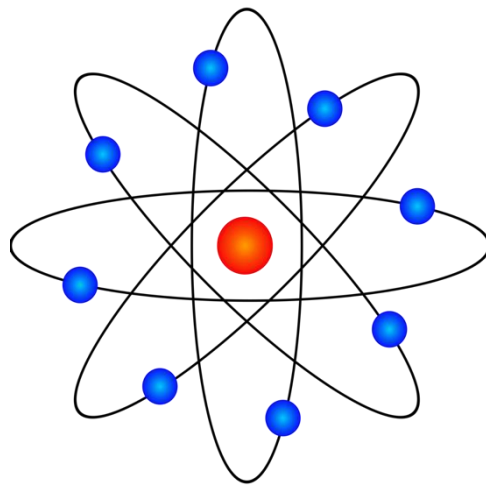




Fairbanks North Star Borough School District

Science Curriculum



Grades K-5: April 5, 2016

Grades 6-12: Adopted June 4, 2024

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Acknowledgements

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ADDITIONAL RECOGNITION

We would also like to recognize the Board Curriculum Advisory Committee, the Fairbanks North Star Borough Board of Education and the many teachers, administrators, parents, and community members who have so willingly given of their time and expertise in the planning and revision process of this document.

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Grades 6-12 science teachers met during professional development in August of 2022 to discuss and begin the research for science curriculum.

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We would also like to recognize

The Board Curriculum Committee, the Fairbanks North Star Board of Education, and the many teachers, administrators, parents, and community members who have provided input during the curriculum revision process.

Philosophy & Mission Statement

Graduates will be

EMPOWERED

critical thinkers who use evidence-based reasoning, and who have a duty to the natural world and their society.

Archived Courses

The following courses have been removed from the science curriculum and archived. If a teacher or school is interested in offering one of these courses in the future, they must fill out a pilot proposal form by the deadline listed at www.k12northstar.org/Page/8841; the course may be offered, pending Teaching and Learning and superintendent approval. If the school would like to look at the old curriculum for the course, contact Teaching and Learning at teachingandlearning@k12northstar.org or (907) 452-2000 ext. 11422.

Archived courses:

- Astrobiology
- Chem Tech
- Conceptual Physics
- Microbiology
- Natural Resources: Biology
- Natural Resources: Physical Science

Explanation of Terms

Alaska Science Standards

Science Standards were adopted by the State Board of Education in 2019. These are general statements of what Alaskans want students to know and be able to do as a result of their public school experience. <https://education.alaska.gov/standards>

Alaska Cultural Standards

Standards endorsed by the State Board of Education that serve to encourage enrichment of the content standards. They are used as a guide to ensure that schools are aware of and sensitive to their surrounding physical and cultural environments.

<https://education.alaska.gov/akstandards/#c3gtabs-cultural>

Objectives

Statements that document specific, essential tasks students are expected to accomplish in a given grade level or course.

Guaranteed and Viable Curriculum (GVC)

A guaranteed and viable curriculum is one that guarantees equal opportunity for learning for all students. Similarly, it guarantees adequate time for teachers to teach content and for students to learn it. A guaranteed and viable curriculum is one that ensures that the curriculum being taught is the curriculum being assessed. It is viable when adequate time is ensured to teach all determined essential content.

Standards Alignment Coding

This Science Curriculum is aligned to the Alaska Science Standards adopted in 2019, which are largely the same as the national Next Generation Science Standards (NGSS). The Alaska Science Standards provide a foundation for defining what students should know and be able to do in terms of scientific knowledge and skills.

(<https://education.alaska.gov/akstandards/science/science-standards-for-alaska.pdf>)

Grade Level:

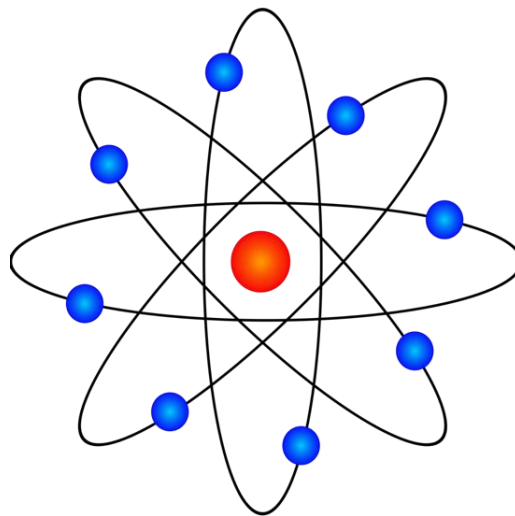
- **MS** – Middle School
- **HS** – High School

Standard

HS-LS1-1

Science Standards for Alaska Disciplinary Core Ideas	
Physical Sciences PS1: Matter and its interactions PS2: Motion and stability: Forces and interactions PS3: Energy PS4: Waves and their applications in technologies for information transfer	Life Sciences LS1: From molecules to organisms: Structures and processes LS2: Ecosystems: Interactions, energy, and dynamics LS3: Heredity: Inheritance and variation of traits LS4: Biological evolution: Unity and diversity
Earth and Space Sciences ESS1: Earth's place in the universe ESS2: Earth's systems ESS3: Earth and human activity	Engineering, Technology, Applications of Science ETS1: Engineering design

Elementary Science Courses



Grades K-5
Adopted April 5, 2016

Scope and Sequence

KINDERGARTEN			
Life Science	Physical Science	Earth & Space Science	Engineering Design
• All animals need food and water in order to live and grow. • Animals obtain their food from plants and/or other animals. • Plants need water and light to live and grow.	• Sunlight warms the Earth's surface. • Pushes and pulls can have different strengths and directions. • Pulling, pushing, or touching an object can change the speed or direction of its motion. • A bigger push or pull makes things speed up or slow down more quickly. • When objects touch, or collide, they push on one another and can change motion.	• Living things need water, air, and resources from the land, and they live in places that have the things they need. • Weather is the combination of sunlight, wind, snow, or rain, and temperature in a region. People measure these conditions to describe and record weather and notice patterns. • Plants and animals can change their environment. • Scientists forecast severe weather so communities can prepare.	• Science and engineering practices are crosscutting concepts that can be taught using any topic at each grade level. These practices are the same for grades kindergarten, first, and second. • Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. • Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. • Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
FIRST GRADE			
• Young animals and plants are very much, but not exactly, like their parents. • Individual of the same kind of plant or animal are similar, but vary in many ways. • All organisms have external parts. Animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food and water.	• Sound can make matter vibrate and vibrating matter can make sound. • Objects can be seen if light is available to illuminate them or if they can give off their own light. • Light travels differently when passing through various objects/materials. • People use a variety of devices to communicate over long distances.	• Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. • Seasonal patterns of sunrise and sunset can be observed, described, and predicted.	• Science and engineering practices are crosscutting concepts that can be taught using any topic at each grade level. These practices are the same for grades kindergarten, first, and second. • Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

FIRST GRADE (cont.)			
Life Science	Physical Science	Earth & Space Science	Engineering Design
- Plants have different parts (e.g., roots, stems, leaves, flowers, fruits) that help them grow and survive. - Adult plants and animals can have young. In many kinds of animals, parents and offspring engage in behaviors that help the offspring to survive. - Animals and plants have body parts that help them grow and survive.			improved object or tool. - Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. - Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
SECOND GRADE			
Life Science	Physical Science	Earth & Space Science	Engineering Design
- Plants depend on water and light to grow. - Plants depend on animals for pollination or to move their seeds around. - There are many different kinds of living things in any area, and they exist in different places on land and in water.	- 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. - Different properties are suited to different purposes. - A great variety of objects can be built up from a small set of pieces. - Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.	- Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. - Wind and water can change the shape of the land. - Maps show where things are located. One can map the shapes and kinds of land and water in any area. - Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.	- Science and engineering practices are crosscutting concepts that can be taught using any topic at each grade level. These practices are the same for grades kindergarten, first, and second. - Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. - Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. - Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

THIRD GRADE

Life Science

- Reproduction is essential to the continued existence of all organisms.
- Being part of a group helps animals obtain food, defend themselves, and cope with changes.
- Plants and animals have traits that are inherited from parents and can be influenced by the environment.
- Use fossils to learn about organisms and environments from long ago.
- Some variations in individuals provide advantages in surviving.
- Habitats are beneficial to some organisms and not others.
- When environments change, the plants and animals that live there may change.

Physical Science

- How balanced and unbalanced forces affect an object.
- Measure and observe the object's motion and look for patterns to predict the future movements.
- Cause and effect relationship of electric or magnetic interactions between two objects.

Earth & Space Science

- Use tables and graphs to describe typical weather patterns and conditions during a specific season.
- Describe climates in different regions of the world.
- Evaluate solution that reduces the impacts of a weather-related hazard.

Engineering Design

- Science and engineering practices are crosscutting concepts that can be taught using any topic at each grade level. These practices are the same for grades third, fourth, and fifth.
- Define a simple design problem reflecting a need or a want that includes specified criteria success and constraints on materials, time, or cost.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

FOURTH GRADE

- Alaskan plants have developed unique adaptations to accommodate their ecological niche in the habitat.
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain.

- The faster a given object is moving, the more energy it possesses and energy can be moved from place to place.
- Energy is present whenever there are moving objects and energy can be transferred from object or place to another.
- When objects collide, the contact forces transfer of energy so as to change the objects' motion.
- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.

- Local, regional, and global patterns in rock formations reveal changes over time due to earth forces, such as earthquakes.
- Rainfall helps to shape the land and affects the types of things living in a region. Water, ice, wind, living organisms, and gravity break down rocks, soils, and sediments into smaller particles and move them around.
- Plate Tectonics and Large-Scale System Interactions: The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes,

- Science and engineering practices are crosscutting concepts that can be taught using any topic at each grade level. These practices are the same for grades third, fourth, and fifth.
- Define a simple design problem reflecting a need or a want that includes specified criteria success and constraints on materials, time, or cost.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify

FOURTH GRADE (cont.)

Life Science	Physical Science	Earth & Space Science	Engineering Design
	- Waves are regular patterns of motion and can be made in water by disturbing the surface. Waves of the same type can differ in amplitude. - An object can be seen when light reflected from its surface enters the eyes. - Digitized information can be transmitted over long distances without significant degradation.	- and volcanoes occur in patterns. - Living things affect the physical characteristics of their regions. - Energy and fuels that humans use are derived from natural sources. - A variety of hazards result from natural processes that humans cannot eliminate.	aspects of a model or prototype that can be improved.

FIFTH GRADE

- | | | | |
|---|---|--|---|
| <ul style="list-style-type: none"> Plants acquire their material for growth chiefly from air and water. Organisms have interdependent relationships in ecosystems. 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. Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. | <ul style="list-style-type: none"> All matter has mass, weight, volume, and density which can be measured and compared. Matter can undergo physical and chemical changes. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. The energy released from food was once energy from the sun that was captured by the planets in the chemical process that forms plant matter. 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. | <ul style="list-style-type: none"> The sun is a star that appears larger and brighter than other stars because it is closer. The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between north and south poles, causes observable patterns. Earth's major systems, the geosphere, the hydrosphere, and the biosphere, interact in multiple ways to affect Earth's surface materials and 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 streams, lakes, wetlands, and the atmosphere. Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean air, and even outer space. | <ul style="list-style-type: none"> Science and engineering practices are crosscutting concepts that can be taught using any topic at each grade level. These practices are the same for grades third, fourth, and fifth. Define a simple design problem reflecting a need or a want that includes specified criteria success and constraints on materials, time, or cost. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. |
|---|---|--|---|

Kindergarten

Performance Expectations:

In the kindergarten performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

NGSS Summary:

The performance expectations in kindergarten help students formulate answers to questions such as: “What happens if you push or pull an object harder? Where do animals live and why do they live there? What is the weather like today and how is it different from yesterday?” Kindergarten performance expectations include PS2, PS3, LS1, ESS2, ESS3, and ETS1.

Disciplinary Core Ideas from the *NCR Framework*:

Students are expected to develop understanding of patterns and variations in local weather and the purpose of weather forecasting to prepare for, and respond to severe weather. Students are able to apply an understanding of the effects of different strengths or different directions of pushes and pulls on the motion of an object to analyze a design solution. Students are also expected to develop a relationship between their needs and where they live.

Crosscutting Concepts:

Crosscutting concepts of patterns: technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas.

These strands are not to be taught in a sequential order, but should be integrated throughout the year.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts	Students who demonstrate understanding will:	
K-LS1: From Molecules to Organisms: Structures and Processes LS1.C: Organization for Matter and Energy Flow in Organisms All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS-1) GLEs: SA.1-3; SC.1-3; SE.2; SG2, 4	K-LS1.1: Use observations to describe patterns of what plants and animals (including humans) need to survive. <i>[Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kind of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]</i>	• Use science notebooks to sketch living and non-living things in a local environment. <i>(Note differences. Discuss with partner. Share with whole group. Document observations on chart paper.)</i> • Use a Double Bubble Map to compare/contrast plants and animals. • Plant seeds. Observe daily. Document observations in science notebook. Draw and label parts of the plant. Brainstorm in small group what plants need to survive and grow. • Follow the life cycle of a butterfly. Document all stages of the life cycle, using pictures and words. Note habitat: food, temperature, lighting, and surroundings. Visit school library to locate non-fiction books. Read books aloud. Document information. • Have each student choose an Alaskan animal. Read book on animal habitat. Have students draw animal in its habitat. Have students present picture sharing type of animal, habitat, and food they eat.
Physical Science Concepts	Students who demonstrate understanding will:	
K-PS2: Motion and Stability: Forces and Interactions PS2.A: Forces and Motion • Pushes and pulls can have different strengths and directions. (K-PS2.1-2) • Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2.1-2) PS2.B: Types of Interactions When objects touch or collide, they push on one another and can change motion. (K-PS2.1)	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. <i>[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.]</i> 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. <i>[Clarification Statement: Examples of problems requiring a solution could include tools such as a ramp to increase the speed of the object and a</i>	• Using balls, race cars, and/or marbles to experiment with motion; move objects to collide with one another, cause objects to speed up and slow down. Work with a partner, note patterns and changes in movement, make observations and note possible explanations. • Build a variety of ramps-experiment with the speed of objects moving on an incline. Make predictions. Encourage students to study data, change variables, and analyze results. • Participate in numerous Tug-of-War activities. Analyze strategies. • Participate in a game of kickball. Experiment with gentle kicks and hard kicks. What happens when your foot swings harder, connecting with the ball? What happens when the ball bumps into something? • Brainstorm words to describe the sun. Create a Circle Map.

	structure that would cause an object	
CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Physical Science Concepts (cont.)	Students who demonstrate understanding will:	
PS3.C: Relationship Between Energy and Forces A bigger push or pull makes things speed up or slow down more quickly. (Secondary to K-PS2.1) ETS1.A: 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 K-PS2.2) K-PS3: Energy PS3.B: Conservation of Energy and Energy Transfer Sunlight warms Earth's surface. (K-PS3.1-2) GLEs: SA.1-2; SB.1-4; SG.1-4	<i>as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]</i> K-PS3.1: Make observations to determine the effect of sunlight on Earth's surface. <i>[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.]</i> K-PS3.2: Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area. <i>[Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]</i>	• Write a <i>Sun</i> poem. • Create a list of natural resources heated by the sun (e.g., soil, water, rocks) • Draw a picture of yourself outside on a hot, sunny day. • Describe where you are and what you are doing. • Draw a picture of yourself on a cold day, with no sunshine. Describe how the pictures are different. • Measure and record temperatures of objects placed in light. • Conduct experiments that illustrate the movement of heat from one object to another.
Earth & Space Concepts	Students who demonstrate understanding will:	
K-ESS2: Earth's Systems ESS2.D: 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 these conditions to describe and record the weather and to notice patterns over time. (K-ESS2.1) ESS2.D: Biogeology Plants and animals can change their environment. (K-ESS2.2)	K-ESS2.1: Use and share observations of local weather conditions to describe patterns over time. <i>[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 day versus cloudy days in different months.] [Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.]</i> K-ESS2.2: Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.	• Participate in classroom practices that conserve natural resources. • Explore ways Alaska Natives conserve natural resources. • Take a walking field trip to record instances of human impact. • Track temperature daily, sunlight, wind, snow, rain, and clouds. Use the data to build graphs for use in analyzing and interpreting weather data. Describe patterns and draw conclusions based on data. • Take a daily nature walk. Observe and record descriptions of the weather. Document behavior of people, animals, and plants. Note patterns. Discuss patterns with table partners. • Choose a plant, animal, or person you observed on the nature walk. Explain to partner how it was impacted by the

	<i>[Clarification Statement: Examples of plants and</i>	weather, and how it adapted to the environment.
CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Earth & Space Concepts (cont.)	Students who demonstrate understanding will:	
ESS3.C: Human Impact on Earth Systems Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impact on the land, water, air, and other living things. (Secondary to K-ESS2.2)	<i>animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.]</i>	• Pictorially record weather observations and label. • Draw and dress a paper doll for a specific Alaskan season. Name the season and explain why you chose the clothing you did. Discuss the clothing necessary for the Alaskan outdoors in each of the four seasons.
K-ESS3: Earth and Human Activity ESS3.A: 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) ESS3.B: Natural Hazards Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K-ESS3.2) ESS3.C: Human Impacts on Earth Systems Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (K-ESS3.3) ETS1.A: Defining and Delimiting an Engineering Problem Asking questions, making observations, and gathering information are helpful in	K-ESS.1: Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. <i>[Clarification Statement: 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.]</i> KESS3.2: Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. <i>[Clarification Statement: Emphasis is on local forms of severe weather.]</i> 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. <i>[Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Example of solutions could include reusing paper and recycling cans and bottles.]</i>	• Visit a school garden. Have student choose a plant to study and research. Take a photo of student and plant. Draw a picture. Research plant care and use. Measure plant growth weekly. Document data. Share observations with others. • Write a class story that depicts a setting with severe Alaskan weather. Act out the story using appropriate props for given weather. • Gather information on the four seasons. Create a weather poem for each season. Illustrate each poem.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Earth & Space Concepts (cont.)	Students who demonstrate understanding will:	
thinking about problems. (Secondary to K-ESS3.2) ETS1.B: Developing Possible Solutions Designs can be conveyed through drawings or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (Secondary to K-ESS3.3) GLEs: SA.1, 3; SB.1; SD.2-3; SE.1-3; SF.1; SG.2, 4; CS.D.5		

First Grade

Performance Expectations:

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

NGSS Summary:

The performance expectations in first grade help students formulate answers to questions such as: “What happens when materials vibrate? What happens when there is no light? What are some ways plants and animals meet their needs so that they can survive and grow? How are parents and their children similar and different? What objects are in the sky and how do they seem to move?” First grade performance expectations include PS4, LS1, LS3, and ESS1.

Disciplinary Core Ideas from the *NRC Framework*:

Students are expected to develop understanding of the relationship between sound and vibrating materials as well as between the availability of light and ability to see objects. The idea that light travels from place to place can be understood by students at this level through determining the effect of placing objects made with different materials in the path of a beam of light. Students are also expected to develop understanding of how plants and animals use their external parts to help them survive, grow, and meet their needs as well as how behaviors of parents and offspring help the offspring survive. The understanding is developed that young plants and animals are like, but not exactly the same as, their parents. Students are able to observe, describe, and predict some patterns of the movement of objects in the sky.

Crosscutting Concepts:

The crosscutting concepts of patterns: cause and effect; structure and function; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas.

