by catalysts, such as enzymes. S:PS2:11:2.2 • Recognize that a large number of important reactions involve the transfer of either electrons or hydrogen ions between reacting ions, molecules, or atoms. S:PS2:11:2.3 • Identify the variety of structures that may be formed from the bonding of carbon atoms, and describe their roles in various chemical reactions, including those required for life processes. S:PS2:11:2.4 • Demonstrate how transformations of energy produce some energy in the form of heat and therefore the efficiency of the system is reduced (chemical, biological, and physical systems). S:PS2:11:2.5 • Explain that all energy can be considered to be either kinetic energy, potential energy, or energy contained by a field. S:PS2:11:3.1 • Provide examples of how kinetic and potential energy can be transformed from one to the other. S:PS2:11:3.2 • Describe how the energy associated with individual atoms and molecules can be used to identify the substances they comprise; and explain that each kind of atom or molecule can gain or lose energy only in particular discrete amounts, absorbing and emitting light only at wavelengths corresponding to these amounts. S:PS2:11:3.3 • Describe the relationship between heat and temperature, explaining that heat energy consists of the random motion and vibrations of atoms, molecules, and ions; and that the higher the temperature, the greater the atomic or molecular motion. S:PS2:11:3.6 • Describe how electrons flow easily in some materials, such as metals, whereas in insulating materials, such as glass, they can hardly flow at all. S:PS2:11:3.9 • Using information provided about chemical changes, draw conclusions about the energy flow in a given chemical reaction (e.g., exothermic reactions, endothermic reactions). [PS2(9-**11**)INQ+SAE-**6**] S:PS2:11:3.10
Common Summative Assessments	
Standards	• **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).** [Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically -charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]

	• **HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into anotherformofenergy.*** [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.][Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.] • **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).** [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually . Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [Assessment Boundary : Assessment is limited to investigations based on materials and tools provided to students.]

Windham School District Science Curriculum
Physics

Title of Core Map	Physics
Title of Unit	Motion and Stability: Forces and Interactions
Essential Questions	• How is motion described? • What relationships exist between position, velocity, and acceleration? • What is a vector and how is it used in physics? • How are free-body diagrams (FBD) used to explain outcomes of force interactions? • What is the strength and range of gravitational interactions? • Why do celestial bodies move the way they do and how is that related to circular motion on Earth? • What is meant by weightlessness? • How is work related to force, displacement and changes in energy? • How is energy transformed in open and closed systems? • How is impulse related to momentum? • What are the characteristics of different types of collisions? • How do charged objects interact and move from one place to another? • How do electrical circuits distribute charge in useful ways? • How is electricity generated and distributed and what are its environmental and economic costs?
Content	• **Forces and Motion-** Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1) Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2) If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2), (HS-PS2-3) • **Types of Interactions-** Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4) Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4), (HS-PS2-5) 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. (HS-PS2-6), (secondary to HS-PS1-1), (secondary to HS-PS1-3) • **Definitions of Energy-** "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5)

Skills	• **Explain relationships between and among electric charges, magnetic fields, electromagnetic forces, and atomic particles.** [PS2(9-**11**)SAE-**7**] **S:PS2:11:1.5** • Explain that all energy can be considered to be either, kinetic energy, potential energy, or energy contained by a field. S:PS2:11:3.1 • Provide examples of how kinetic and potential energy can be transformed from one to the other. S:PS2:11:3.2 • Explain that magnetic forces are related to the action of electrons and can be thought of as different aspects of a single electromagnetic force; and describe how the interplay of these forces is the basis for electric motors, generators, radio, television, and many other modern technologies. S:PS3:11:1.1 • Recognize that the strength of the electric force between two charged objects is proportional to the charges and, as with gravitation, is inversely proportional to the square of the distance between them. S:PS3:11:1.2 • Recognize that the strength of the gravitational force between two masses is proportional to the masses and inversely proportional to the square of the distance between them. S:PS3:11:1.3 • Compare the strength of nuclear, electromagnetic and gravitational forces; and explain that the strength of nuclear forces account for the great amounts of energy released from the nuclear reactions in atomic or hydrogen bombs, and in the Sun and other stars. S:PS3:11:1.4 • Recognize that electromagnetic forces exist within and between atoms. S:PS3:11:1.5 • Recognize that different kinds of materials respond to electric forces in various ways; and differentiate between insulators, semiconductors, conductors and superconductors. S:PS3:11:1.6 • Describe the difference between materials that contain equal proportions of positive and negative charges and those that have a very small excess or deficit of negative charges. S:PS3:11:1.7 • **Given information (e.g., graphs, data, diagrams), use the relationships between or among force, mass, velocity, momentum, and acceleration to predict and explain the motion of objects. [PS3(9-11)INQ+POC-8] S:PS3:11:1.8** • Interpret and apply the laws of motion to determine the effects of forces on the motion of objects. S:PS3:11:2.1 • **Apply the concepts of inertia, motion, and momentum to predict and explain situations involving forces and motion, including stationary objects and collisions. [PS3(9-11)POC-9] S:PS3:11:2.3**
Common Summative Assessments	

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.** [Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force.] [Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.] • **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.** [Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.] [Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.] • **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.** [Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [Assessment Boundary: Assessment is limited to systems with two 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.** [Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.] • **HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*** [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.

Title of Core Map	Physics
Title of Unit	Waves and Their Applications in Technologies for Information Transfer
Essential Questions	• What are the characteristics and behaviors of different types of waves? • What is a standing wave and how does that relate to various musical instruments? • How are images formed by various mirrors and lenses? • 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?
Content	• **Energy in Chemical Processes-** Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy . (secondary to HS-PS4-5) • **Wave Properties-** 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. (HS-PS4-1) Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (H S -P S 4-2),(H S - PS4-5) [F rom the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary : The discussion at this grade level is qualitative only ; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3) • **Electromagnetic Radiation-** Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3) 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-ray s, gamma ray s) can ionize atoms and cause damage to living cells. (HS-PS4-4) Photoelectric materials emit electrons w hen they absorb light of a high-enough frequency . (H S -P S 4-5) • **Information Technologies and Instrumentation-** Multiple technologies based on the understanding of waves and their interactions with matter are part of every day 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. (HS-PS4-5)

Skills	• Explain the range of the electromagnetic spectrum as it relates to both wavelength and energy; and provide examples of practical applications of the different wavelengths in the spectrum. S:PS2:11:3.4 • Recognize that the human eye can only see a narrow range of wavelengths within the electromagnetic spectrum; and explain how the variations of wavelength within that range of visible light are perceived as differences in color. S:PS2:11:3.5 • Explain that waves, such as light, seismic, sound waves, have energy and can transfer energy when they interact with matter. S:PS2:11:3.7 • Recognize that apparent changes in wavelength can provide information about changes in motion; explain that the observed wavelength of a wave depends upon the relative motion of the source and the observer; and relate these to the differences between shorter and longer wavelengths. S:PS3:11:2.2 • **Explain the effects on wavelength and frequency as electromagnetic waves interact with matter (e.g., light diffraction, blue sky). [PS3(9-11)SAE-10] S:PS3:11:2.4**
Common Summative Assessments	
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.** [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.][Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.] • **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.** [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary: Assessment does not include using quantum theory.] • **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.*** [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity ; medical imaging; and communications technology .] [Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.]