These strands are not to be taught in a sequential order, but should be integrated throughout the year.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts	Students who demonstrate understanding will:	
NGSS-1-LS1: From Molecules to Organisms: Structures and Processes LS1.A: 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 take in food, water and air. Plants also have parts (roots, stems, leaves, flowers, fruits) that help them survive. (1-LS1.2) LS1.B: 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 to survive. (1-LS1.1) LS1.D: 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 external inputs. (1-LS1.1) GLEs: SA.1; SC.1-2	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. <i>[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].</i> 1-LS1.2: Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. <i>[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)].</i>	• Create a model or drawing which represents the parts of a plant. • Choose an animal/habitat. Draw a picture of the animal in its habitat, camouflaged. Have students share pictures, find camouflaged animals, and discuss camouflage techniques. • Create a shoebox diorama. Include plants/animals living in their habitat. How do they protect themselves? How do they find food and water? • Using animal cards, one with animal and one with a body part, have students participate in the following activities: ◦ "I have... Who has..." (I have porcupine, who has quills) ◦ Kagan Quiz Trade ◦ Memory ◦ Alaska Department of Fish & Game, Division of Wildlife Conservation: www.wildlife.alaska.gov
NSGG 1-LS3: Heredity: Inheritance and Variation of Traits LS3.A: Inheritance of Traits Young animals are very much, but not exactly like, their parents. Plants also are very much, but not exactly like their parents. (1-LS3.1) LS3.B: Variation of Traits Individuals of the same kind of plant or animal are recognizable as similar but can	1-LS3.1: Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. <i>[Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plants 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.]</i>	• Interview or listen to a Native elder presentation on the uses and importance of local plants and animals, including changes over time.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	Students who demonstrate understanding will:	
also vary in many ways. (1-LS3.1) GLEs: SA.1; SC.1-2		
Physical Science Concepts	Students who demonstrate understanding will:	
1.PS4: Waves and their Applications in Technologies for Information Transfer PS4.A: Wave Properties Sound can make matter vibrate and vibrating matter can make sound. (1-PS4.1) PS4.B Electromagnetic Radiation - Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4.2) - 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. (<i>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.</i>) (1-PS4.3) PS4.C: Information Technologies and Instrumentation People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4.4) GLEs: SA.1; SB.2, 4; SF.2-3; CS.D.4	1-PS4.1: Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sounds can make materials vibrate. <i>[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 hold an object near a vibrating tuning fork.]</i> 1-PS4.2: Make observations to construct an evidence-based account that can be seen only when illuminated. <i>[Clarification Statement: Examples of observation 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.]</i> 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. <i>[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.]</i> 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. <i>[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.]</i>	- Create shadows of various styles, shapes, and colors. - Explore how shadows change their shape and size. - Have students trace their shadows with chalk. Measure and document time of day. Repeat activity, noting time of day and location of sun in the sky. - Discover properties and uses of prisms. - Read <i>Raven: A Trickster Tale From the Pacific Northwest</i> by Gerald McDermott (Harcourt 1993). - Explore how to reflect, refract, and absorb light. - PBS Learning Media: www.pbslearningmedia.org

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Earth & Space Concepts	Students who demonstrate understanding will:	
1-ESS1 Earth's Place in the Universe ESS1.A: 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) GLEs: SA.1-2; SB.2, 4	1-ESS1.1: Use observations of the sun, moon, and stars to describe patterns that can be predicted. <i>[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.]</i>	- Visit a Star Lab. Have students write a descriptive paragraph sharing what they saw and learned. Illustrate using realistic colors and drawings. - Track the temperature and weather daily on a classroom chart. Include sunrise and sunset. Use the data to build graphs for use in predictive reasoning.
ESS1.B: Earth and the Solar System Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1.2) GLEs: SA.1-2, SB.2, 4	1-ESS1.2: Make observations at different times of year to relate the amount of daylight to the time of year. <i>[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 qualifying the hours or time of daylight.]</i>	- Name three conclusions that can be made by reading a class graph of the weather (e.g., there are three more rainy days than cloudy days, there was a gain of five minutes of sunlight today). - Invite a meteorologist to speak to the class. Following the interview, have students write a sentence or two sharing why they would like to be a meteorologist. Share with partner. - Paint a sunset picture using watercolors. Describe the picture using complete sentences. Include adjectives. Paint a sunrise picture using watercolors. Describe the picture using complete sentences. Include adverbs.

Second Grade

Performance Expectations:

In the second grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

NGSS Summary:

In second grade, help students formulate answers to questions such as: “How does land change and what are some things that cause it to change? What are the different kinds of land and bodies of water? How are materials similar and different from one another, and how do the properties of the materials relate to their use? What do plants need to grow? How many types of living things live in a place?” Second grade performance expectations include PS1, LS2, LS4, ESS1, ESS2, and ETS1.

Disciplinary Core Ideas from the *NRC Framework*:

Students are expected to develop an understanding of what plants need to grow and how plants depend on animals for seed dispersal and pollination. Students are also expected to compare the diversity of life in different habitats. An understanding of observable properties of materials is developed by students at this level through analysis and classification of different materials. Students are able to apply their understanding of the idea that wind and water can change the shape of the land to compare design solutions to slow or prevent such change. Students are able to use information and models to identify and represent the shapes and kinds of land and bodies of water in an area and where water is found on Earth.

Crosscutting Concepts:

The crosscutting concepts of patterns; cause and effect; energy and matter; structure and function; stability and change; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the second grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

These strands are not to be taught in a sequential order, but should be integrated throughout the year.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts	Students who demonstrate understanding will:	
2-LS2: Ecosystems: Interactions, Energy, and Dynamics LS2.A: Interdependent Relationships in Ecosystems - Plants depend on water and light to grow. (2-LS2.1) - Plants depend on animals for pollination or to move their seeds around. (2-LS2.2) ETS1.B: 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) GLEs: SA.1-2; SC.1-3; SE.2	2-LS2.1: Plan and conduct an investigation to determine if plants need sunlight and water to grow. <i>[Assessment Boundary: Assessment is limited to testing one variable at a time.]</i> 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. <i>[Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]</i>	- Grow lima beans in bags: Students will see which liquid will allow a lima bean to grow the fastest. Students will place bean seeds and cotton balls in plastic baggies. Set up four different test areas: - sunlight and water - sunlight and no water - water and no sunlight - no water and no sunlight
2-LS4: Biological Evolution: Unity and Diversity LS4.D: Biodiversity and Humans There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4.1) GLEs: SA.1-2; SC.1-3	2-LS4.1: Make observations of plants and animals to compare the diversity of life in different habitats. <i>[Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]</i>	- Habitat Elements: Hike and Games. Students will identify the five components of habitat: - food - water - shelter - air - space - Students will identify ways in which living things depend on one another for survival. Discussion will include: - food webs - What kinds of animals and homes are found in this local habitat? - How does that differ from animals in other habitats (i.e., desert, ocean, polar regions)? - Compare the diversity of life within different habitats.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	Students who demonstrate understanding will:	
		- Students may match animals with their homes using picture cards. - Games exemplify the struggle for survival in the wild and may include <i>Predator/Prey</i>; <i>Bat and Moth</i>; <i>Hibernate</i>, <i>Migrate</i>, <i>Stay Active</i>; <i>Shrinking Habitat</i>; or <i>Oh Deer!</i>
Physical Science Concepts	Students who demonstrate understanding will:	
2-PS1: Matter and its Interactions PS1.A: 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-PS1.2-3) - A great variety of objects can be built up from a small set of pieces. (2-PS1.4) PS1-B: Chemical Reactions Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1.4) GLEs: SA.1-2; SB.1-3; SE.1-2	2-PS1.1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. 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. <i>[Assessment Boundary: Assessment of quantitative measurements is limited to length.]</i> 2-PS.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. 2-PS1.4: Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.	- Using observable similarities and differences, sort leaves, shells, coins, books, and/or other classroom accessible objects into morphological groupings of relatedness. Students present their classification scheme and explain the sorting criteria they used. - Learn about the three states of matter (solids, liquids, gases). Use knowledge of a gas to complete the following challenge: design and build a model of a hot air balloon, using the materials provided. www.resa.net - Explore the three states of matter by observing an ice sculpture snowman through the frozen form, melting, and finally evaporation.
Earth & Space Concepts	Students who demonstrate understanding will:	
2-ESS1: Earth's Place in the Universe ESS1.C: The History of Planet Earth Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1.1) AKSS: SA.1-2; SD.2	2-ESS1.1: Use information from several sources to provide evidence that Earth events can occur quickly or slowly. <i>[Assessment Boundary: Assessment does not include quantitative measurements of timescales.]</i>	- Models of volcanoes and earthquakes. - Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Earth & Space Concepts (cont.)	Students who demonstrate understanding will:	
2-ESS2: Earth's Systems ESS2.A: Earth Materials and Systems Wind and water can change the shape of the land. (2-ESS2.1) ESS2.B: 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 any area. (2-ESS2.2) ESS2.C: The Roles of Water in Earth's Surface Processes Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2.3) ETS1.C: 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-ESS-2.1) GLEs: S.A.1-2, S.E.1-3, S.G.3-4	2-ESS2.1: Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. 2-ESS2.2: Develop a model to represent the shapes and kinds of land and bodies of water in an area. <i>[Assessment Boundary: Assessment does not include quantitative scaling in models.]</i> 2-ESS2.3: Obtain information to identify where water is found on Earth and that it can be solid or liquid.	- Investigate erosion revealing how human-made devices can mitigate impact of erosion. - 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.

Third Grade

Performance Expectations:

In the third grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems; developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations, and designing solutions, engaging in argument from evidence, and obtaining evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

NGSS Summary:

The performance expectations in third grade help students formulate answers to questions such as: What is typical weather in different parts of the world and during different times of the year? How can the impact of weather-related hazards be reduced? How do organisms vary in their traits? How are plants, animals, and environments of the past similar or different from current plants, animals, and environments? What happens to organisms when their environment changes? How do equal and unequal forces on an object affect the object? How can magnets be used?

Disciplinary Core Ideas from the *NRC Framework*:

Third grade performance expectations include PS2, LS1, LS3, LS4, ESS2, and ESS3 Disciplinary Core Ideas from the *NRC Framework*. Students are able to organize and use data to describe typical weather conditions expected during a particular season. By applying their understanding of weather-related hazards, students are able to make a claim about the merit of a design solution that reduces the impacts of such hazards. Students are expected to develop an understanding of the similarities and differences of the organisms' life cycles. An understanding that organisms have different inherited traits, and that the environment can also affect the traits that an organism develops, is acquired by the students at this level. In addition, students are able to construct an explanation using evidence for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

Students are expected to develop an understanding of types of organisms that lived long ago and also about the nature of the environments. Third graders are expected to develop an understanding of the idea that when the environment changes, some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. Students are able to determine the effects of balanced and unbalanced forces on the motion of an object and the cause and effect relationships of electric or magnetic interactions to define a simple design problem that can be solved with magnets.

Crosscutting Concepts:

The crosscutting concepts of patterns: cause and effect; scale, proportion, and quantity; systems and system models; interdependence of science, engineering and technology; and influence of engineering, technology and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas.

These strands are not to be taught in a sequential order, but should be integrated throughout the year.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts	Students who demonstrate understanding will:	
3-LS1: From Molecules to Organisms: Structures and Processes LS1.B: 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) GLEs: SA.1-3; SC.1-3; SE.2; SF.1; SG.4; CS.D.3	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. <i>[Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.]</i>	• Model plant life cycles of flowering plants. • Show how the changes of organisms go through in their lives forms a pattern. • Use information gained from illustration and the words in a text to model a life cycle. • Model with mathematics.
3-LS2: Ecosystems: Interactions, Energy, and Dynamics LS2.D: 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. (3-LS2.1) GLEs: SA.1-3; SC.1-3; SE.2; SF.1; SG.4; CS.D.3	3-LS2.1: Construct an argument that some animals form groups that help members survive.	• Engage in an argument from evidence. • Construct an argument with evidence, data, and/or a model.
3-LS3: Heredity: Inheritance and Variation of Traits LS3.A: Inheritance of Traits • Many characteristics of organisms are inherited from their parents. (3-LS3.1) • Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3.2) LS3.B: Variation of Traits • Different organisms vary in how they	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. <i>[Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.]</i> 3-LS3.2: Use evidence to support the explanation that traits can be influenced by the environment.	• Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans. • 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.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	Students who demonstrate understanding will:	
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) GLEs: SA.1-3; SC.1-3; SE.2; SF.1; SG.4; CS.D.3		
3-LS4: Biological Evolution: Unity and Diversity LS2.C: Ecosystem Dynamics, Functioning, and Resilience When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (Secondary to 3-LS4.4) LS4.A: Evidence of Common Ancestry and Diversity - Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (3-LS4.1) - Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4.1) LS4.B: Natural Selection Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (3-LS4.2) LS4.C: Adaptation For any particular environment, some kinds	3-LS4.1: Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. <i>[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.]</i> 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. 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. 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. <i>[Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]</i>	- 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. - 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. - 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. - Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	Students who demonstrate understanding will:	
of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4.3) LS4.D: Biodiversity and Humans Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4.4) GLEs: SA.1-3; SC.1-3; SE.2; SF.1; SG.4; CS.D.3		
Physical Science Concepts	Students who demonstrate understanding will:	
3-PS2: Motion and Stability: Forces and Interactions PS2-A: 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) - The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (3-PS2.2) PS2-B: 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	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. <i>[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.]</i> 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. <i>[Assessment Boundary: Assessment does not include technical terms such as period and frequency.]</i> 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. <i>[Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]</i> 3-PS2.4: Define a simple design problem that can be solved by applying scientific ideas about magnets.	- An example 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. - An example 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. - An example 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; an example 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. An example 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. - Ask questions to define problems. Plan and carry out investigations.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Physical Science Concepts (cont.)	Students who demonstrate understanding will:	
two magnets, on their orientation relative to each other. (3-PS2.3-4) GLEs: SA.1; SB.2-3; SE.1-2		
Earth & Space Concepts	Students who demonstrate understanding will:	
3-ESS2: Earth's Systems ESS2.D: 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) GLEs: SD.1-2; SF.2; CS.B.4	3-ESS2.1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. <i>[Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.]</i> 3-ESS2.2: Obtain and combine information to describe climates in different regions of the world.	Examples of data could include average temperature, precipitation, and wind direction.
3-ESS3: Earth and Human Activity ESS3.B: 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) GLEs: SB.3; SD.2-3	3-ESS3.1: Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.	Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.

Fourth Grade

Performance Expectations:

In fourth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

NGSS Summary:

The performance expectations in fourth grade help students formulate answers to questions such as: "What are waves and what are some things they can do? How can water, ice, wind, and vegetation change the land? What patterns of Earth's features can be determined with the use of maps? How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals? What is energy and how is it related to motion? How is energy transferred? How can energy be used to solve a problem?" Fourth grade performance expectations include PS3, PS4, LS1, ESS1, ESS2, ESS3, and ETS1 disciplinary core ideas from the *NRC Framework*.

Disciplinary Core Ideas from the *NRC Framework*:

Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move. Students are expected to develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. Fourth graders are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents or from object to object through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another.

Crosscutting Concepts

The crosscutting concepts of patterns; cause and effect; energy and matter; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas.

These strands are not to be taught in a sequential order, but should be integrated throughout the year.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts	Students who demonstrate understanding will:	
4-LS1: From Molecules to Organisms: Structures and Processes LS1.A: Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1.1) LS1.D: Information Processing Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1.2) GLEs: SA.1, 3; SC.1-3; CF.2; CS.A.3	4-LS1.1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. <i>[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.]</i> 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. <i>[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.]</i>	• Diagram or make a model of plant and/or animal cells. • Contrast inherited traits with those that are not inherited. • Explore how Alaskan plants have adapted to their unique environments.
Physical Science Concepts	Students who demonstrate understanding will:	
4-PS3: Energy PS3.A: Definitions of Energy • The faster a given object is moving; the more energy it possesses. (4-PS3.1) • Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3.2-3) PS3.B: 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-PS3.2-3)	4-PS3.1: Use evidence to construct an explanation relating the speed of an object to the energy of that object. <i>[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.]</i> 4-PS3.2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. <i>[Assessment Boundary: Assessment does not include quantitative measurements of energy.]</i> 4-PS3.3: Ask questions and predict outcomes about the changes in energy that occur when objects collide. <i>[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.]</i> 4-PS3.4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	• Demonstrate how light travels with model. • Use frozen, saturated peat moss and a variety of coverings (e.g., leaves, snow, soil) to simulate how ground cover affects light absorption and reflection. • Research Aurora Borealis. • Design an experiment that investigates the effectiveness of different insulating and conducting materials. • Demonstrate how sound travels with a model.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Physical Science Concepts (cont.)	Students who demonstrate understanding will:	
- 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.C: Relationship Between Energy and Forces When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3.3) PS3.D: 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) ETS1.A: Defining Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (Secondary to 4-PS3.4) 4-PS4: Waves and their Applications in Technologies for Information Transfer	<i>[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.]</i> 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. <i>[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.]</i> 4-PS4.2: Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. <i>[Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]</i> 4-PS4.3: Generate and compare multiple solutions that use patterns to transfer information. <i>[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.]</i>	

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Physical Science Concepts (cont.)	Students who demonstrate understanding will:	
PS4.A: Wave Properties Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (4-PS4.1) Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4.1) PS4.B: Electromagnetic Radiation An object can be seen when light reflected from its surface enters the eyes. (4-PS4.2) PS4.C: Information Technologies and Instrumentation Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4.3)		

ETS1.C: Optimizing The Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (Secondary to 4-PS4.3) GLEs: SA.1; SB.1-3; SE.3		
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CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Earth & Space Concepts	Students who demonstrate understanding will:	
4-ESS1: Earth's Place in the Universe ESS1.C: The History of Planet Earth Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1.1) ESS2.A: Earth Materials and Systems Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2.1) ESS2.B: Plate Tectonics and Large-Scale System Interactions The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2.2) ESS2.E: Biogeology Living things affect the physical characteristics of their regions. (4-ESS2.1)	4-ESS1.1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. <i>[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.]</i> 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. <i>[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.]</i> 4-ESS2.2: Analyze and interpret data from maps to describe patterns of Earth's features. <i>[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.]</i> 4-ESS3.1: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. <i>[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.]</i>	• Take field trip to Fort Knox Gold Mine. • Take a field trip to UAF Geophysical Institute. • Demonstrate the movement of the Earth's fault lines with a model or map. • Design a model that demonstrates the forces that cause earthquakes. • Use map or puzzle to demonstrate plate tectonics. • Analyze traditional stories of earthquakes and volcanoes.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Earth & Space Concepts (cont.)	Students who demonstrate understanding will:	
ESS3.A: Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3.1) ESS3.B: Natural Hazards A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3.2) ETS1.B: Designing Solutions to Engineering Problems Testing a solution involves investigating how well it performs under a range of likely conditions. (Secondary to 4-ESS3.2) GLEs: SA.1, 3; SD.1-4; SE.1, 3; SF.2; SG.1, 3	4-ESS3.2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. <i>[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.]</i>	

Fifth Grade

Performance Expectations:

In fifth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, engaging in argument from evidence, and obtaining, evaluating, and communicating information; and to use these practices to demonstrate understanding of the core ideas.

NGSS Summary:

The performance expectations in fifth grade help students formulate answers to questions such as: "When matter changes, does its weight change? How much water can be found in different places on Earth? Can new substances be created by combining other substances? How does matter cycle through ecosystems? Where does the energy in food come from and what is it used for? How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?" Fifth grade performance expectations include PS1, PS2, PS3, LS1, LS2, ESS1, ESS2, and ESS3 disciplinary core ideas from the *NRC Framework*.

Disciplinary Core Ideas from the *NRC Framework*:

Students are able to describe that matter is made of particles too small to be seen through the development of a model. Students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved. Students determine whether the mixing of two or more substances results in new substances. Through the development of a model using an example, students are able to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. They describe and graph data to provide evidence about the distribution of water on Earth. Students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment and that energy in animals' food was once energy from the sun. Students are expected to develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Crosscutting Concepts:

The crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; energy and matter; and systems and systems models are called out as organizing concepts for these disciplinary core ideas.

These strands are not to be taught in a sequential order, but should be integrated throughout the year.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts	Students who demonstrate understanding will:	
5-LS1: From Molecules to Organisms: Structures and Processes LS1.C: Organization for Matter and Energy Flow in Organisms - Food provides animals with the materials they need for body repair and growth and the 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) 5-LS2: Ecosystems: Interactions, Energy, and Dynamics LS2.A: Interdependent Relationships in Ecosystems The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2.1)	5-LS1.1: Support an argument that plants get the materials they need for growth chiefly from air and water. <i>[Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]</i> 5-LS2.1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. <i>[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.]</i> <i>[Assessment Boundary: Assessment does not include molecular explanations.]</i>	- Create models of food webs/chains. - Take a field trip to the Chena River Riparian System on Chena Hot Springs Road. - Create a <i>The most important thing about...</i> pattern book focused on Alaskan plants (based on <i>The Important Book</i> by Margaret Wise Brown). - Make a food chain diagram.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Life Science Concepts (cont.)	Students who demonstrate understanding will:	
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases and water from the environment and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2.1) GLEs: SA.1, 3; SC.1-3; SE.3; SF.3; SG.3		
Physical Science Concepts	Students demonstrate understanding will:	
5-PS1: Matter and Its Interactions PS1.A: Structure and Properties of Matter Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (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)	5-PS 1.1: Develop a model to describe that matter is made of particles too small to be seen. <i>[Clarification Statement: Examples of evidence supporting a model 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.]</i> 5-PS 1.2: 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 conserved. <i>[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.]</i> 5-PS 1.3: Make observations and measurements to identify materials based on their properties. <i>[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.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]</i>	Adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water. Reactions or changes could include phase changes and dissolving/mixing new substances. Materials to identify could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response of magnetic forces, and solubility; density is not intended as an identifiable property.

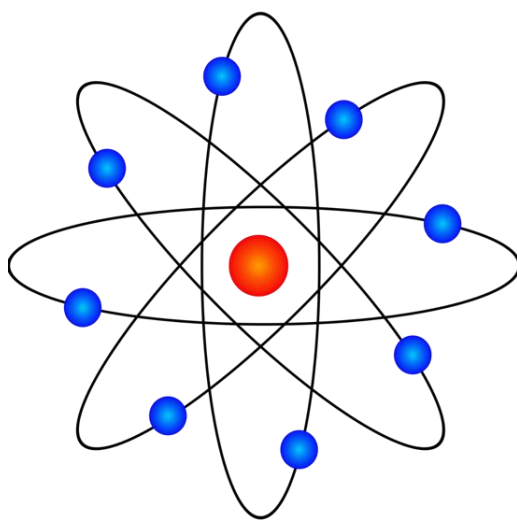
CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Physical Science Concepts (cont.)	Students demonstrate understanding will:	
PS1.B: Chemical Reactions When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1.4) No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (5-PS1.2) 5-PS2: Motion and Stability: Forces and Interactions PS2.B: Types of Interactions The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5- PS2.1) 5-PS3: Energy PS3.D: Energy in Chemical Processes and Every day Life The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3.1) GLEs: SA.1-2; SB.1-4; SC.2; SD.1-2, 4; SE.1, 3; SF.1; SG.2-3; CS.A.3	5-PS1.4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances. 5-PS2.1: Support an argument that the gravitational force exerted by Earth on objects is directed down. <i>[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.]</i> 5-PS3.1: Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. <i>[Clarification Statement: Examples of models could include diagrams, and flow charts.]</i> 5-PS2.1: Support an argument that the gravitational force exerted by Earth on objects is directed down. <i>[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.]</i> 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. <i>[Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (e.g., stellar masses, age, stage).]</i> 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. <i>[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.]</i>	

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Earth & Space Concepts	Students who demonstrate understanding will:	
5-ESS1: Earth's Place in the Universe ESS1.A: The Universe and its Stars The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1.1) ESS1.B: Earth and the Solar System The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1.2) 5-ESS2: Earth's Systems ESS2.A: Earth Materials and Systems Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple 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)	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. <i>[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).]</i> 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. <i>[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.]</i> 5-ESS2.1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. <i>[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.]</i> 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. <i>[Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]</i> 5-ESS3.1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	Demonstrate the movement of Earth's fault lines with a model or map. Design a simple model that demonstrates the forces that cause earthquakes. Use a map or puzzle to demonstrate plate tectonics. Take a field trip to the UAF's Geophysical Institute. Analyze traditional stories that describe earthquakes and volcanoes. Invite UAF's <i>Tunnel-man</i> into the classroom.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Earth & Space Concepts (cont.)	Students who demonstrate understanding will:	
ESS2.C: 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) 5-ESS-3: Earth and Human Activity ESS3.C: Human Impacts on Earth Systems Human activities in agriculture, industry, and every day 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) GLEs: SA.1-3; SB.1, 3-4; SD.1-4; SE.1-3, SF.1; SG.3; CS.A.3		
Engineering, Technology & Applications of Science	Students who demonstrate understanding will:	
3-5-ETS1: Engineering Design ETS1.A: Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1.1)	3-5-ETS1.1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1.2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1.3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	Bridge building. <i>Engineering is Elementary</i> kits in Library Media Services. Look at house structures in the book <i>The Three Little Pigs</i>. Activity: Marshmallow Tower. Activity: Shapes of Strength. Bring in practicing engineers from the community.

CORE IDEAS	PERFORMANCE EXPECTATIONS	SUGGESTED EXPLORATIONS
Engineering, Technology & Applications of Science (cont.)	Students who demonstrate understanding will:	
ETS1.B: Developing Possible Solutions Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1.2) At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1.2) Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1.3) ETS1.C: Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1.3)		

Middle School Science Courses



Grades 6 – 8
Adopted June 4, 2024

Grade 6 Science

Grade(s): 6 Length: two semesters	Course Overview: Sixth grade science focuses on Earth’s systems, astronomy, and gravity. In Earth’s systems, students will explore the history of our changing planet through impacts of water, rock, and soil cycles on Earth’s surface processes, and construct weather and climate observations to explain influences on Earth’s surface. In astronomy, the students will model the solar system to observe, describe, and predict the motion of various bodies in our solar system. In gravity, students will investigate Newton’s Third Law of Motion in relation to planetary motion. Throughout the year, interwoven into the curriculum content, students will design and conduct repeatable scientific investigations to continue to develop an awareness that different ways of thinking, curiosity, and the exploration of multiple paths are involved in scientific inquiry. Adopted Textbook: <i>Into Science: Earth & Space Sciences</i>. HMH, 2022 Volumes: <i>Circulation of the Earth’s Air and Water, Weather and Climate, The Dynamic Earth, Earth’s Natural Hazards, Resources in Earth Systems, Human Impacts on Earth Systems, Patterns in the Solar System, The Solar System and Universe.</i>
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Units (Recommended Order)	
Semester 1	Semester 2
• Circulation of Earth’s Air and Water • Weather and Climate • The Dynamic Earth • Earth’s Natural Hazards • Resources in Earth’s Systems	• Human Impacts on Earth’s Systems • Patterns in the Solar System • The Solar System and Universe • Performance Expectations*

Notes:

- The *Earth and Space Science* Unit 4 “Earth through Time” book was intentionally skipped, as it is utilized by grade 7.
- *Science process skills are best taught in context. Therefore, the performance expectations will be incorporated into the units below. Not all of these performance expectations will be incorporated into every activity; however, the opportunities to learn these skills will be provided throughout the course.

UNIT 1: CIRCULATION OF EARTH'S AIR & WATER

Timing: Semester 1, Quarter 1

Teaching Time Required: All estimated teaching times are based on a 45 minute period.

Textbook: *Into Science* book 1: *Circulation of Earth's Air and Water*

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Circulation in the Earth's Atmosphere	5 days	Identify and analyze movements of air masses from regions of high to low pressure (convection currents) and the effects on weather.	- Convection - Coriolis Effect - Air Pressure - Atmosphere - Circulation - Density - Energy System	Unit 1 (Book 1, p. 3A) Lesson 1: Circulation in the Earth's Atmosphere
Circulation in the Earth's Oceans	5 days	Describe the effects of the ocean on Earth's weather.	- Ocean Current - Density - Salinity - Temperature	Unit 1 (Book 1, 11A) Lesson 2: Circulation in Earth's Oceans
The Water Cycle	5.5 days	Describe and illustrate the water cycle, and the forces that drive it (gravity and sunlight).	- Evaporation - Condensation - Transpiration - Crystallization - Precipitation - Runoff - Groundwater Flow	Unit 1 (Book 1, 19A) Lesson 3: The Water Cycle
Unit Test/ Labs	2 days			
Standards List:	MS ESS2-4, MS ESS2-6			

UNIT 2: WEATHER & CLIMATE				
Timing: Semester 1, Quarter 1 Teaching Time Required: All estimated teaching times are based on a 45 minute period. Textbook: <i>Into Science</i> Unit 2: <i>Weather and Climate</i>				
Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Weather and Weather Prediction	5.5 days	- Identify and analyze movement of air masses from regions of high to low pressure (convection currents), and the effects on the weather. - Describe the effects of the ocean and the water cycle on the weather.	- Weather - Air Mass - Front - Weather Forecast	Unit 2 (Book 2, pg. 3A) Lesson 1: Weather and Weather Prediction
Influences on Climate	6.5 days	Describe how unequal heating and the rotation of the Earth determines regional climates.	Climate	Unit 2 (Book 2, pg. 11A) Lesson 2: Influences on Climate
Unit Test/ Labs	2.5			
Standards List:	MS-ESS2-5, MS-ESS2-5			

UNIT 3: THE DYNAMIC EARTH

Timing: Semester 1, Quarter 2

Teaching Time Required: All estimated teaching times are based on a 45 minute period.

Textbook: *Into Science* Unit 3

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Geologic Change and Surface Processes	5.5 days	Explain how geoscience processes have changed the Earth's surface at varying times and spatial scales.	- Weathering - Sediment - Erosion - Deposition	Unit 3: Lesson 1 Geologic Change and Surface Processes
The Rock Cycle	6.5 days	Know that sedimentary, igneous, and metamorphic rocks contain evidence of the minerals, temperatures, and the forces that created them.	- Mineral - Igneous Rock - Sedimentary Rock - Metamorphic Rock - Rock Cycle	Unit 3: Lesson 2 The Rock Cycle
Earth's Plates	5.5 days	Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.	- Tectonic Plate - Plate Tectonics - Convection Current	Unit 3: Lesson 3 Earth's Plates
Unit Test/ Labs	2.5 days			
Standards List:	MS ESS2-1, MS ESS2-2, MS ESS2-3			

UNIT 4: EARTH'S NATURAL HAZARDS

Timing: Semester 1, Quarter 2

Teaching Time Required: All estimated teaching times are based on a 45 minute period.

Textbook: *Into Science* Unit 5

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Natural Hazard Prediction	5.5 days	Analyze and interpret data on natural hazards to forecast future catastrophic events.	- Natural Disaster - Natural Hazard - Historical - Interpret - Likelihood - Monitor - Prediction	Unit 5 Lesson 1: Natural Hazard Prediction p. 3A
Reducing the Effects of Natural Hazards	5.5 days	Define criteria and constraints of model for mitigating natural hazards.	- Mitigation - Constraint - Criterion - Engineering Design Process - Preparation - Recovery - Response - Solution - Technology	Unit 5 Lesson 2: Engineer it: Reducing the Effects of Natural Hazards p. 11A
Unit Test/ Labs	2.5 days			
Standards List:	MS-ESS3-2, MS-ETS1-1			

UNIT 5: RESOURCES IN EARTH'S SYSTEMS

Timing: Semester 2, Quarter 3

Teaching Time Required: All estimated teaching times are based on a 45 minute period.

Textbook: *Into Science* Unit 6

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Natural Resources	5.5 days	- Construct an evidence-based explanation of the formation of natural resources (such as oil, propane, and natural gas) are the result of past geoscience processes. - Gather information and explain how synthetic materials come from natural resources and impact society.	- Natural Resources - Renewable Resource - Nonrenewable Resource	Unit 6 Lesson 1: Natural Resources
Human Population and Resource Use	5 days	Construct an argument, supported by evidence, for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	- Per Capita Consumption - Population	Unit 6 Lesson 2: Human Population and Resource Use
Resource Use and Earth's Systems	5.5 days	- Construct an argument, supported by evidence, for how increases in human population and per-capita consumption of natural resources impact Earth's systems - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	- Pollution - Deforestation - Extinction - Greenhouse Gas - Resource Use	Unit 6 Lesson 3: Resource Use and Earth's Systems
Unit Test/ Labs	2.5 days			
Standards List:	MS ESS3-1, MS ESS3-2			

UNIT 6: HUMAN IMPACTS ON EARTH'S SYSTEMS

Timing: Semester 2, Quarter 3

Teaching Time Required: All estimated teaching times are based on a 45 minute period.

Textbook: *Into Science* Unit 7

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Reducing Human Impacts on the Environment	8.5 days	Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.		Unit 7: Lesson 1 Engineer It: Reducing Human Impacts on the Environment.
Climate Change	5.5 days	- Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	Greenhouse Effect	Unit 7: Lesson 2 Climate Change
Unit Test/ Labs	2.5 days			
Standards List:	MS-ESS3-3, MS-ESS3-5, MS-ETS1-2			

UNIT 7: PATTERNS IN THE SOLAR SYSTEM

Timing: Semester 2, Quarter 4

Teaching Time Required: All estimated teaching times are based on a 45 minute period.

Textbook: *Into Science* Unit 8

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Earth – Sun – Moon System	7 days	Develop and use a model of the Earth-Sun-Moon system to describe the cyclic patterns of lunar phases, and eclipses of the sun and moon.	- Orbit - Phase - Eclipse	Unit 8 Lesson 1: The Earth-Sun-Moon System, pg. 3A
Seasons	6 days	Develop and use a model of the Earth-Sun-Moon system to describe the seasons.	Season	Unit 8 Lesson 2: Seasons, pg. 15A
Unit Test/ Labs	2.5 days			
Standards List:	MS-ESS1-1			

UNIT 8: THE SOLAR SYSTEM AND UNIVERSE

Timing: Semester 2, Quarter 4

Teaching Time Required: All estimated teaching times are based on a 45 minute period.

Textbook: *Into Science* Unit 9: *The Solar System and Universe*

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Earth and the Solar System	5 days	Analyze and interpret data to determine scale properties of objects in the solar system.	- Asteroid - Comet - Dwarf Planet - Meteoroid - Parallax - Moon - Telescope - Heliocentric - Retrograde - Transit	Unit 9 Lesson 1: Earth and the Solar System
Gravity and the Universe	6.5 days	Describe the role of gravity in the motions within galaxies and the solar system.	- Orbit - Chemical Composition - Condense - Density - Inertia - Projectile - Protoplanetary Disk - Satellite - Velocity - Speed	Unit 9 Lesson 2: Gravity and the Universe
Modeling in Space Science	6.5 days	Construct and present arguments to support the claim that gravitational interactions are attractive and depend on masses of interacting objects.	- Astronomical Unit - Galaxy - Light-Year - Universe Diameter - Distinguish Location - Order of Magnitude - Ratio - Scale	Unit 9 Lesson 3: Modeling in Space Science
Unit Test/ Labs	2.5 days			
Standards List:	MS ESS1-2, MS ESS1-3, MS PS2-4			

SCIENTIFIC PROCESS SKILLS	
Timing: All year Teaching Time Required: Varies Textbook: Embedded throughout	
Objectives	
• Ask questions, predict, observe, describe, measure, classify, make generalizations, infer, and communicate. • Plan and carry out scientific investigations of various types (such as systematic observations or experiments), identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions. • Select appropriate tools for collecting qualitative and quantitative data and record measurements (volume, mass, distance) in metric units. • Develop a model describing phenomenon. • Conduct research to learn how the local environment is used by a variety of competing interests (e.g. competition for habitat/resources, tourism, oil, mining companies, and hunting groups). • Use standard safety practices for all classroom laboratory and field investigations.	

Grade 7 Science

Grade(s): 7 Length: two semesters	Course Overview: <i>Science 7</i> is an introductory course designed to expand seventh grade students' understanding of the natural world by focusing on the characteristics of living things, cellular organization, the diversity of life, and how organisms and populations change over time in terms of biological adaptation, heredity and genetics, evolution, natural selection, and changes over time in Earth's history. Adopted Textbook: <i>Into Science</i> . HMH, 2022
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Units (Recommended Order)	
Semester 1	Semester 2
• Introduction • Cells and Organization in Organisms • Reproduction, Heredity, and Growth • Matter and Energy in Living Systems	• Ecosystem Dynamics • The History of Life on Earth • Evolution

UNIT 1: CELLS & ORGANIZATION IN ORGANISMS

Suggested Pacing: Semester 1, Quarter 1

Teaching Time Required: 17 days

Textbook: *Into Science*

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Cell Structure/ Function	5 days	- All living things are made of one or more cells. - Cells can be described by the types of structures in which they are made. - The cell membrane serves as a barrier that allows matter and energy to enter and exit the cell. - Students use a model to describe how a cell's functions are performed by specific cell structures.	- Cell Membrane - Cell Wall - Chloroplast - Mitochondrion - Nucleus - Organelle	<i>Into Science: Life Science</i> Unit 1 Cells and Organization in Organisms – Lesson 1 Cell Structure and Function
Plant Body Systems	5 days	Students use evidence to support an explanation about how the survival needs of plants are met by systems working together.	- Leaf - Organ - Organism - Organ System - Tissue	<i>Into Science: Life Science</i> Unit 1 Cells and Organization in Organisms – Lesson 2 Plant Body Systems
Animal Body Systems	5 days	Students use evidence to evaluate how the survival needs of animals are met by systems working together.	- Behavior - Homeostasis - Memory - Sensory - Receptor	<i>Into Science: Life Science</i> Unit 1 Cells and Organization in Organisms – Lesson 3 Animal Body Systems
Unit Test/ Labs	2 days			
Standards List:	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. 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 MS-LS1-3 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. 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.			

UNIT 2: REPRODUCTION, HEREDITY, & GROWTH

Timing: Semester 1, Quarter 2

Teaching Time Required: 17.5 – 26.5 days

Textbook: *Into Science*

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Inheritance and Reproduction	5 – 8 days	Students investigate how genetic factors influence an organism's traits, describe how asexual reproduction results in offspring with identical genetic information, and how sexual reproduction results in offspring with genetic variation.	- Allele - Asexual Reproduction - Chromosome - DNA - Gamete - Gene - Inheritance - Offspring - Sexual Reproduction - Trait - Probability	<i>Into Science: Life Science</i> Unit 2 Reproduction, Heredity, and Growth – Lesson 1 Inheritance and Reproduction
Plant Reproduction & Growth	5 – 8 days	Students explain how genetic and environmental factors affect the growth and reproduction of plants.	- Pollination - Seed Dispersal - Environmental Factor - Fertilization Genetic - Factor - Germination	<i>Into Science: Life Science</i> Unit 2 Reproduction, Heredity, and Growth – Lesson 2 Plant Reproduction and Growth
Animal Reproduction & Growth	5.5 – 8.5 days	Students gather evidence to explain how an animal's behavior influences its reproductive success and survival.	- Asexual Reproduction - Behavior - Environmental Factor - Fertilization - Genetic Factor - Reproductive Success - Sexual Reproduction - Variation	<i>Into Science: Life Science</i> Unit 2 Reproduction, Heredity, and Growth – Lesson 3 Animal Reproduction and Growth
Unit Test/ Labs	2 days			
Standards List:	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. MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. 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.			

UNIT 3: MATTER & ENERGY IN LIVING SYSTEMS

Timing: Semester 1, Quarter 2

Teaching Time Required: 26.5 – 38.5 days

Textbook: *Into Science*

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Matter & Energy in Organisms	6 – 9 days	Students explain the role of photosynthesis and cellular respiration in the cycling of matter and energy within and between organisms.	- Matter Molecule - Energy - Chemical Reaction - Photosynthesis - Cellular Respiration	<i>Into Science: Life Science</i> Unit 3 Matter and Energy in Living Systems – Lesson 1 Matter and Energy in Organisms
Resource Availability Affects Organisms	7 – 10 days	Students interpret data to predict the effects of resource availability on the growth of organisms and populations in an ecosystem.	- Ecosystem - Biotic Factor - Abiotic Factor - Species - Population - Community	<i>Into Science: Life Science</i> Unit 3 Matter and Energy in Living Systems – Lesson 2 Resource Availability Affects Organisms
Interactions in Ecosystems	5 – 8 days	Students explain patterns of interaction between organisms.	- Predator - Prey - Herbivore - Symbiosis - Competition	<i>Into Science: Life Science</i> Unit 3 Matter and Energy in Living Systems – Lesson 3 Interactions in Ecosystems
Matter & Energy in Ecosystems	6.5 – 9.5 days	Students develop a model to explain how matter and energy flow through ecosystems.	- Producer - Consumer Decomposer - Food Web - Energy Pyramid	<i>Into Science: Life Science</i> Unit 3 Matter and Energy in Living Systems – Lesson 4 Matter and Energy in Ecosystems
Unit Test/ Labs	2 days			
Standards List:	PE 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. PE 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. PE 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. PE MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. PE MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.			

UNIT 4: ECOSYSTEM DYNAMICS

Timing: Semester 2, Quarter 3

Teaching Time Required: 15 – 17 days

Textbook: *Into Science*

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Biodiversity in Ecosystems	4 – 5 days	Students use evidence to support an explanation of how changes in biodiversity can affect ecosystem health.	- Biodiversity - Ecological Health - Biodiversity Hotspot - Influence - Disturbance - Introduced Species - Recovery - Stability	<i>Into Science: Life Science</i> Unit 4 Ecosystem Dynamics – Lesson 1 Biodiversity in Ecosystems
Changes in Ecosystems	4 – 5 days	Students use evidence to support an explanation of how changes in ecosystems cause changes in populations.	- Disturbance - Succession - Biodiversity - Dynamic - Gradual Change - Interconnected - Pioneer Species - Recovery	<i>Into Science: Life Science</i> Unit 4 Ecosystem Dynamics – Lesson 2 Changes in Ecosystems
Maintaining Ecosystems	5 days	Students will be able to evaluate competing design solutions for maintaining biodiversity and ecosystem services.	- Habitat Destruction - Habitat Fragmentation - Ecosystem Service	<i>Into Science: Life Science</i> Unit 4 Ecosystem Dynamics – Lesson 3 Maintaining Ecosystems
Unit Test/ Labs	2 days			
Standards List:	PE MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. PE MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services. PE MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.			

UNIT 5: THE HISTORY OF LIFE ON EARTH

Timing: Semester 2, Quarter 4

Teaching Time Required: 19 – 25 days

Textbook: *Into Science*

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Fossil Record	6 – 8 days	Students will be able to explain how patterns in fossil data can be used to provide evidence for the history of life on Earth.	- Fossil - Radiometric Dating - Fossil Record - Extinction	<i>Into Science: Life Science</i> Unit 5 History of Life on Earth – Lesson 1 Fossil Record
Patterns of Change in Life on Earth	5.5 – 7.5 days	Students will be able to analyze patterns in the fossil record to explain changes in life on Earth over time.	Extinction	<i>Into Science: Life Science</i> Unit 5 History of Life on Earth – Lesson 2 Patterns of Change in Life on Earth
Evidence of Common Ancestry	5.5 – 7.5 days	Students will be able to analyze patterns in data to provide evidence for evolutionary relationships among organisms.	- Evolution - Common Ancestry - Anatomy - Embryology	<i>Into Science: Life Science</i> Unit 5 History of Life on Earth – Lesson 3 Evidence of Common Ancestry
Unit Test/ Labs	2 days			
Standards List:	MS-LS4-1: Students who demonstrate understanding can: 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. MS-LS4-2: Students who demonstrate understanding can: 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. MS-LS4-3: Students who demonstrate understanding can: 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.			

UNIT 6: EVOLUTION

Timing: Semester 2, Quarter 4

Teaching Time Required: 17.5 – 26.5 days

Textbook: *Into Science*

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Genetic Change and Traits	5 – 8 days	Students model analysis of fossil evidence, and explore relative and absolute age.	- Adaptation - DNA - Gene Mutation - Protein - Amino Acid - Chromosome - Environment - Sequence - Trait	<i>Into Science: Life Science</i> Unit 6 Evolution – Lesson 1 Genetic Change and Traits
Natural Selection	5 – 8 days	Students explore evidence of change in life over time, analyze patterns in extinction data, and model analysis of rock and fossil sequences.	- Allele Frequency - Evolution - Extinction - Natural Selection - Variation - Advantage - Distribution - Genotype - Phenotype - Population	<i>Into Science: Life Science</i> Unit 6 Evolution – Lesson 2 Natural Selection
Human Influence on Traits	5.5 – 8.5 days	Students identify patterns of similarities in the anatomy and embryological development across species.	- Artificial Selection - Biotechnology - Genetic Engineering - Genetically Modified Organism (GMO) - Disrupt - Ethics - Individual - Selective Breeding - Society	<i>Into Science: Life Science</i> Unit 6 Evolution – Lesson 3 Human Influence on Traits
Unit Test/ Labs	2 days			
Standards List:	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.			

	• 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. • MS-LS4-5 Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. • 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.
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SCIENTIFIC PROCESS SKILLS	
Timing: All year Teaching Time Required: Varies Textbook: Embedded throughout	
Objectives	
• Ask questions, predict, observe, describe, measure, classify, make generalizations, infer, and communicate. • Plan and carry out scientific investigations of various types (such as systematic observations or experiments), identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions. • Select appropriate tools for collecting qualitative and quantitative data and record measurements (volume, mass, distance) in metric units. • Develop a model describing phenomenon. • Conduct research to learn how the local environment is used by a variety of competing interests (e.g. competition for habitat/resources, tourism, oil, mining companies, and hunting groups). • Use standard safety practices for all classroom laboratory and field investigations.	

Grade 8 Science

Grade(s): 8 Length: two semesters	Course Overview: <i>Science 8</i> is designed to expand student investigation of physics and chemistry. Aspects of physics are studied through laboratory investigations including sound, light, electricity, mechanics, motion, and energy. Aspects of chemistry are studied based on the Periodic Table of the Elements and through basic chemical laboratory investigations. Laboratory work, laboratory reporting, and engineering design will be included and is an integral part of the learning process. Adopted Textbook: <i>Into Science</i> . HMH, 2022
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Units (Recommended Order)	
Semester 1	Semester 2
• Structure of Matter • Chemistry of Materials • Chemical Process & Equations • Energy • Ongoing, yearlong learning objects: Scientific Process Skills and Engineering Design Concepts	• Energy Transfer • Forces and Motion • Eclectic and Magnetic Forces • Waves and Information Transfer

UNIT 1: STRUCTURE OF MATTER				
Timing: Semester 1, Quarter 1 Teaching Time Required: 24 days Textbook: <i>Into Science</i> , Unit 3				
Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Properties of Matter	6 days	Investigate and explain that all matter is made up of atoms, and understand that substances have physical properties that are unique to each.	- Matter - Mass - Volume - Density - Solid - Liquid - Gas	<i>Into Science: Physical Science</i> Unit 3 Structure of Matter
Changes of State	5.5 days	Investigate changes that occur in physical and chemical properties of matter using a qualitative description of changes on a molecular level, including conservation of matter.	- Change of State - Thermal Energy - Temperature - Pressure	<i>Into Science: Physical Science</i> Unit 3 Structure of Matter
Atoms and Elements	4.5 days	- Describe the relationship between atomic mass, atomic number, and location on the periodic table, with chemical properties of the elements. - Structure of atoms and how atoms combine into compounds.	- Element - Atom - Periodic Table	<i>Into Science: Physical Science</i> Unit 3 Structure of Matter
Molecules and Extended Structure	5.5 days	- Develop and use models to demonstrate how atoms and elements form molecules and compounds. - Classify everyday materials as elements, compounds, or mixtures.	- Pure Substance - Chemical Bond - Molecule - Compound	<i>Into Science: Physical Science</i> Unit 3 Structure of Matter
Unit Tests/ Labs	2.5 days			<i>Into Science: Physical Science</i> Unit 3 Structure of Matter
Standards List:	MS-PS1-1, MS-PS1-4			

UNIT 2: CHEMISRY OF MATERIALS

Suggested Pacing: Semester 1, Quarter 1

Teaching Time Required: 13 days

Textbook: *Into Science* Unit 5

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Natural and Synthetic Materials	5.5 days	Collect information that supports the idea that synthetic materials come from the use of natural resources, and analyze the positive and negative effects of use and development of synthetics on society.	- Pure Substance - Natural Substance - Polymer - Synthetic Material	<i>Into Science: Physical Science</i> Unit 5 The Chemistry of Materials
The Cycle of Synthetic Materials	5 days	Recognize the role chemistry has in our everyday lives, including the production of synthetic materials from natural resources (e.g. soil and water testing, extraction of minerals, and consumer science).		<i>Into Science: Physical Science</i> Unit 5 The Chemistry of Materials
Unit Tests/ Labs	2.5 days			<i>Into Science: Physical Science</i> Unit 5 The Chemistry of Materials
Standards List:	MS-PS1-3			

UNIT 3: CHEMICAL PROCESS & EQUATIONS

Timing: Semester 1, Quarter 2

Teaching Time Required: 17.5 days

Textbook: *Into Science* Unit 4

Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Chemical Reactions	5 days	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.	- Chemical Reaction - Reactant - Product	<i>Into Science Physical Science</i> Unit 4 Chemical Process & Equations
Chemical Equations	5 days	Describe the relationship between atomic mass, atomic number, and location on the periodic table, with chemical properties of the elements.	- Chemical Formula - Chemical Equation - Law of Conservation of Matter	<i>Into Science Physical Science</i> Unit 4 Chemical Process & Equations
Thermal Energy and Chemical Processes	5 days	Apply scientific principles to design, construct, and test a device that either minimize or maximize thermal energy transfer.	Heat	<i>Into Science Physical Science</i> Unit 4 Chemical Process & Equations
Unit Tests/ Labs	2.5 days			<i>Into Science Physical Science</i> Unit 4 Chemical Process & Equations
Standards List:	MS-PS1-2, MS-PS1-5, MS-PS1-6			

UNIT 4: ENERGY				
Timing: Semester 1, Quarter 2 Teaching Time Required: 18.5 days Textbook: <i>Into Science</i> Unit 1				
Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Introduction to Energy	5 days	Identify various sources and forms of energy, and classify them as potential or kinetic.	- Energy - Potential Energy - Kinetic Energy	<i>Into Science: Physical Science</i> Unit 1: Energy
Changes in Energy	5.5 days	Investigate relationships among the amount of energy transferred, the type of matter, the mass, and the change in temperature of a sample.	- Energy Transfer - System	<i>Into Science: Physical Science</i> Unit 1: Energy
Transforming Energy	5.5 days	Apply the engineering and design process.		<i>Into Science: Physical Science</i> Unit 1: Energy
Unit Tests/ Labs	2.5 days			<i>Into Science: Physical Science</i> Unit 1: Energy
Standards List:	MS-PS3-1, MS-PS3-2, MS-PS3-5			

UNIT 5: ENERGY TRANSFERS				
Timing: Semester 2, Quarter 3 Teaching Time Required: 14.5 days Textbook: <i>Into Science</i> Unit 2				
Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Temperature and Heat	5.5 days	Examine energy transfers, conservation of energy, and identify energy that is useful vs. energy that is unavailable	- Temperature - Thermal Energy - Heat	<i>Into Science: Physical Science</i> Unit 2 Energy Transfer
Thermal Energy Transfer in Systems	6.5 days	- Differentiate between renewable and non-renewable energy resources. - Investigate how energy is produced and used, including alternative energy sources in Alaska. Evaluate the impact of energy production methods on the environment.		<i>Into Science: Physical Science</i> Unit 2 Energy Transfer
Unit Tests/ Labs	2.5 days			<i>Into Science: Physical Science</i> Unit 2 Energy Transfer
Standards List:	MS-PS3-3, MS-PS3-4			

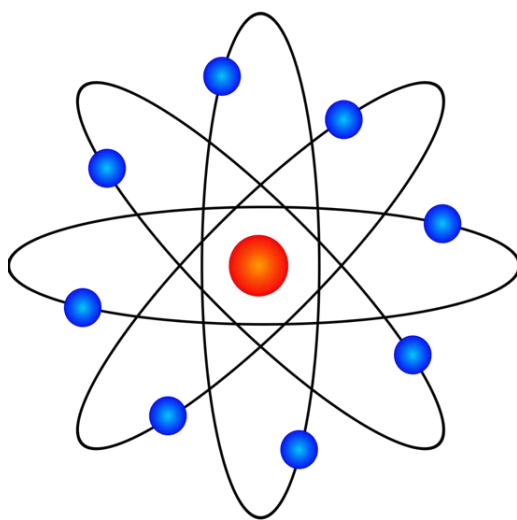
UNIT 6: FORCES & MOTION				
Timing: Semester 2, Quarter 3 Teaching Time Required: 18.5 days Textbook: <i>Into Science</i> Unit 6				
Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Introduction to Forces	5.5 days	- Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. - Conduct an investigation to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. - Investigate through experimentation and “real-life” examples the relationship among (1) force, mass, acceleration, and gravity, (2) speed, distance, time and acceleration, (3) force and friction.	- Motion - Speed - Velocity - Acceleration - Force - Gravity	<i>Into Science: Physical Science</i> Unit 6 Forces & Motion
Newton’s Laws of Motion	5.5 days	- Describe gravity as an attractive force between two objects that depends on the mass of the interacting objects. Explain how the orbital motion of planets provides evidence for this force. - Explain “real-life” examples of linear and rotational motion using Newton’s Laws of Motion.	Inertia	<i>Into Science: Physical Science</i> Unit 6 Forces & Motion
Collisions Between Objects	5 days	- Conduct an investigation to provide evidence that fields exist between objects exerting forces on each other, even though the objects are not in contact. - Describe gravity as an attractive force between two objects that depends on the mass of the interacting objects. Explain how the orbital motion of planets provides evidence for this force.		<i>Into Science: Physical Science</i> Unit 6 Forces & Motion
Unit Tests/ Labs	2.5 days			<i>Into Science: Physical Science</i> Unit 6 Forces & Motion
Standards List:	MS-PS2-1, MS-PS2-2			

UNIT 7: ELECTRIC & MAGNETIC FORCES				
Timing: Semester 2, Quarter 4 Teaching Time Required: 24.5 days Textbook: <i>Into Science</i> Unit 7				
Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
The Magnetic Force	6.5 days	Ask questions about data to determine the factors that affect the strength of magnetic forces.	- Magnet - Magnetic Force - Magnetic Domain	<i>Into Science: Physical Science</i> Unit 7 Electric & Magnetic Forces
The Electric Force	5.5 days	Ask questions about data to determine the factors that affect the strength of electric forces.	- Electric Charge - Electric Force	<i>Into Science: Physical Science</i> Unit 7 Electric & Magnetic Forces
Fields	4.5 days	Conduct an investigation to provide evidence that fields exist between objects exerting forces on each other, even though the objects are not in contact.	- Field - Gravitational Field - Magnetic Field	<i>Into Science: Physical Science</i> Unit 7 Electric & Magnetic Forces
Electromagnetism	5.5 days	Demonstrate the relationship between electricity and magnetism.	- Electric Current - Electric Field - Electromagnetism - Electromagnet - Electromagnetic Induction	<i>Into Science: Physical Science</i> Unit 7 Electric & Magnetic Forces
Unit Tests/ Labs	2.5 days			<i>Into Science: Physical Science</i> Unit 7 Electric & Magnetic Forces
Standards List:	MS-PS2-3, MS-PS2-5			

UNIT 8: WAVES & INFORMATION TRANSFER				
Timing: Semester 2, Quarter 4 Teaching Time Required: 24.5 days Textbook: <i>Into Science</i> Unit 8				
Topic	# Days	Objectives	Key Vocabulary	Resources & Materials
Introduction to Waves	6 days	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.	- Wave - Medium - Amplitude - Frequency - Wavelength	<i>Into Science: Physical Science</i> Unit 8 Waves & Information Transfer
The Behavior of Mechanical Waves	5 days	Investigate the ways that light and sound interact with matter, expanding on wavelength, color, refraction, and reflection.	- Mechanical Wave - Absorption - Transmission - Reflection - Refraction	<i>Into Science: Physical Science</i> Unit 8 Waves & Information Transfer
The Behavior of Light Waves	5.5 days	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	Electromagnetic Waves	<i>Into Science: Physical Science</i> Unit 8 Waves & Information Transfer
Information Transfer	5.5 days	Support the claim that digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	- Signal - Encoding - Analog Signal - Digital Signal - Noise	<i>Into Science: Physical Science</i> Unit 8 Waves & Information Transfer
Unit Tests/ Labs	2.5 days			<i>Into Science: Physical Science</i> Unit 8 Waves & Information Transfer
Standards List:	MS-PS4-1, MS-PS4-2, MS-PS4-3			

SCIENTIFIC PROCESS SKILLS	
Timing: All year Teaching Time Required: Varies Textbook: Embedded throughout	
Objectives	
• Ask questions, predict, observe, describe, measure, classify, make generalizations, infer, and communicate. • Plan and carry out scientific investigations of various types (such as systematic observations or experiments), identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions. • Select appropriate tools for collecting qualitative and quantitative data and record measurements (volume, mass, distance) in metric units. • Develop a model describing phenomenon. • Conduct research to learn how the local environment is used by a variety of competing interests (e.g. competition for habitat/resources, tourism, oil, mining companies, and hunting groups). • Use standard safety practices for all classroom laboratory and field investigations.	

High School Science Courses



Grades 9-12
Adopted June 4, 2024

Introduction to High School Science

The Fairbanks North Star Borough School District (FNSBSD) High School Science Curriculum is designed to be interesting and rigorous. It also provides the background required to allow every student to interpret and use the scientific information that they need to make informed decisions in daily life. Upon graduation, students will be able to pursue science and technical careers if they choose.

Following national recommendations, the FNSBSD Science Curriculum Team recommends that science education in grades K-12 be built around three major dimensions. These Next Generation Science Standards (NGSS) core ideas in disciplinary areas are:

- Scientific and Engineering Practices.
- Crosscutting concepts that unify the study of science and engineering through their common application across fields.
- Core ideas in four disciplinary areas:
 - Physical Sciences
 - Life Sciences
 - Earth & Space Sciences
 - Engineering, Technology, & Applications of Science

To support students' meaningful learning in science and engineering, all three dimensions need to be integrated into standards, curriculum, instruction, and assessment. Engineering and technology are featured alongside the natural sciences (physical sciences, life sciences, and earth and space sciences) for two critical reasons:

1. to reflect the importance of understanding the human-built world, and
2. to recognize the value of better integrating the teaching and learning of science, engineering, and technology. (A Framework for K-12 Science Education, 2012)

Science Graduation Requirements

The student must complete a total of three credits (six semesters) of high school science courses to include:

- 1.0 credits of Life Science
- 1.0 credits of Physical Science
- 1.0 credits of Science electives

Life Science Options	Physical Science Options	Science Electives
• <i>Alaska Zoology: Fish and Birds</i> • <i>Alaska Zoology: Mammals</i> • <i>AP Biology</i> • <i>AP Environmental Science (semester 1)</i> • <i>Biology or Honors Biology</i> • <i>Environmental Science (semester 1)</i> • <i>Human Anatomy and Physiology</i> • <i>Marine Science</i> • <i>Wildlife Biology</i>	• <i>AP Chemistry</i> • <i>AP Environmental Science (semester 2)</i> • <i>AP Physics 1</i> • <i>AP Physics 2</i> • <i>AP Physics C: Mechanics</i> • <i>Chemistry</i> • <i>Earth & Space Science</i> • <i>Environmental Science (semester 2)</i> • <i>Geology</i> • <i>Physical Science</i> • <i>Physics</i>	• <i>Astronomy</i> • <i>Forensic Science 1</i> • <i>Forensic Science 2</i> • <i>Introduction to Basic Pathophysiology</i> • <i>Paleontology</i> • <i>Any course from the Life Science and Physical Science lists.</i> • <i>CTE Courses:</i> ○ <i>Advanced Automotive Technology 1B (second semester)</i> ○ <i>Engineering Design and Development B</i> ○ <i>Introduction to Exercise Science and Sports Medicine 1B</i> ○ <i>Medical Terminology</i> ○ <i>Pharmacy Technician 1B</i> ○ <i>Principles of Engineering A/B</i>

Life Science Options

Advanced Placement Biology

Grade(s): 11-12 Length: two semesters Credit: 1.0 Prerequisites: Teacher recommendation or <i>Biology</i> and <i>Chemistry</i>	Course Overview: <i>AP Biology</i> is an introductory college-level biology course. Students cultivate their understanding of biology through inquiry-based investigations as they explore the following topics: evolution, cellular processes, energy and communication, genetics, information transfer, ecology, and interactions. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). Adopted Textbook: <i>Biology</i>. Glencoe/McGraw-Hill, 2017
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Advanced Placement Environmental Science (semester 1)

Grade(s): 11-12 Length: two semesters Credit: 1.0 Prerequisites: Teacher recommendation or <i>Biology</i> , and <i>Chemistry</i>	Course Overview: The <i>AP Environmental Science</i> course is designed to engage students with the scientific principles, concepts, and methodologies required to understand the interrelationships within the natural world. The course requires that students identify and analyze natural and human-made environmental problems, evaluate the relative risks associated with these problems, and examine alternative solutions for resolving or preventing them. Environmental science is interdisciplinary, embracing topics from geology, biology, environmental studies, environmental science, chemistry, and geography. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). Semester one fulfills the Life Science graduation requirement and semester two fulfills the Physical Science requirement.
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Alaska Zoology: Fish & Birds

Grade(s): 9-12 Length: one semester Credit: 0.5 Prerequisites: Teacher recommendation or <i>Biology</i>	Course Overview: <i>Alaska Zoology: Fish & Birds</i> explores major Alaskan fish and bird groups. The general anatomy, physiology, and behavioral patterns of the major fish and bird groups found in Alaska are discussed. The course also includes game laws/regulations, and environmental issues including conservation. Adopted Textbook: “Alaska Wildlife Notebook Series” on the Alaska Department of Fish & Game (ADFG) website - http://www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries
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Units (Recommended Order)
• Diversity of Organisms and Evolution - Fish • Interdependence - Fish • Local Knowledge - Fish • Diversity of Organisms and Evolution - Birds • Interdependence - Birds • Local Knowledge - Birds

UNIT 1: DIVERSITY OF ORGANISMS AND EVOLUTION - FISH	
Suggested Pacing: 5 weeks	Textbook Chapter(s)/Lessons: ADFG website
Key Objectives	Suggested Activities & Resources
Distinguish the patterns of similarity and diversity in the world of the major fish groups of Alaska.	Compare pictures of different Alaskan fish groups such as salmon, halibut, pike or trout and devise unique classification schemes.
Identify the major fish groups of Alaska including general anatomy, physiology, and behavioral patterns.	
Explain how the diversity of present species through evolution fills all available niches with organisms.	
Construct an explanation based on evidence that the process of evolution primarily results from four factors: - The potential for a species to increase in number. - The heritable genetic variation of individuals in a species due to mutation and sexual reproduction. - Competition for limited resources. - The proliferation of those organisms that are better able to survive and reproduce in the environment.	
Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	
Standards List:	LS3.A: Inheritance of Traits: HS-LS3.1; LS3.B: Variation of Traits: HS-LS3.2; HS-LS3.3; LS4.C: Adaptation: HS-LS4.2; HS-LS4.3; HS-LS4.4; HS-LS4.5

UNIT 2: INTERDEPENDENCE - FISH	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: ADFG website
Key Objectives	Suggested Activities & Resources
Know that the living environment of the major Alaskan fish groups consists of individuals, populations, and communities.	- Dissect different Alaskan fish including salmon and halibut. - Go on a field trip to Chena Landing, Ester Dome, and/or Creamer's Field. - Invite an Alaska Native elder to share in cultural relevance.
Discuss Alaska ecosystems and environmental issues and their relationship and impact on the major Alaskan fish groups.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in: - Increases in the number of individuals of some species. - The emergence of new species over time. - The extinction of other species	
Standards List:	LS4.C: Adaptation: HS-LS4.2; HS-LS4.3; HS-LS4.4; HS-LS4.5

UNIT 3: LOCAL KNOWLEDGE - FISH	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: ADFG website
Key Objectives	Suggested Activities & Resources
Read and review the laws and regulations that govern Alaska game management.	Invite a subsistence fisherman to present.
Discuss the economic impact of trapping and hunting of the major fish groups of Alaska.	
Discuss the economic impact of trapping and hunting of the major fish groups of Alaska.	
Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.	
Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	
Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	
Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	
Standards List:	LS2.C: Ecosystem Dynamics, Functioning, & Resilience: HS-LS2.6; HS-LS2.7; HS-LS2.8; LS4.D: Biodiversity & Humans: HS-LS4.4; HS-LS4.5; HS-LS4.6

UNIT 4: DIVERSITY OF ORGANISMS AND EVOLUTION - BIRDS	
Suggested Pacing: 5 weeks	Textbook Chapter(s)/Lessons: ADFG website
Key Objectives	Suggested Activities & Resources
Distinguish the patterns of similarity and diversity in the world of the major bird groups of Alaska.	Compare pictures of different Alaskan bird groups and devise unique classification schemes.
Identify the major bird groups of Alaska including general anatomy, physiology, and behavioral patterns.	
Explain how the diversity of present species through evolution fills all available niches with organisms.	
Construct an explanation based on evidence that the process of evolution primarily results from four factors: - The potential for a species to increase in number. - The heritable genetic variation of individuals in a species due to mutation and sexual reproduction. - Competition for limited resources. - The proliferation of those organisms that are better able to survive and reproduce in the environment. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	
Standards List:	LS3.A: Inheritance of Traits: HS-LS3.1; LS3.B: Variation of Traits: HS-LS3.2; HS-LS3.3; LS4.C: Adaptation: HS-LS4.2; HS-LS4.3; HS-LS4.4; HS-LS4.5

UNIT 5: INTERDEPENDENCE - BIRDS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: ADFG website
Key Objectives	Suggested Activities & Resources
Know that the living environment of the major Alaskan bird groups consists of individuals, populations, and communities.	- Go on a field trip to Chena Landing, Ester Dome, and/or Creamer's Field. - Invite an Alaska Native elder to share in cultural relevance.
Discuss Alaska ecosystems and environmental issues and their relationship and impact on the major Alaskan bird groups.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in: - Increases in the number of individuals of some species. - The emergence of new species over time. - The extinction of other species	
Standards List:	LS4.C: Adaptation: HS-LS4.2; HS-LS4.3; HS-LS4.4; HS-LS4.5

UNIT 6: LOCAL KNOWLEDGE -BIRDS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: ADFG website
Key Objectives	Suggested Activities & Resources
Read and review the laws and regulations that govern Alaska game management.	Invite a local falconer to speak.
Discuss the economic impact of trapping and hunting of the major bird groups of Alaska.	
Discuss the economic impact of trapping and hunting of the major bird groups of Alaska.	
Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.	
Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	
Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	
Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	
Standards List:	LS2.C: Ecosystem Dynamics, Functioning, & Resilience: HS-LS2.6; HS-LS2.7; HS-LS2.8; LS4.D: Biodiversity & Humans: HS-LS4.4; HS-LS4.5; HS-LS4.6

Alaska Zoology: Mammals

Grade(s): 9-12 Length: one semester Credit: 0.5 credits Prerequisites: Teacher recommendation or <i>Biology</i>	Course Overview: <i>Alaska Zoology: Mammals</i> explores major Alaskan mammal groups. The general anatomy, physiology, and behavioral patterns of the major Alaskan mammal groups are discussed. The course will also include game laws/regulations, and environmental issues including conservation. Adopted Textbook: : “Alaska Wildlife Notebook Series” on the Alaska Department of Fish & Game (ADFG) website - http://www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries
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Units (Recommended Order)
• Diversity of Organisms • Interdependence • Local Knowledge • Evolution – ongoing throughout the semester

UNIT 1: DIVERSITY OF ORGANISMS	
Suggested Pacing: 8 weeks	Textbook Chapter(s)/Lessons: ADFG website
Key Objectives	Suggested Activities & Resources
Distinguish the patterns of similarity and diversity in the world of major mammal groups of Alaska.	Compare pictures of different Alaskan mammal groups and devise a unique classification scheme.
Identify the major mammal groups of Alaska including general anatomy, physiology, and behavioral patterns.	
Explain how the diversity of present species through evolution fills all available niches with organisms.	
Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.	
Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	
Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	
Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	
Standards List:	LS2.C: Ecosystem Dynamics, Functioning, & Resilience: HS-LS2.6, HS-LS2.7, HS-LS2.8; LS3.A: Inheritance of Traits: HS-LS3.1, HS-LS3.2, HS-LS3.3; LS4.C: Adaptation: HS-LS4.2, HS-LS4.3, HS-LS4.4, HS-LS4.5, HS-LS4.6

UNIT 2: INTERDEPENDENCE	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: ADFG website
Key Objectives	Suggested Activities & Resources
Know that the environment of the major Alaskan mammal groups consists of individuals, populations, and communities. Discuss Alaska ecosystems and environmental issues and their relationship and impact on the major Alaskan mammal groups. Evaluate the evidence supporting claims that changes in environmental conditions may result in: - Increases in the number of individuals of some species. - The emergence of new species over time. - The extinction of other species.	- Dissect different Alaskan mammals. - Go on a field trip to Chena Landing, Ester Dome, or Creamer's Field. - Invite an Alaska Native elder to share the cultural relevance of Alaskan mammals.
Standards List:	LS4.C: Adaptation: HS-LS4.2, HS-LS4.3, HS-LS4.4, HS-LS4.5

UNIT 3: LOCAL KNOWLEDGE	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: ADFG website
Key Objectives	Suggested Activities & Resources
Read and review the laws and regulations that govern Alaska game management.	• Invite game wardens from U.S. Fish and Wildlife and Alaska Fish & Game speak. • Create a Student Game Guide.
Discuss the economic impact of trapping and hunting on the major mammal groups of Alaska.	
Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.	
Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	
Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	
Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	
Standards List:	LS2.C: Ecosystem Dynamics, Functioning, & Resilience: HS-LS2.6, HS-LS2.7, HS-LS2.8; LS4.D: Biodiversity & Humans: HS-LS4.6

EVOLUTION	
Suggested Pacing: Concepts covered throughout each unit when relevant.	Textbook Chapter(s)/Lessons: ADFG website
Key Objectives	Suggested Activities & Resources
Describe how species evolve over time due to recombination and mutations of genes.	• Read and discuss The Origin of Species. • Create a 3D model of an environmental barrier. • Classify different fossils based on different characteristics. • Create a poster of stratigraphic sequence showing fossil change in one species.
Know that variation in a species increases survival opportunities.	
Explain how the diversity of present species fills all available niches with organisms.	
Understand why natural selection is the scientific explanation for fossils and for molecular similarity of present species.	
Describe classifications based on evolutionary relationships.	
Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	
Make and defend a claim based on evidence that inheritable genetic variations may result from: • New genetic combinations through meiosis. • Viable errors occurring during replication. • Mutations caused by environmental factors.	
Standards List:	LS3.A: Inheritance of Traits: HS-LS3.1; LS4.B: Natural Selection: HS-LS4.2, HS-LS4.3

Biology & Honors Biology

Grade(s): 9-12 Length: two semesters Credit: 1 Prerequisites: Teacher recommendation, Freshman entry-level class	Course Overview: <i>Biology</i> is designed to meet the Life Science requirement for graduation. The academic focus is to develop student reading, writing, processing, and organizational skills. The scientific focus is to improve science vocabulary, scientific observation, inquiry, experimentation, and analysis skills. Safety skills will be stressed each semester. The first semester begins with the study of cells, cell structures and their functions, protein synthesis, genetics, and the study of heredity. Second semester will include evolution, characteristics of multicellular organisms with attention to organs and organ systems, and the diversity of organisms and ecology. Biology Honors: Students will master all of the topics from Biology listed above, with a variety of additional topics. These additional topics (content objectives) are documented within each unit in RED. Adopted Textbook: To be determined. This curriculum was written using the Illinois Phenomenon-Driven Storylines.
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Units (Recommended Order)	
Semester 1	Semester 2
Traditional Teaching Method: - Scientific Method - Ecology* - Chemistry of Life - Cytology - Genetics *This unit can be taught in the fall or spring to allow for place-based lessons. Storyline Teaching Method: - Africa Storyline - Homeostasis Storyline	Traditional Teaching Method: - Scientific Method - Biotechnology - Evolution - Ecology* *This unit can be taught in the fall or spring to allow for place-based lessons. Storyline Teaching Method: - Homeostasis Storyline - Melanin Storyline - Disease Storyline

SCIENTIFIC METHOD	
Suggested Pacing: Intermixed through other units	Textbook Chapter(s)/Lessons: Africa Storyline and Homeostasis Storyline
Key Objectives	Suggested Activities & Resources
- Design experiments that require asking questions, developing hypotheses, collecting data, interpreting data, and developing conclusions. - Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	- Macromolecules in Food Lab - Ocean Acidification Lab - Elephant Poop Lab
- Use graphical techniques to describe data. - Use mathematical and/or computational representations of phenomena or design solutions to support explanations. - Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. - Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	- Labs that incorporate quantitative data - Examples: Pendulum Lab, Zookeeper Nutrition Lab, Elephants Population Lab, Calculating Evolution Lab
- Critically review current literature about scientific topics. - Practice formulating logical conclusions. - Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. - Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Practice writing Claim Evidence Reasoning (CER) reports
Standards List:	GLEs: S.A.1-, Developing and Using Models, Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions, Using Mathematics and Computational Thinking, Engaging in Argument from Evidence, Asking Questions and Defining Problems, Analyzing and Interpreting Data, Obtaining, Evaluating, and Communicating Information

UNIT 1 or 6: ECOLOGY	
This unit can be taught in the fall or spring to allow for place-based lessons.	
Suggested Pacing: 4-6 weeks	Textbook Chapter(s)/Lessons: Africa Storyline , Homeostasis Storyline , and Melanin Storyline
Key Objectives	Suggested Activities & Resources
• Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem (e.g., carbon, energy, water). • Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. • Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.	• Model ecosystem energy transfers. • Make posters of food webs/chains from local habitats. • Describe specific ways in which indigenous people use local species. • Individual research projects on local plants and animal species. • Arctic Ecosystems Lab • Africa Storyline, Homeostasis Storyline, and Melanin Storyline
• Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales, specifically in Alaskan ecosystems. • Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. • Describe symbiotic interactions between organisms in a community.	• What Happened to the Otters Lab • Carrying Capacity Lab • Africa Storyline, Homeostasis Storyline, and Melanin Storyline
• Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. • Use food webs of local plant and animal species that show ecological relationships • 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. • evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	• Use web-based data to graph the extent of sea ice in the Arctic Ocean since 1970. • Explore the causes of that change and its consequences on the organisms of the Arctic. • Invasive plant studies. • Discussions of current ecological issues. • Ocean Acidification Lab • Africa Storyline, Homeostasis Storyline, and Melanin Storyline
Standards List:	HS-LS2: Ecosystems: Interactions, Energy, and Dynamics , LS2.A: Interdependent Relationships in Ecosystems, LS2.B: Cycles of Matter and Energy Transfer in Ecosystems, LS2.C: Ecosystem Dynamics, Functioning, and Resilience, HS-LS4: Biological Evolution: Unity and Diversity , LS4.D: Biodiversity and Humans, GLEs: SC.2-3

UNIT 2: CHEMISTRY OF LIFE	
Suggested Pacing: 4-6 weeks	Textbook Chapter(s)/Lessons: Africa Storyline and Homeostasis Storyline
Key Objectives	Suggested Activities & Resources
Describe and model the basic atomic structure.	- PhET Digital Lab on Atoms Elements & Compounds - Animal Digestion Lab
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.	- Flow chart-type drawings of cellular respiration. - Cellular Respiration Lab - Africa Storyline and Homeostasis Storyline
Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	- Flow chart-type drawings of photosynthesis. - Understanding Photosynthesis Activity - Africa Storyline and Homeostasis Storyline

UNIT 3: CYTOLOGY	
Suggested Pacing: 4-6 weeks	Textbook Chapter(s)/Lessons: Africa Storyline , Homeostasis Storyline , and Melanin Storyline
Key Objectives	Suggested Activities & Resources
Describe cell organelles and their functions. Systems of specialized cells within organisms help them perform the essential functions of life.	- Models of plant and animal cells. - Microscope skills labs including wet mounts of plant and animal cells and cell drawings. Africa Storyline, Homeostasis Storyline, Melanin Storyline
Describe diffusion and osmosis and the importance of these processes for cells.	- Predictions and tests of the behavior of cells in salt solutions and distilled water. 3D molecular models of diffusion and osmosis. - Computer animations of diffusion and osmosis. - Student-built models of DNA. - Labs examining the diffusion of materials into different sized objects. - Ocean Acidification Lab Africa Storyline, Homeostasis Storyline, Melanin Storyline
- Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. - Describe the process of cell division and its role in reproduction and multicellular organisms (mitosis and meiosis).	- Use a cell model to work through all the steps of mitosis and meiosis. Africa Storyline, Homeostasis Storyline, Melanin Storyline
Standards List:	HS-LS1: From Molecules to Organisms: Structures and Processes, LS1.A: Structure and Function, LS1.B: Growth and Development of Organisms

UNIT 4: GENETICS AND HEREDITY	
Suggested Pacing: 3-5 weeks	Textbook Chapter(s)/Lessons: Africa Storyline , Melanin Storyline , and Disease Storyline
Key Objectives	Suggested Activities & Resources
- Recognize that cells use DNA to store information and manage cellular functions. - Describe the role of chromosomes in sex determination.	- Student-built models of DNA. - Africa Storyline, Melanin Storyline, and Disease Storyline
- Make and defend a claim based on evidence that inheritable genetic variations may result from: (a) new genetic combinations through meiosis, (b) viable errors occurring during replication, and/or (c) mutations caused by environmental factors. - Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	- Human traits activity. - Punnett squares activity. - Lulu the Lioness Lab - Albinism & Pedigrees Lab - Africa Storyline, Melanin Storyline, and Disease Storyline
- 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. - Explain how cell functions are regulated through changes in protein activity. - Model and interpret basic Mendelian patterns of genetics using Punnett squares, and non-Mendelian patterns (e.g., incomplete, codominance, sex-linked traits).	- Melanin Lab - Central Dogma of Biology Activity - Africa Storyline, Melanin Storyline, and Disease Storyline
Standards List:	HS-LS1: From Molecules to Organisms: Structures and Processes, HS-LS3: Heredity: Inheritance and Variation of Traits , LS3.A: Inheritance of Traits, LS3.B: Variation of Traits, GLEs: SC.1-2

UNIT 5: BIOTECHNOLOGY	
Suggested Pacing: 4-6 weeks	Textbook Chapter(s)/Lessons: Africa Storyline , Melanin Storyline , and Disease Storyline
Key Objectives	Suggested Activities & Resources
- Recognize that cells use DNA to store information and manage cellular functions. - 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.	- Restriction Enzyme Lab - Strawberry Electrophoresis - CRISPR Activity - Africa Storyline, Melanin Storyline, and Disease Storyline
Critically review current literature about scientific topics.	- Research project on current advances in biotechnology - Bioethics Research - Africa Storyline, Melanin Storyline, and Disease Storyline
Standards List:	Engaging in Argument from Evidence, Asking Questions and Defining Problems, Analyzing and Interpreting Data, Obtaining, Evaluating, and Communicating Information, HS-LS1: From Molecules to Organisms: Structures and Processes, LS4.D: Biodiversity and Humans

UNIT 6: EVOLUTION	
Suggested Pacing: 6-8 weeks	Textbook Chapter(s)/Lessons: Africa Storyline , Homeostasis Storyline , Melanin Storyline , and Disease Storyline
Key Objectives	Suggested Activities & Resources
- Utilize tools to categorize organisms (i.e., taxonomic keys, cladograms). - Describe the characteristics of domains and kingdoms of organisms. - Within each kingdom, describe how the anatomical characteristics can affect an organism's survival. - Explain the relationship between structure and function in major phyla. - Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. - Describe classification based on evolutionary relationships.	- UC Berkeley Evolution website: http://evolution.berkeley.edu. - Natural selection simulations. - Build a bird. - Africa Storyline, Homeostasis Storyline, Melanin Storyline, and Disease Storyline
- Describe the changes that have occurred over geologic time. - Chronicle the development of evolutionary theory by natural selection. - Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence (homologous structures, embryology, DNA, adaptive radiation, fossil record). - Construct an explanation based on evidence for how natural selection leads to adaptation of populations. - Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) the change in allele frequency within the population, (2) the emergence of new species over time, and (3) the extinction of other species. - Explain how variation within a species and natural selection could result in speciation or extinction. - Create or revise a simulation to test a solution to mitigate adverse impacts on human activity on biodiversity.	- Fossil building simulations. - Interpretation of fossil exercises. - Geological Time activities - Elephant Forensics Lab - Africa Storyline, Homeostasis Storyline, Melanin Storyline, and Disease Storyline
- Explain how the diversity of life has arisen through evolutionary processes. - Describe how variation within species is maintained over time through recombination and mutations of genes. - Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. - Construct an explanation based on evidence 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.	- Peppered Moth activity. - Rock Pocket Mice activity. (HHMI) - Toothpick Fish. - What Happened to the Elephants Lab - Melanin Lab - Evidence for Skin Selection Lab - Africa Storyline, Homeostasis Storyline, Melanin Storyline, and Disease Storyline
Standards List:	HS-LS4: Biological Evolution: Unity and Diversity, LS4.A Evidence of Common Ancestry and Diversity, LS4.B: Natural Selection, LS4.C: Adaptation, LS4.D: Biodiversity and Humans, HS-LS1: From Molecules to Organisms: Structures and Processes, LS1.A: Structure and Function, GLEs: S.A.1; SC.1-2; SG.1-3

Environmental Science 1A/1B

Grade(s): 9-11 Length: two semesters Credit: 1 (0.5 life science credit and 0.5 physical science credit) Prerequisites: Teacher recommendation	Course Overview: Students in this course explore systems and the ways in which human systems affect and are affected by environmental systems. Students approach environmental issues by understanding ecological components and human perspectives. Students address bias and misunderstandings to develop their own opinions about environmental issues. This course focuses on climate change, natural resources, pollution, and energy, and uses all fields of sciences to help students form educated opinions and solutions based on evidence about current and future environmental problems facing society. Semester one (1A) fulfills the Life Science graduation requirement and semester(1B) two fulfills the Physical Science requirement. Adopted Textbook: To be determined (Used to develop this curriculum: <i>Environmental Science</i>. National Geographic, 2022)
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Units (Recommended Order)	
Semester 1 (1A)	Semester 2 (1B)
• Introduction to Environmental Science • Ecology • Biodiversity • Human Populations	• Systems in Environmental Science • Climate Science • Natural Resources • Pollution and Waste Management • Concepts of Energy

UNIT 1: INTRODUCTION TO ENVIRONMENTAL SCIENCE	
Suggested Pacing: 4-5 weeks	Textbook Chapter(s)/Lessons: Chapters 1 and 18
Key Objectives	Suggested Activities & Resources
• Explain What Science Is & the focus of Environmental Science • Describe The Process Of Science • Describe the major roles of the scientific community the process of science	• Oasis Earth: Planet in Peril (free textbook)
• Describe the recent trends human population and resource consumption	
• Explain the relationship between economics and the environment • Describe ways that economics are working towards sustainability • Explain the purpose of environmental policy	
Standards List:	GLEs: S.A.1- , Asking Questions and Defining Problems, Obtaining, Evaluating and Communicating Information, LS2.A: Interdependent Relationships in Ecosystems

UNIT 2: ECOLOGY	
Suggested Pacing: 4-5 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
• Describe the different levels of organization studied by ecologists • Explain the difference between biotic and abiotic factors • Explain how limiting factors and biotic potential affect population growth	• Case Study: Caribou Conservation Conundrum • Case Study: Mystery in Alaska • Case Study: The Moose, The Wolf, and the Fir Tree • ESRI Geoinquiries • Treehugger
• Compare and contrast predation, parasitism, and herbivory • Describe mutualism and commensalism • Explain the difference between a producer and a consumer	
• Explain what a biogeochemical cycle is and recognize that nutrients cycle through the environment endlessly • Summarize the roles of producers and consumers in carbon cycle Including chemical formulas for photosynthesis and cellular respiration	
Standards List:	GLEs: S.A.1- , Developing and Using Models, Planning and Carrying Out Investigations, Analyzing and Interpreting Data, LS2.A: Interdependent Relationships in Ecosystems, LS2.B: Cycles of Matter and Energy Transfer in Ecosystems, LS2.C: Ecosystem Dynamics, Functioning and Resilience

UNIT 3: BIODIVERSITY	
Suggested Pacing: 4-5 weeks	Textbook Chapter(s)/Lessons: Chapters 4, 5, 6, 7, and 8
Key Objectives	Suggested Activities & Resources
• Explain how biomes are characterized • Describe how net primary production varies among biomes • Describe the four primary mechanisms of biological evolution	• HHMI Biointeractive Biome Viewer • HHMI Biointeractive short film “From Ants to Grizzlies: A General Rule for Saving Biodiversity” • HHMI Biointeractive: “Mystery of the Missing Tusks” • Case Study: Complexity in Conservation • ESRI Geoinquiries
• Describe how speciation and extinction affect the diversity life on Earth • Differentiate the components of biodiversity • Explain two ways in which biodiversity varies across groups or geography • Describe how biodiversity is monitored and explain current biodiversity trends	
• List the major causes of biodiversity loss • Explain legal actions nations can take to protect biodiversity • Explain the conditions necessary for a species to become invasive	
Standards List:	GLEs: S.A.1- , Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions, Engaging in Argument from Evidence, LS4.B: Natural Selection, LS4.C: Adaptation, LS4.D: Biodiversity and Humans, ESS3.C: Human Impacts on Earth Systems, ETS1.B: Developing Possible Solutions

UNIT 4: HUMAN POPULATIONS	
Suggested Pacing: 4-5 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
- Describe how technological advances have contributed to human population growth - Explain recent trends in population growth - Describe total fertility rates and replacement fertility - Explain how the age structure and sex ratio of a population define its potential for growth	ESRI Geoinquiries
- Identify characteristics of human population that are studied by demographers - Describe the demographic transition - Discuss social factors that affect population - List the types of environmental health hazards	
- Describe how humans impact their environments - Compare and contrast epidemiology and toxicology - Discuss risk assessment - Describe how infectious diseases spread - Explain why emerging diseases are important to monitor and control - Differentiate between social hazards that are lifestyle choices and those that cannot be controlled	
Standards List:	GLEs: S.A.1- , Using Mathematics and Computational Thinking, Constructing Explanation and Designing Solutions, LS2.A: Interdependent Relationships in Ecosystems, LS2.C: Ecosystem Dynamics, Functioning and Resilience, ESS3.A: Natural Resources

UNIT 5: PHYSICAL SYSTEMS IN ENVIRONMENTAL SCIENCE	
Suggested Pacing: 4-5 weeks	Textbook Chapter(s)/Lessons: Chapter 3
Key Objectives	Suggested Activities & Resources
- State the definition of an environmental system and give examples - Explain that the geosphere, biosphere, atmosphere, and hydrosphere are defined according to their functions Earth's systems - Explain the importance of the cycling of nutrients, both macro and micro to all life on Earth	- Selected chapters and data-based activities from the “Earth Exploration Toolbook” - HHMI Biointeractive: “Understanding Global Change” Interactive
- Identify the layers of the atmosphere in the correct order - Explain how the ozone layer protects us from harmful ultraviolet radiation	
Connect plate tectonics to environmental science concepts such as biogeochemical cycles, volcanoes and air pollution, geothermal energy, earthquakes, and risk assessment	
Standards List:	GLEs: S.A.1- , Developing and Using Models, Using Mathematics and Computational Thinking, LS2.B: Cycles of Matter and Energy Transfer in Ecosystems, LS2.C: Ecosystem Dynamics, Functioning and Resilience, ESS2.A: Earth's Materials and Systems, ESS2.B: Plate Tectonics and Large Scale System Interactions

UNIT 6: CLIMATE SCIENCE	
Suggested Pacing: 4-5 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
- Distinguish between weather and climate and list the factors that affect them - Use conduction, convection, and radiation to explain how heat is transferred in the environment - Explain the reason for the seasons	- Selected chapters and data-based activities from the “Earth Exploration Toolbook” - HHMI BioInteractive lesson: “Trends in Atmospheric Carbon Dioxide” - PBS Lab: “Seasons on Earth” - Earth Labs: “Greenhouse Gas Lab” - Data Nuggets lab on tree ring analysis: “A Window Into a Tree’s World” - SPRINTT Climate Change Curriculum - Project Learning Tree Unit: “Southeastern Forests and Climate Change” - Documentary Film Cosmos Episode 12: “The World Set Free”
- Identify greenhouse gasses and their sources - Explain how scientists study changes in climate - Describe the evidence indicating that global warming has been caused largely by the increase in greenhouse in the atmosphere	
- Describe how global climate change is affecting aspects of human life such farming, forestry, the economy, living space, health, and biodiversity - List ways of reducing the production of greenhouse gasses and explain why this is important	
Standards List:	GLEs: S.A.1- Planning and Carrying Out Investigations, Asking Questions and Defining Problems, Analyzing and Interpreting Data, ESS2.D: Weather and Climate, ESS3.D: Global Climate Change

UNIT 7: NATURAL RESOURCES	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons: Chapters 11, 12, and 13
Key Objectives	Suggested Activities & Resources
• Explain why agricultural lands can lose productivity over time as nutrients are consumed and what are current soil conservation methods • Describe human practices that may lead to soil erosion and techniques that can mitigate it	• Selected chapters and data-based activities from the “Earth Exploration Toolbook” • <i>Alaska Resource Education Curriculum</i>: “The Story of Alaska’s Mineral and Energy Resources” • Virtual Tour of Copper Mine • Project Wet Activities - see website to access guides and resources • Documentary Film: The Last Mountain • Case Study: The Poopin Composting • CaseStudy: “The Wealth of Water”
• Describe the most common methods of mining and their environmental consequences • Describe how different minerals are formed and are cycled through the Earth • Identify mineral resources available in Alaska and how their mining affects humans and the environment, including mining regulations	
• Identify how water is used in society and how water use affects ecosystems.(agricultural, industrial, residential, recreational) • Explain what a watershed is and give an example local to Fairbanks • Identify the distribution of water on Earth. (surface, groundwater, icecaps, ocean)	
Standards List:	GLEs: S.A.1- Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions, ESS3.A: Natural Resources, ESS2.E: Biogeology, ESS3.C: Human Impacts on Earth Systems

UNIT 8: POLLUTION AND WASTE MANAGEMENT	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons: Chapters 9, 10, 16, and 17
Key Objectives	Suggested Activities & Resources
- Describe different types of water pollution, its sources and treatment - Describe different types of air pollution caused by human activity and natural processes, its sources and treatment - List different ways environmental policies have reduced pollution in the US and globally	- Selected chapters and data-based activities from the “Earth Exploration Toolbook” - Air Actions Curriculum (background reading, labs, video labs on air quality)
- Describe the conventional methods of waste disposal; landfills, incinerators and recycling - Discuss the importance of waste reduction and what we as consumers can do about it (the 3 R's reduce, reuse, recycle)	
Discuss hazardous waste, identify common everyday items that are hazardous waste and associated problems with its disposal. (e-waste, cfl's, batteries etc.)	
Standards List:	GLEs: S.A.1- Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions, ESS2.C: The Roles of Water in Earth's Surface Processes, ESS3.A: Natural Resources, ESS3.C: Human Impacts on Earth Systems

UNIT 9: CONCEPTS OF ENERGY	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons: Chapter 2
Key Objectives	Suggested Activities & Resources
- Describe the different forms of energy and how they can be harnessed for human use - Describe how although energy cannot be created or destroyed it can be converted to less useful forms such as thermal energy in the environment	- Email Renewable Energy Alaska Project (REAP) at education@realaska.org to request a guest speaker to lead an energy activity using Kill-A-Watt Meters “Renewable Energy Atlas of Alaska” - information about renewable energy resources in Alaska - Documentary Movie: Who Killed the Electric Car <i>National Energy Education Development (NEED)</i> project curriculum guides - Case Study: “A Green Light for CFLs?”
- Make connections between types of renewable and nonrenewable energy and the sun as the initial source energy - Identify the pros and cons of using fossil fuels and other nonrenewable sources of energy - Describe types of fossil fuels used, how they have formed, and are extracted	
- Describe alternative energy resources and how they may be harnessed and used - Identify the pros and cons of using different renewable resources (solar, wind, hydro, geothermal)	
Standards List:	GLEs: S.A.1- Engaging in Argument from Evidence, Obtaining, Evaluating, and Communicating Information, PS3.A: Definitions of Energy, PS3.B: Conservation of Energy and Energy Transfer, ESS3.A: Natural Resources, ESS3.C: Human Impacts on Earth Systems, ESS3.D: Global Climate Change

Human Anatomy & Physiology

Grade(s): 11-12 Length: two semester Credit: 1 Prerequisites: Teacher recommendation or <i>Biology</i>	Course Overview: <i>Human Anatomy & Physiology</i> is a course that advanced students will learn about the major organ systems of the human body and how they work together to sustain life and maintain health. Academic skills will focus on independent reading and analysis. Content focus will be on the relationship between the structure (anatomy) of organs and organ systems and the functions (physiology) of those systems. Students will have the opportunity to study how healthy life choices can help to enhance the functioning of those systems; they will also be introduced to the many careers available in the modern health care system. Adopted Textbook: <i>Body Structures and Functions</i>. National Geographic/Cengage, 2022.
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Units (Recommended Order)	
Semester 1	Semester 2
• Basis of Anatomy and Physiology • Integumentary System • Skeletal System • Muscular System • Nervous System *Components of the Endocrine system will be studies as appropriate to other systems (i.e pituitary gland with the nervous system).	• Circulatory and Respiratory Systems – Macro: Lungs, Heart, and Vessels • Circulatory Systems – Micro: Cells, Proteins, Lymph, and Immunity • Digestive System • Renal System • Reproductive System *Components of the Endocrine system will be studies as appropriate to other systems (i.e. pancreas with the digestive system).

UNIT 1: BASIS OF ANATOMY AND PHYSIOLOGY	
Suggested Pacing: 4-5 weeks	Textbook Chapter(s)/Lessons: Chapters 2, 3, 4 and 5.
Key Objectives	Suggested Activities & Resources
Identify and discuss the different branches of anatomy and the eleven body systems.	• View and discuss Deadly Ascent; a Nova film about the challenges of high altitude. • Make drawings/watercolors examples of the four tissue types. • Dissect celery using anatomical terms. • View Thai Cave Rescue to apply homeostasis. • Lab simulation “Homeostasis” to maintain homeostasis of model.
Learn basic anatomical vocabulary including directional planes, directional terms, and body cavities.	
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.	
Describe the structure and function of the major types of cells.	
Describe levels of organization in the human body.	
Define the function and location of tissues.	
Explain the structure of an atom, an element, and a compound.	
Describe the four main groups of organic compounds: carbohydrates, fats, proteins, and nucleic acids.	
Explain the difference between an acid, a base, and salt and the acid-base balance.	
Demonstrate understanding of homeostasis and how it is maintained by the body.	
Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	
Standards List:	LS1.A: Structure & Function: HS-LS1.1, HS-LS1.3, HS-LS3.1

UNIT 2: INTEGUMENTARY SYSTEM	
Suggested Pacing: 3-4 weeks	Textbook Chapter(s)/Lessons: Chapter 6
Key Objectives	Suggested Activities & Resources
Describe the functions of the skin.	• Lab: Microscopic examination of the skin • Tissue box model of the skin • Exploration of why tattoos are permanent • Biology of skin color (HHMI) • Wound lab • Medical highlights – hazards of the sun
Describe the structures found in the three skin layers.	
Explain how the skin serves as a channel of excretion.	
Understand the physiology of skin color	
Describe common skin (cancer), hair, and nail disorders. Describe wounds to the skin and how the skin heals, including scarring.	
Standards List:	LS1.A: Structure & Function: HS-LS1.1, HS-LS1.2, HS-LS1.3, HS-LS3.1

UNIT 3: SKELETAL SYSTEM	
Suggested Pacing: 4-5 weeks	Textbook Chapter(s)/Lessons: Chapter 7
Key Objectives	Suggested Activities & Resources
Identify the main functions of the skeletal system.	• Label a life size skeleton, or assemble bones into a skeleton. • Bone strength lab.
Explain how bones can grow in length and diameter over the lifetime of the person.	• Identify bone fractures in X-rays, labeling affected bones and type of fractures.
Name and locate the bones of the skeleton, including the types of joints.	• Demonstrate joint types through active pictures
Be familiar with some disorders caused by malfunctions within this system (i.e. osteoporosis).	
Give examples of how the skeletal system maintains homeostasis by controlling the level of calcium in the blood.	• Bone calcium and parathyroid POGIL
Standards List:	LS3.B: Variation of Traits: HS-LS3.2, HS-LS3.3

UNIT 4: MUSCULAR SYSTEM	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons: Chapter 8
Key Objectives	Suggested Activities & Resources
Identify the three types of muscle cells and their functional differences.	• Invite a physical therapist to demonstrate the skills required for successful therapy. • Identify muscular systems and how they control movement. • Draw and label muscles on a life-sized model. • Muscle contraction POGIL • Clay build of muscles. • Muscle art – label and name muscles of famous statues. • Dissect a chicken wing to view muscles, ligaments, and tendons. • Discuss body dysmorphia – Project Hope
Explain the molecular mechanism for muscular contraction through the sliding filament theory.	
Describe systems of opposing muscle, including how muscles attach to bones and function to make joints work.	
List the major groups of skeletal muscles.	
Become familiar with the scientific literature regarding various performance enhancing drugs used by athletes. Demonstrate an understanding of the acute and chronic effects, and the special risks of anabolic steroids in teens.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	LS1.A: Structure & Function: HS-LS1.1, HS-LS1.2, HS-LS3.1

UNIT 5: NERVOUS SYSTEM	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons: Chapters 9, 10, and 12.
Key Objectives	Suggested Activities & Resources
Explain the role of nervous system in coordinating the functions of the whole organism.	• Class visit from community experts on steroid abuse and traumatic brain injuries. • Labs testing the sensory neurons of skin, reaction times, blind spots, color blindness, etc. • Visit from pathologist with brain tissue. • Dissect a cow's eye. • Clay build of the brain and spinal cord, including innervation of a muscle. • Drug addiction nerve pathways. • View "Human the World Within- React or Senses."
Explain how a nervous impulse travels through an action potential, including neurotransmitters.	
Describe the major parts of the brain and their functions.	
Explain the role of sensory organs.	
Explain how muscles are innervated through the peripheral nervous system.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	LS1.A: Structure & Function: HS-LS1.1, HS-LS1.2, HS-LS1.3, HS-LS3.1

UNIT 6: CIRCULATORY AND RESPIRATORY SYSTEMS – MACRO: LUNGS, HEART AND VESSELS	
Suggested Pacing: 3-4 weeks	Textbook Chapter(s)/Lessons: Chapters 13, 14, 15, and 18.
Key Objectives	Suggested Activities & Resources
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.	• Examine and draw a pig heart. • Learn to measure blood pressure. Examine the effects of exercise on pulse and blood pressure. • Coloring models of the four-chambered heart. • Dissect the major arteries and veins of the fetal pig. Look at the fetal circulation through the umbilical cord. • Life size sketch with major vessels drawn and labeled. • Clay build of heart and lungs • Stop motion video of how blood moves through heart, to lungs, back to heart and out to body • Build a model of the lungs in a plastic bottle, simulate pressure required to inflate lungs
Explain the role of alveoli oxygenating blood.	
Give examples of how negative feedback loops in the circulatory system maintain homeostasis.	
Give examples of how positive feedback loops decrease homeostatic stability.	
Label the major vessels of the body.	
Explain the structure of the heart and how its form follows its function.	
Describe the structure of the body's vessels.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	LS1.C: Organization for Matter and Energy Flow in Organisms: HS-LS1.6, HS-LS1.7

UNIT 7: CIRCULATORY SYSTEMS – MICRO: CELLS, PROTEINS, LYMPH, AND IMMUNITY	
Suggested Pacing 4-5 weeks	Textbook Chapter(s)/Lessons: Chapters 4 and 16
Key Objectives	Suggested Activities & Resources
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.	• Blood type testing with a school nurse or simulated blood typing. • Use Punnett Squares to determine the genetics of blood typing. • Immune system comic.
Describe the role of hemoglobin in oxygenating tissues.	
Describe the ABO and RH proteins on red blood cells and the genetics.	
Describe the cellular makeup of blood.	
Describe the function of each of the blood cells. Differentiate between red and white blood cells.	
List the different types of white blood cells and explain how they function in immunity.	
Describe immunity and the defense mechanisms of the body.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	LS1.C: Organization for Matter and Energy Flow in Organisms: HS-LS1.6, HS-LS1.7

UNIT 8: DIGESTIVE SYSTEM	
Suggested Pacing: 3-4 weeks	Textbook Chapter(s)/Lessons: Chapters 19 and 20.
Key Objectives	Suggested Activities & Resources
List the functions of the digestive system.	• Measure the calories in various easily burned foods. • Use Biuret solution, Benedicts solution and iodine to test various foods. • Dissect the digestive system of a fetal pig. • Class visit from diabetes prevention specialist. • Digestion in a bag. • Build a model of the digestive system to size, using craft material like yarn. • Clay build of the digestive system and accessory organs. • Blue frosting lab.
Name and describe the functions of the organs of the digestive tract and accessory organs.	
Describe metabolism. Recognize that food is chemical energy that is measured in calories.	
List the major types of nutrients, where they are absorbed, and how they are used by the body.	
Understand the production and excretion of feces in the microbiome of the gut.	
Explain the role of insulin in metabolism and the effects of diabetes.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	LS1.A: Structure & Function: HS-LS1.1, HS-LS1.2, HS-LS1.3, HS-LS3.1

UNIT 9: RENAL SYSTEM	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons: Chapter 21
Key Objectives	Suggested Activities & Resources
Explain the function of the urinary system.	• Urinalysis lab • Dissect a pig kidney. • Draw or model the functional unit of the kidney - the nephron. • Trace blood flow into, through, and out of the kidney.
Describe the structure and function of the organs in the urinary system.	
Explain how kidneys regulate water balance and remove nitrogenous wastes from the blood.	
Understand how the urinary system and circulatory system work together to clean the blood and create urine.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	LS1.A: Structure & Function: HS-LS1.1, HS-LS1.2, HS-LS1.3, HS-LS3.1

UNIT 10: REPRODUCTIVE SYSTEM	
Suggested Pacing: 3-4 weeks	Textbook Chapter(s)/Lessons: Chapter 22
Key Objectives	Suggested Activities & Resources
Describe the organs and glands of the male and female reproductive systems.	• Finish dissecting the reproductive system of the fetal pig. • Invite medical professionals to show students how to suture their pigs closed. • Invite medical professionals to talk to students about anabolic steroids. • Lab: Birth Control. • View “The 9 Months that Made You” (PBS) • Clay build of the reproductive systems • Public Health
Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	
List the major hormones of the male and female reproductive system.	
Explain the relative effects of estrogen and progesterone during the female menstrual cycle.	
Explain the importance of the placenta to healthy prenatal development.	
Explain why a fetus is particularly vulnerable to damage by drugs, alcohol, or environmental contaminants.	
Describe the trimesters of pregnancy and the fetal development that is occurring during each one.	
Describe the structure of the lactating breast. Summarize the process of lactation. Explain how the composition of breast milk changes during the first days of lactation and in the course of a single feeding.	
Be familiar with some disorders caused by malfunctions within this system.	
Standards List:	HS-LS1: Growth & Development of Organisms: HS-LS1.4

Marine Science

Grade(s): 10-12 Length: one semester Credit: 0.5 Prerequisites: Teacher recommendation or <i>Biology</i>	Course Overview: <i>Marine Science</i> explores the adaptation of marine organisms, ecological concepts, and physical processes that structure the marine environment. The course is a study of the environmental impacts of chemistry, geology, and other abiotic conditions and the organisms that live in marine environments. The course also examines human interactions with marine ecosystems and the many careers associated with it. Special attention will be given to students' knowledge of Alaska's marine environment, its importance to indigenous people, local economies, food production, and career possibilities. Adopted Textbook: New textbook to be determined. <i>Introduction to Marine Biology</i>. Brooks Cole/ Cengage, 2010.
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Units (Recommended Order)
Semester 1
• Physical and Chemical Oceanography • Organisms and Their Effects on Ecosystems • Biochemical Cycles • Interdependence Between Organisms • Evolution of Marine Species • Marine Sciences and Culture

UNIT 1: PHYSICAL AND CHEMICAL OCEANOGRAPHY	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons: TBD
Key Objectives	Suggested Activities & Resources
Use the properties of water, salinity, and temperature to explain water stratification.	• Use a 10-gallon aquarium to demonstrate the effects of different densities and temperatures on stratification. • Label and color code a world map with sea/ocean names and locations of currents. • Read The Perfect Storm and use it for small group discussions of weather patterns and environmental impacts of the fishing industry. • Explain the impact of atmospheric CO2 on ocean acidification.
Describe and explain periodic variations in the marine ecosystem such as tides, currents, and seasons.	
Explain how the surface of the Earth changes through plate tectonics, earthquakes, volcanoes, erosion, and deposition.	
Give examples of interactions between marine and terrestrial ecosystems.	
Describe how weather is affected by the oceans.	
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.	
Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	
Standards List:	ESS2.A: Earth Materials & Systems: HS-ESS2.1, HS-ESS2.2, ESS2.B: Plate Tectonics & Large-Scale System Interactions: HS-ESS2.3, ESS2.C: The Roles of Water in Earth's Surface Processes: HS-ESS2.5

UNIT 2: ORGANISMS AND THEIR EFFECTS ON ECOSYSTEMS	
Suggested Pacing: 6 weeks	Textbook Chapter(s)/Lessons: TBD
Key Objectives	Suggested Activities & Resources
Describe the major abiotic and biotic characteristics of the important ecological zones within the marine biome.	• Build a bulletin board showing benthic habitats. • Use the characteristics of preserved invertebrates to develop a classification system. • Student reports on the major phyla. • Discussions of the abiotic challenges of various marine habitats and the physiological and behavioral responses of organisms.
Describe how biochemical and anatomical characteristics define an organism's anatomy and physiology, its behavior, survival and reproductive capabilities.	
Explain how taxonomy is used to describe the diversity of phyla and classes.	
List the characteristics of major chordate and invertebrate phyla that allow them to survive in a marine environment.	
Compare environmental characteristics and the adaptations organisms have to adapt and survive.	
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.	
Standards List:	LS2.A: Interdependent Relationships in Ecosystems: HS-LS2.1, HS-LS2.2, LS2.C: Ecosystem Dynamics, Functioning, & Resilience: HS-LS2.6

UNIT 3: BIOCHEMICAL CYCLES	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: TBD
Key Objectives	Suggested Activities & Resources
Describe the transfer of energy through marine ecosystems.	• Draw models of energy flow. • Diagram the carbon, nitrogen, and phosphorous cycles.
Describe the cycling of matter through marine ecosystems.	
Provide examples of how cycles of matter and energy link living organisms and their environment.	
Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.	
Standards List:	LS2.4: Interdependent Relationships in Ecosystems: HS-LS2.1, HS-LS2.2, LS2.B: Cycles of Matter & Energy Transfer in Ecosystems: HS-LS2.4

UNIT 4: INTERDEPENDENCE BETWEEN ORGANISMS	
Suggested Pacing: 6 weeks	Textbook Chapter(s)/Lessons: TBD
Key Objectives	Suggested Activities & Resources
Give examples of the interdependence between marine organisms and their environment.	• Draw food webs of local marine plant and animal species. • Use individual student reports to explore the characteristics of predator/prey, symbiotic, and herbivorous organism interactions.
Describe the levels of organization in marine ecosystems from the individuals to populations and communities.	
Describe theories that explain patterns of diversity from the equator to the poles.	
Standards List:	LS2.D: Social Interactions & Group Behavior: HS-LS2.8; LS4.C: Adaptation: HS-LS4.5, HS-LS4.6; LS4.D: Biodiversity & Humans: HS-LS2.7

UNIT 5: EVOLUTION OF MARINE SPECIES	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: TBD
Key Objectives	Suggested Activities & Resources
Explain how variation in the environment provides the mechanisms for natural selection, evolution, and diversity of species.	Do a report on one of the extinct sea species from the Cambrian.
Give examples of how the natural variation in individuals allows species to survive in changing environments.	
Describe the evidence scientists use to link the evolutionary history of organisms and their classification.	
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in:	
Increases in the number of individuals of some species.	
The emergence of new species over time.	
The extinction of other species.	
Standards List:	LS4.D: Biodiversity & Humans: HS-LS2.7, HS-LS4.6; LS4.A: Evidence of Common Ancestry & Diversity: HS-LS4.1; LS4.C: Adaptation: HS-LS4.4, HS-LS4.5

UNIT 6: MARINE SCIENCES AND CULTURE	
Suggested Pacing: Ongoing throughout the course.	Textbook Chapter(s)/Lessons: TBD
Key Objectives	Suggested Activities & Resources
Recognize the importance of marine systems to society.	• Research career possibilities in the field of marine biology. • Describe the fisheries of the North Pacific.
Describe how indigenous people use local marine organisms.	
Give examples of how humans can alter ecosystems.	
Explain why it is important for citizens to be knowledgeable on current issues and policies of natural resource use.	
Give examples of specific examples of Alaskan marine use issues.	
Describe human dependence upon the marine environment, concentrating on Alaskan uses.	
List and describe marine careers.	
Give examples of how humans can alter the structures of ecosystems.	
Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	
Standards List:	LS4.D: Biodiversity & Humans: HS-LS2.7, HS-LS.4-6

Wildlife Biology

Grade(s): 9-12 Length: two semesters Credit: 1 Prerequisites: None	Course Overview: <i>Wildlife Biology</i> is focused on teaching key biological concepts through the study of Alaska wildlife. Through a placed-based lens, students who take this class will learn how to connect local, indigenous, and scientific knowledge together. Adopted Textbook: TBD
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Units (Recommended Order)	
Semester 1	Semester 2
• Studying Wildlife • Ecology • Evolution of Alaska Life • Wildlife Nutrition • Single Celled Life of Alaska: ○ Bacteria ○ Protist • Viruses and Biotechnology	• Simple Multicellular Life in Alaska • Complex Multicellular Life of Alaska: ○ Plants ○ Fungi • Complex Multicellular Life of Alaska ○ Invertebrates ○ Vertebrates • Wildlife Management and Human Impact

UNIT 1: STUDYING WILDLIFE	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Show the methods of studying wildlife in Alaska from remote tracking, tagging, sample collection, and other methods.	Create or gather models that students can use to collect data for study of organisms & populations.
Look at the research of AK wildlife to show how we study organisms as individuals in order to look at the health of the whole population.	Do an activity to show how different forms of tracking wildlife are developed and used to inform scientists and policy makers.
Use current wildlife studies to show how & why key Alaska organisms are being studied for the longevity of life in AK.	Read through recent wildlife research to show how research drives conservation.
Look into the importance of wildlife conservation and study.	Look at past event in human history to show the importance of study & conservation (e.g. whale).
Standards List:	GLEs: S.A.1-3, HS LS 1-4, PS 1.1

UNIT 2: ECOLOGY	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	Create an activity to show how biogeochemical cycles work to connect the biosphere with all the other spheres on Earth.
Describe symbiotic interactions between organisms in a community.	Any symbiotic interaction activity to show students how the interaction between different organisms work.
Show how a community of organisms are built with the interactions of populations of organisms.	Build food chains and webs to illustrate the unique connection between AK wildlife & their environment.
Look at the ecosystems of Alaska & how they are made up of a unique collections of both physical & biological elements.	Play an ecosystem game to explain the interconnectedness of the physical and biological world.
Standards List:	HS PS3.3-4, HS LS2.1-4, HS LS4.1-6, HS PS1.1

UNIT 3: EVOLUTION OF ALASKA LIFE	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	Use a variety of activities to show the evidence of evolution such as the homologous structure coloring or the fossil building or the various natural selection simulations online (pHet or Biointeractive).
Describe the mechanisms that drive the evolutionary process and how it has driven the wide diversity of AK life.	Simulation online to show the mechanisms and can be linked back to AK animals during to Pleistocene.
Explain how the diversity of AK life has arisen through geological & evolutionary processes.	
Explain how variation within a species and natural selection could result in speciation or extinction.	Create a speciation activity to show how different speciation events can happen and link them to past and current events in AK history.
Standards List:	HS LS3.1-3, HS LS4.1-6

UNIT 4: WILDLIFE NUTRITION	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Show the importance of micro & macro nutrients to biological life by using the student own needs as a reference.	Use online nutrient calculators to figure out the needs of each kid and connect it to their current eating habits.
Build a model organism to calculate how much and what they need to eat to survive.	Design an activity to show an organisms need for nutrients and how much they would need.
Use a model to explain the process of cellular respiration & how organism release energy from the breaking of chemical bonds.	Any Cellular respiration activity found online could work.
Standards List:	HS LS1, HS PS1, HS PS3

UNIT 5: SINGLE CELLED LIFE OF ALASKA - BACTERIA	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Explain the structure and function of the cell membrane and cell wall.	Bubblelicious membrane lab or any activity teaching how the cell membrane works.
Describe diffusion and osmosis and the importance of these processes for cells.	Gummy bear osmosis or orbeez osmosis/diffusion labs.
Show the importance of bacteria to all life in AK.	Look at the bacteria in mammal guts (ruminants &/or humans) and how many organisms cannot live without a healthy amount bacteria.
Explain how antibiotics work and how growing resistance is a large concern to the human population.	Run through a game or simulation explaining how antibiotics work & how bacteria can grow resistance to them.
Standards List:	HS PS3, HS LS1.1-7, HS LS3.1

UNIT 6: SINGLE CELLED LIFE OF ALASKA - PROTISTS	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Describe the structure & functional differences to bacteria to introduce eukaryotes.	Build models of protists with organelles to describe their structure and function and differences to bacteria.
Explain the difference between prokaryotes & eukaryotes.	Compare the structure and function of bacteria and protists.
Show the importance of protists to other life in AK, and how protists are a crucial part of many food webs and produce 50% of the Earth's oxygen.	Numerous Algae labs online as well as algae growth activities.
Show the structure and function of cell organelles in eukaryotes.	Cell analogy activity to help understand the structure and function of cell organelles in Eukaryotes.
Standards List:	HS PS 3, HS LS 1.1-7, HS LS 3.1

UNIT 7: VIRUSES AND BIOTECHNOLOGY	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Show how viruses are not living organisms but how they affect organisms.	Research viral diseases in AK life.
Describe the structure and function of viruses.	Build virus models and show how they spread.
Look into how humans are using virus in a number of ways from gene editing to new gen antibiotics.	Use CRISPR labs to see gene editing in action.
Standards List:	HS LS1; HS LS 4; ETS 1.2; HS PS 1; HS ESS 3

UNIT 8: SIMPLE MULTICELLULAR LIFE OF ALASKA	
Suggested Pacing: 1-2 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Utilize tools to categorize organisms (i.e., taxonomic keys, cladograms).	Build a Cladogram using multicellular organisms.
Describe the characteristics of domains and kingdoms of organisms.	
Explain the way cell communication works.	
Show how multicellular life is built of a large interconnected relationship between single cells communicating.	Tissue lab or build models of tissue and how they communicate.
Standards List:	HS LS3.1-3, HS LS4.1-6, HS LS2.1-4, HS PS3, ETS1.2

UNIT 9: COMPLEX MULTICELLULAR LIFE OF ALASKA - PLANTS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	Any photosynthesis lab or activity building the macromolecules crucial to life.
Explain the structure and function of plants, and how/why they are the foundation of most terrestrial food webs.	Study the different plants native to Alaska.
Look at how plants have been used by the indigenous peoples and organisms of Alaska for food, shelter, etc.	Gather samples of AK plants to make stuff with, or maybe even bring in a guest speaker to talk about how groups of people use different plants of AK.
Standards List:	HS LS3.1-3, HS LS4.1-6, HS LS2.1-4, HS PS3, ETS1.2

UNIT 10: COMPLEX MULTICELLULAR LIFE IN ALASKA - FUNGI	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Use models or samples to show the structure and function of fungi and the mycelial network they form in an area.	Mushroom dissection. Mycelial network communication articles.
Explain the importance of fungi as decomposers.	Decompose bread, fruit, or veggies using fungi in a sealed bag.
Show how mycorrhizal fungi are a crucial part of the boreal forest.	Dissect the roots of spruce trees to see the mycorrhizal fungi growing into and around the roots.
Standards List:	HS LS3.1-3, HS LS4.1-6, HS LS2.1-4, HS PS3, ETS1.2

UNIT 11: COMPLEX MULTICELLULAR LIFE OF ALASKA - INVERTEBRATES	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Explain the relationship between structure and function of invertebrate.	Build or dissect invertebrates (build models with air dry clay).
Show the importance of many invertebrates to plant life in AK, and where they fit in the AK food web.	Simulate pollination by insects and how they are crucial to the reproduction of plants.
Identify the major invertebrate groups of Alaska, including general anatomy.	Compare the various invertebrate groups of Alaska through samples or pictures.
Look at the importance of invertebrate to human life in Alaska both for needed sustenance and economic value.	Poll the class on how many students know of or themselves rely on invertebrate. Research the nutritional &/or economic value of AK invertebrates (crab fishing, etc.).
Standards List:	HS LS3.1-3, HS LS4.1-6, HS LS2.1-4, HS PS3, ETS1.2

UNIT 12: COMPLEX MULTICELLULAR LIFE OF ALASKA - VERTEBRATES	
Suggested Pacing: 5-7 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Explain the relationship between structure and function of vertebrate.	Build or dissect vertebrates (build models with air dry clay).
Show the interconnectedness of many vertebrates and where they fit in the various AK ecosystems.	
Identify the major vertebrate groups of Alaska, including general anatomy, physiology, and behavioral patterns.	Compare the various vertebrate groups of Alaska through samples or pictures.
Look at the importance of vertebrates to human life in Alaska, both needed sustenance & economic value.	Poll the class on how many students know of or themselves rely on invertebrate. Research the nutritional &/or economic value of AK invertebrates (crab fishing, etc.).
Standards List:	HS LS3.1-3, HS LS4.1-6, HS LS2.1-4, HS PS3, ETS1.2

UNIT 13: WILDLIFE MANAGEMENT AND HUMAN IMPACT	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Look into mass extinctions to see the effect of rapid changes in an ecosystem on wildlife.	Research mass extinctions.
Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	Human impact project (kids choose a way humans impact wildlife and research possible solutions).
Show how sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.	Biodiversity lab showing the impact of changes in ecosystems.
Study local wildlife management laws and why they are important to maintaining Alaska's biodiversity.	Read over hunting & fishing regulations and discuss their importance to the longevity of AK wildlife.
Standards List:	HS ESS3.1-3, HS PS3.3-4, HS LS2.1-4, HS LS4.1-6, ETS1.2

Physical Science Options

Advanced Placement Chemistry

Grade(s): 11-12 Length: two semesters Credit: 1.0 Prerequisites: Teacher recommendation	Course Overview: The <i>AP Chemistry</i> course provides students with a college-level foundation to support future advanced coursework in chemistry. Students cultivate their understanding of chemistry through inquiry-based investigations, as they explore content such as: atomic structure, intermolecular forces and bonding, chemical reactions, kinetics, thermodynamics, and equilibrium. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). Adopted Textbook: <i>Chemistry: A Molecular Approach</i> . Savvas/Pearson, 2023
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Advanced Placement Environmental Science (semester 2)

Grade(s): 11-12 Length: two semesters Credit: 1.0 Prerequisites: Teacher recommendation, <i>Biology</i>, and <i>Chemistry</i>	Course Overview: The <i>AP Environmental Science</i> course is designed to engage students with the scientific principles, concepts, and methodologies required to understand the interrelationships within the natural world. The course requires that students identify and analyze natural and human-made environmental problems, evaluate the relative risks associated with these problems, and examine alternative solutions for resolving or preventing them. Environmental science is interdisciplinary, embracing topics from geology, biology, environmental studies, environmental science, chemistry, and geography. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). Semester one fulfills the Life Science graduation requirement and semester two fulfills the Physical Science requirement.
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Advanced Placement Physics 1

Grade(s): 11-12 Length: two semesters Credit: 1.0 Prerequisites: Teacher recommendation	Course Overview: <i>AP Physics 1</i> is an algebra-based, introductory college-level physics course. Students cultivate their understanding of physics through inquiry-based investigations as they explore these topics: kinematics, dynamics, circular motion and gravitation, energy, momentum, simple harmonic motion, torque and rotational motion, electric charge and electric force, DC circuits, and mechanical waves and sound. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). Adopted Textbook: <i>Cutnell & Johnson Physics</i> . HMH/Wiley, 2018
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Advanced Placement Physics 2

Grade(s): 11-12 Length: two semesters Credit: 1.0 Prerequisites: Teacher recommendation	Course Overview: <i>AP Physics 2</i> is an algebra-based, introductory college-level physics course. Students cultivate their understanding of physics through inquiry-based investigations as they explore these topics: fluids; thermodynamics; electrical force, field, and potential; electric circuits; magnetism and electromagnetic induction; geometric and physical optics; and quantum, atomic, and nuclear physics. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). Adopted Textbook: <i>Cutnell & Johnson Physics</i>. HMH/Wiley, 2018
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Advanced Placement Physics C: Mechanics

Grade(s): 11-12 Length: two semesters Credit: 1.0 Prerequisites: <i>Calculus</i> (May be concurrently enrolled.)	Course Overview: <i>AP Physics C: Mechanics</i> is a calculus-based, college-level physics course. It covers Kinematics, Newton's laws of motion, work, energy, and power, systems of particles and linear Momentum, circular motion and rotation, oscillations, and gravitation. Please visit the College Board-AP Central website for more information (http://apcentral.collegeboard.com). Adopted Textbook: <i>Physics for Scientist and Engineers</i>. Cengage, 2019
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Chemistry

Grade(s): 10-12 Length: two semesters Credit: 1.0 Prerequisites: Teacher recommendation or <i>Algebra 1</i>	Course Overview: <i>Chemistry</i> is an introductory, general chemistry course that builds a foundation for college-level chemistry, physics, and biology courses. Students learn about chemical reactions and the structure of matter in order to explain how and why substances react the way they do. Laboratory work and laboratory reporting are an integral part of the course, helping students develop an understanding of the concepts as well as the process of science. Adopted Textbook: <i>Glencoe Chemistry: Matter and Change</i> . McGraw-Hill, 2016.
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Units (Recommended Order)	
Semester 1	Semester 2
• Changes and Interactions of Matter • Structure of Matter • Ionic Bonding	• Covalent Bonding • Stoichiometry and Chemical Reactions • Gases • Acids and Bases If time allows, explore the following topics: • Polymers, plastics, and hydrocarbons • Electrochemistry

SCIENTIFIC PRACTICE AND DESIGN	
Suggested Pacing: These principles should be present throughout all units of study.	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Recognize SI units of measurements.	• Flinn Safety Contract and Test. • Lab safety classroom scavenger hunt. • Make a poster of conversion tips/significant digit rules. • Lab: Density of Unknown Metal (slope of the line mass vs. volume gives density). • Lab: Measurement. • Lab: Equipment Identification.
Convert data into scientific notation and from one unit to another.	
Round numbers correctly based on the certainty of the measurement.	
Use and create graphs to represent data.	
Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	
Use mathematical representations of phenomena to support claims.	
Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	
Use a model to predict the relationships between systems or between components of a system.	
Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	
Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	
Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.	
Standards List:	PS1.A: Structure and Properties of Matter: HS-PS1.1, HS-PS1.3; PS1B: Chemical Reactions: HS-PS1.2, HS-PS1.5, HS-PS1.6

UNIT 1: CHANGES AND INTERACTIONS OF MATTER	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: Chapter 3
Key Objectives	Suggested Activities & Resources
Describe the changes and interactions that result in observable changes in the properties of matter including chemical, physical, and nuclear changes such as radioactive decay.	• Lab: Separation of a Mixture. • Lab: Chemical and Physical Changes. • Demo: Electrolysis of Water.
Explain the Law of Conservation of Mass as it relates to chemical and physical changes.	
Distinguish between endothermic and exothermic reactions.	
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.	
Standards List:	PS1.B: Chemical Reactions: HS-PS1.2, HS-PS1.4, HS-PS1.5, HS-PS1.6, HS-PS1.7; PS1.C: Nuclear Processes: HS-PS1.8

UNIT 2: STRUCTURE AND MATTER	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: Chapters 4 and 5.
Key Objectives	Suggested Activities & Resources
Draw or build models describing the nature of molecules, atoms, and subatomic particles.	• Lab: Isotope (pennies/Runts candy). • Periodic chart poster (trends and grouping). • Lab/Observations: Atomic Emission Spectra. • Lab: Reactivity of the Alkaline Earth Metals. • Design and construct atom model (element includes p orbitals).
Describe how the current model of the atom is related to the structure and behavior of matter.	
Explain the relationship between nuclear stability and radioactivity.	
Compare wave and particle models of light.	
Express the arrangements of electrons in atoms using orbital notation.	
Relate the group and periodic trends (periodic table) to the electron configuration of atoms.	
Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	
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.	
Standards List:	PS1.A: Structure and Properties of Matter: HS-PS1.1, HS-PS1.2, HS-PS1.4; PS1.C: Nuclear Processes: HS-PS1.8

UNIT 3: IONIC BONDING	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: Chapters 7
Key Objectives	Suggested Activities & Resources
Define and describe chemical bonding; differentiating between ionic, covalent, and metallic bonding.	• Lab: Formation of an Ionic Compound. • Lewis Structures. • Demo: Formation of NaCl. • Demo: Polarity of Liquids.
Describe how ions form.	
Use and understand the current model of an atom to predict the formulas of simple ionic and covalent compounds.	
Write the names and formulas of simple ionic and covalent compounds.	
Determine shapes/geometry of molecules.	
Compare and contrast polar and nonpolar molecules.	
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.	
Standards List:	PS1.A: Structure and Properties of Matter: HS-PS1.3

UNIT 4: COVALENT BONDING	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons: Chapter 8.
Key Objectives	Suggested Activities & Resources
Define and describe chemical bonding; differentiating between ionic, covalent, and metallic bonding.	• Lab: Modeling Covalent Compounds Using Computer-based Models. • Lewis Structures. • Demo: Formation of NaCl. • Demo: Polarity of Liquids.
Describe how ions form.	
Use and understand the current model of an atom to predict the formulas of simple ionic and covalent compounds.	
Write the names and formulas of simple ionic and covalent compounds.	
Determine shapes/geometry of molecules.	
Compare and contrast polar and nonpolar molecules.	
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.	
Standards List:	PS1.A: Structure and Properties of Matter: HS-PS1.3

UNIT 5: STOICHIOMETRY AND CHEMICAL REACTIONS	
Suggested Pacing: 4weeks	Textbook Chapter(s)/Lessons: Chapters 10 and 11
Key Objectives	Suggested Activities & Resources
Balance chemical equations.	• Mole poster. • Lab: Empirical Formula of Magnesium Oxide. • Lab: Formula of a Hydrate. • Lab: Formation of a Precipitate/% Yield. • Statistical Analysis: Mean, Median, Mode. • PhET Online Lab: Balancing Equations https://phet.colorado.edu.
Translate written descriptions of chemical reactions into chemical equations.	
Classify and identify chemical reactions.	
Convert among moles, mass, and number of particles.	
Calculate empirical and molecular formulas for compounds and determine formulas for hydrates.	
Solve stoichiometry problems.	
Solve limiting reactant problems.	
Determine the percent yield of a chemical reaction.	
Solve reaction stoichiometry problems.	
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.	
Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.	
Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	
Standards List:	PS1.B: Chemical Reactions: HS-PS1.2, HS-PS1.4, HS-PS1.5, HS-PS1.6, HS-PS1.7

UNIT 6: GASSES	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons: Chapter 12, section 1 and chapter 13.
Key Objectives	Suggested Activities & Resources
Use the kinetic molecular theory to explain physical properties of solids, liquids, and gasses.	PhET Gas Law Online Lab: https://phet.colorado.edu
Describe the role of energy in phase changes.	
Use gas laws to calculate how pressure, temperature, volume and number of moles change.	
Apply gas laws and Avogadro's principle to chemical equations.	
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.	
Standards List:	PS1.B: Chemical Reactions: HS-PS1.4, HS-PS1.5

UNIT 7: ACIDS AND BASES	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons: Chapter 18
Key Objectives	Suggested Activities & Resources
Compare acids and bases and understand why strengths vary.	- Lab: Titration of Vinegar. - PhET Online Lab: PH https://phet.colorado.edu
Calculate pH and pOH of aqueous solutions.	
Standards List:	PS1.A: Structure and Properties of Matter: HS-PS1.3; PS1.B: Chemical Reactions: HS-PS1.6

Earth & Space Science

Grade(s): 9-12 Length: two semesters Credit: 1 Prerequisites: None	Course Overview: <i>Earth & Space Science</i> is often broken down into five major areas of specialization: geology, astronomy, meteorology, oceanography and environmental science. Geology is the study of the Earth's surface and below. It includes minerals, rocks, the Earth's crust and interior, and the processes that change them. Astronomy is the study of everything beyond Earth's atmosphere. This includes the Earth & moon system, the solar system, the stars, galaxies, galaxy clusters, and the universe. Meteorology is the study of Earth's atmosphere and the weather. Oceanography is the study of the 70% of Earth covered in seawater and its interactions with the rest of the Earth. Environmental science adds life to the mix, and combines all the other categories and how they support life on this planet; so environmental science is "cross disciplinary." Given Alaska's high latitude and seasons, geology in the fall before the cold, dark and heavy snow allows for fieldtrips to examine rock outcrops at road cuts, visit mining operations, etc. Astronomy in mid-winter, when it is dark, lets classes go outside and use telescopes. Weather and oceanography in spring can mean clouds will have more variety. One can vary the order, however. If hurricanes and tornadoes are in the news in the fall, some of the weather and ocean material can be slipped in early to make the class relevant to what is happening in the news. The actual units can be studied in full detail later and teachers can refer back. Adopted Textbook: <i>Earth Science: Geology, the Environment, and the Universe</i>. Glencoe/ McGraw-Hill, 2017
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Units (Recommended Order)	
Semester 1	Semester 2
• Introduction to Earth and Space Science • Composition of the Earth • Surface Processes (Optional) • Resources and Our Environment (Optional) • Dynamic Earth	• Beyond the Earth • Earth's Atmosphere, Weather, and Climate • Earth's Oceans and the Marine Environment • Geologic Time

INTRODUCTION TO EARTH AND SPACE SCIENCE	
Suggested Pacing: 10 days	Textbook Chapter(s)/Lessons:
Since science is a process, as well as a body of knowledge, this course is taught through lab activities and experiences as well as book work. The NGSS grounding phenomenon / driving questions (storyline) teaching process is different from the traditional teaching. A poor music analogy is teaching Jazz instead of Classical music. “Helping Students Make Sense of the World: Using Next Generation Science & Engineering Practices” (NSTA Press 2017) explains the new methods.	
Key Objectives	Suggested Activities & Resources
• Demonstrate understanding of how Earth is a complex system of interacting subsystems of Rock, Water, Air and Life by engaging in argument from evidence. • Explain the importance of technology in the study of Earth Science. Exploring these requires lab activities maps to visually organize the information, remote sensing and geographic information systems (computer software that puts all the information into visual overlays that can be displayed on the maps as needed) • Design experiments that require asking questions, developing hypotheses, collecting data, interpreting data, and developing conclusions. • Demonstrate appropriate laboratory procedures and use of safety equipment in the science classroom. • Develop, revise, test and then use models to describe phenomena and design systems. • See the appendix for a detailed explanation of Earth Systems. • Use lines of latitude and longitude, and other common map features, to navigate a global map. • See the appendix for a detailed explanation of Map Latitude and Longitude. • Describe and utilize different types of maps of the Earth and their digital equivalents. • See the appendix for a detailed explanation of Map Types and Overlays. • Explain how satellites and sonar are used to collect data and map Earth’s surface. Students will be able to describe the difference between GPS and GIS and how each works. • See the appendix for a detailed explanation of GPS and GIS Systems.	• Two Teaching Styles may be implemented depending on circumstances:: ○ Student Driven: Grounding Phenomenon/ Driving Questions/ Students’ Sense Making (Storyline for short) According to the NGSS guidelines is more engaging and effective for student retention. It is also more work for the teacher and takes more time. Our textbook is not set up for this. ○ See “Teacher Handbook for NextGen Science Storylines, v1.1.” (NextGen Science Storylines, 2019) ○ Teacher Driven: Teacher introduces & leads the discussion. It is the traditional way of teaching science. Follow the suggested lessons in the Teacher Handbook and use labs, activities and the internet software that came with the textbook. These lessons are well thought out, but not as effective as Student Driven. If a teacher has to prepare for classes on three or four different subjects or a teacher is running out of time to finish a unit; this is an option. • Module 1: Introduction: Grounding Phenomenon: The Earth (1.0 days) ○ Observe “Image of Earth” (pages 4-5) or show “One Year in Earth’s Life” video (KUAC PBS) ○ Asking Driving Questions: ▪ After introductions and class rules, syllabus, etc, explain the difference between closed and open ended questions. ▪ Each group submits three to five of their best open-ended questions about the Earth (e.g. inside, outside, beyond). Help students turn any one word answer question into open-ended.

	▪ As a class, sort the best twenty five or so questions into four or five categories. Store the categorized twenty five questions into Google. ▪ Jamboard - put the sticky notes on a classroom bulletin board. ▪ As you go through the unit, you will revisit the list. • Lab safety (1.5 days): Flinn Lab Safety Review & contract for parents & students to sign. (OR families read pages 904-905 in textbook and use the safety contract at “Student Earth and Environmental Science Laboratory Safety Agreement” (Carolina Biological Supply Company, 2016). • Students draw individual lab safety maps of the classroom showing exits, fire extinguisher, fire blanket, emergency eye wash, emergency shower, phone with emergency #'s posted (1.5 days). • Internet Resources: Assign the students the <i>Brain Pop</i> Science Lab Safety video; it works like <i>Ed Puzzle</i>. The students stop and answer questions to be able to proceed. It is entertaining and accurate. • Example of Earth Systems Interacting: (4.0 days) ○ Textbook: read pp. 6-9 ○ Internet Resources: Show these two video clips: ▪ Earth Systems (2 NASA video clips 5 and 5.5 minutes linked) (0.5 days) ▪ “Real World: Earth System Video” (Chose 9-12) (KUAC PBS) ○ (Teachers can make ed puzzle quizzes from all videos for easier formative testing & grade entry if desired.) • Investigation 1, Interacting parts of the Earth System. (3.5 days) ○ Show 1st video clip “Changing Hunting at Barrow (Utqiagvik)” ○ “Arctic Climate Perspective Rural Alaska Seeing Changes” (KUAC PBS) • Class discussion about what systems are interacting making this a problem. Groups record their ideas and save for the next part. ○ Work through the “What’s a feedback loop and Daisy world” interactive activity. ○ “Daisy World Interactive Models Feedback Loops” (KUAC PBS) • Individuals write their final essay on notebook paper and keep it for the next discussion.
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	• In light of the “feedback loop activity,” class discusses and comes to consensus on what is making it harder to hunt whales in the arctic in spring. • When there is a class model for what is causing changes in the spring hunt, students write a first draft of their claim as to what causes it, followed by supporting evidence and the reasons showing why the evidence supports the claim. • Students work in teams to help each other be sure they are using complete sentences and that the grammar and spelling are correct. Now make a second draft using conjunctions “because, but, and so” to expand and clarify the reasoning. Present these second drafts to class either on whiteboards or projected on a slide. Classmates make positive editing suggestions to each presenter so that the corrections can be made while the presentation is happening. Then each perfected final product is checked off by the teacher for a grade. • Wrap it Up. Summarize the evidence you gathered from your investigations around the phenomenon and research on the questions. What conclusions did you reach about the best model for what is happening? State your conclusion as a Claim. Explain how your evidence supports your claim. Be sure to write in complete sentences. • Big Idea 3: “Earth Systems Interact” (YouTube, AGIeducation) • Understanding Maps: (2.0 days) ○ Textbook: Read pp. 28-30 ○ View Internet Resources: ○ Map Projections: How to Make the Surface of a Ball Flat. It's Hard! – “Why all World Maps are Wrong” (YouTube Vox) ○ Topographic Maps: ▪ “What is a contour map?” ▪ “Calculating the Gradient of a Slope from a Topographic Map” (YouTube, Mike Sammartano) ▪ “Constructing a Profile from a Topographic Map” (YouTube, Mike Sammartano) • Latitude and Longitude coordinates on Earth; Text pp. 30-33 • Do a quick globe activity. Give students globes of the Earth and help them find the equator, north & south poles, and the prime meridian. Explain how the coordinates work. Next, read off some coordinates of places on Earth & help students find them. Then, ask students to find places on the globe that interest them, point to the
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	spot and figure out the latitude and longitude, and share it with the class. Finally do a formative assessment based on what they have learned. Make copies of the worksheet from the text and have the students use the attached map to complete it. • From teacher resources in the textbook Chapter 2, Section 1, Teaching visual 4: The map and question worksheet. Students can work together or individually to locate positions on the map given coordinates and then give the coordinates for cities listed. • Textbook p. 48-49. Complete the Geo lab from the map in the book. Answer all the questions in complete sentences and draw your profile carefully. You may use graph paper if you wish. Turn both the answers and the profile in when you are finished. • Wrap it Up. Summarize the evidence you gathered from your investigations around the phenomenon and research on the questions. What conclusions did you reach about the best model for what is happening? State your conclusion as a Claim. Explain how your evidence supports your claim. Be sure to write in complete sentences. • Remote sensing & GIS: (1.0 days) ○ Textbook: Read pp. 41-47 ○ Internet Resources ▪ “How GPS Works” (YouTube, Seeker) ▪ “What is a GIS” (YouTube, Esri Ireland) • National Geographic Lesson for Earth Science. “Introduction to GIS” (National Geographic Society). This prepackaged lesson gives directions, objectives, preparation, background, and vocabulary. • Example: <i>Alaska Department of Fish & Game</i> Example: GIS for Hunter's AK Fish & Game - Make your own Hunting Map App. Put a check in overlays that say: Special areas, subunits, and Alaska towns. In the top right corner, click the little squares to see six different base maps you can put at the bottom. Explore everything and see what happens. Exit ticket: Make a story about creating a GIS map for friends from out of town visiting where you live. Tell what overlays you would give them and why. Draw a picture of what it might look like with all the overlays in place. Make a claim about how this technology might change people’s lives, support your claim with evidence from your life, and explain the reasons that the evidence supports your claim.
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	• Data sources for further research if desired: ○ Fairbanks North Star Borough website: “Get FNSB GIS Data” ○ USGS National Map USA GIS website: “GIS Data Download” ○ Fun Option - Video Game Version of GIS: Alaska Delta Junction Map Tour Game Explained: “MAP UPDATED The Best All-Around Map Yet?” (YouTube, Mighty Mike Farms - Alaska Delta Junction Map Tour, Farming Simulator 19). ○ Before GPS: Russian Alaska Map 1775 (University of Washington Library) • Wrap it Up. Summarize what you learned about geographic information systems while doing the National Geographic modeling a GIS system activity. Make suggestions about how to improve the lab. Be sure to write in complete sentences.
Standards List:	HS-ESS2-2, HS-ESS3-2, HS-ESS3-1

UNIT 1: COMPOSITION OF THE EARTH	
Suggested Pacing: 26 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
▪ Use the atomic model and the periodic table to predict the properties of different minerals elements and compounds. ▪ Design experiments to test the predictions they made and communicate their results using different formats (written, verbal, or multimedia) in the CER (Claim Evidence Reasoning) form. ▪ Demonstrate understanding of mixtures to explain some properties of rocks (which are mixtures of minerals in solid form) ▪ See the appendix for a detailed explanation of Matter and its Changes.	• Module 2: Matter & Change: (8 days) ○ Grounding Phenomenon: How did these crystals get so big? ○ Show this video: Video Showing the Giant Crystals in Spain (YouTube - from BBC Travel Article) ○ (The source article is from <i>BBC Travel</i>: “The World's Largest Crystal Cave” - BBC Travel Article) • Asking Driving Questions (1 Days): ○ Students in small groups ask questions about the Pulpi Geode while watching the video at their own tables, and put them on sticky notes. ○ Each group submits three to five of their best open-ended questions. As a class, sort the best questions into five categories. Put the categorized twenty five questions into Google jamboard or on sticky notes bulletin board. As you go through the unit, revisit the list. • Matter & The Periodic Table of Elements: ○ Text: pp. 60-65

	○ Internet Resources: Structure of Atoms Interactive Lesson (ChemThink) ● Combining Matter: ○ Chemical Bonding Text pp. 66-70 ○ Internet Resources: ▪ Ionic Bonding Interactive Lesson (ChemThink) ▪ Covalent Bonding Interactive Lesson (ChemThink) ○ Brain Pop (set to 7&8 grade quiz) ○ Chemical Bonds with quiz ○ Metallic Bonding Video: “What are Metallic Bonds, Properties of Matter, Chemistry, FuseSchool” (YouTube – Fuse School) ● Wrap it up: Consider the following images ○ Salt spilled on table: Salt Crystals on Table ○ Salt Diagram: Salt Crystals Atomic Diagram ○ Copper Being Hammered: Artist Hammering Copper ○ Copper Diagram: Copper Metal Atomic Diagram ● In table groups, discuss how you would use the models you have learned about chemical bonding to explain why copper gets dented when hit with a hammer, but salt shatters. When your table comes to consensus on the explanation, share it with the class. When the class reaches consensus on the best way to write it (short and to the point, but leaving nothing out), copy it on half a sheet of paper and turn it in as an exit ticket. ● Mixing ○ Text pp. 71-72 ○ Internet Resources: ▪ “What Is An Atom And How Do We Know?” (YouTube – Stated Clearly) ▪ Bond Breaker Game Classroom Edition (Be The Proton!) ▪ “Mixtures” (YouTube – BioEd Online) ● States (phases) of matter: solid, liquid, gas, plasma ○ Text pp. 73-75 ○ Internet resources: ▪ “Bill Nye The Science Guy Phases of Matter” (YouTube – Scott Thrope) ▪ Granite: Pink Feldspar White Quartz and Black Hornblende Crystals in Granite ▪ Spoonful of Mayonnaise ▪ Example Caesar Salad
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	▪ Water in Dead Sea Near Palestine • Smokey Air: Canadian Wildfire Smoke in New York City Image • Wrap it up: In table groups, sort the images, identify solid, liquid, or gas mixtures, and tell if they are homogeneous or heterogeneous. Explain the reasons you chose that, citing evidence from the pictures. You may not all agree on some of them; that is fine as long as your reasoning from the evidence makes sense. Write up your final idea and turn it in as an exit ticket.
▪ Describe the properties of minerals and mineral groups. ▪ Identify common minerals based on scientific observations and tests. ▪ See the appendix for a detailed explanation of Minerals and their Properties.	• Module 3: Minerals: (6 Days) • Grounding Phenomenon: Pulpi Geode (1.0Day) • As a class, read the 400 word article, in <i>BBC Travel</i>, on the abandoned silver mine in Pulpi, Spain. • “The World's Largest Crystal Cave” – (<i>BBC Travel</i>). Discuss the pictures. Keep this in mind as you go through the lessons coming up. At the end of the unit, decide if the crystals in the cave count as minerals and why. • What is a mineral (2 days) ○ Watch Brain Pop Movie “Crystals” ○ Textbook Read p. 86-89 and p. 96-101 • Identify the types of minerals (3 days) ○ Watch Brain Pop Movie “Mineral Identification” ○ Textbook Read p. 90-95 • Moho’s Hardness scale: “Mohs Hardness Scale - Science Educational Video for Elementary Students” (<i>YouTube</i> – Bow Tie Guy and Wife) • Mineral properties: “Identifying Minerals” (<i>YouTube</i> – Earth Rocks!) • Wrap it up - Identify minerals using various properties. If available, set up class labs using mineral sets your school has, students use common items - fingernails, streak plates, copper pennies, glass slides, iron nails, etc. - to determine hardness and ID tables or dichotomous keys to identify about twenty common minerals for themselves. Unit ends when all students have correctly identified all minerals in the kits.
• Explain how different conditions produce different types of rocks. • Explain how Earth is a closed system that leads to the rock cycle.	• Module 4: Types of Rocks: (12 days) ○ Grounding Phenomenon:

• See the appendix for a detailed explanation of Rocks and the Rock Cycle.	○ “Mars Rock Samples Collect by the Perseverance Rover” (NASA Science Mars Exploration) ○ Think about single elements, compounds and minerals, types of mixtures, and phases of matter. Pause for 5 minutes and discuss what you know about these things with a classmate. Now watch the video from NASA’s Jet propulsion lab about perseverance rover’s rock samples, (select samples #6 & #7) video. ○ Students in small groups ask questions about the two samples of rocks while watching the video at their own tables and put them on sticky notes. ○ Each group submits three to five of their best open-ended questions. As a class, sort the best questions into five categories. Put the categorized twenty five questions into Google jamboard or on sticky notes bulletin board. As you go through the unit, revisit the list. • Internet Resources: ○ Content background for teachers for University of Houston’s open source minerals & rocks: “Chapter 2: Earth Materials” (University of Houston website - <i>The Story of Earth: An Observational Guide</i>) ○ The Three Types of Rocks Video: “Geology Kitchen: The 3 Types of Rocks” (YouTube – Esteem Education Co.) • Igneous Rocks: (6 days) ○ “Identifying Igneous Rock” (YouTube – Earth Rocks!) ○ 1 What are igneous rocks: Text pp. 112-117 (1.0 days) ○ 2 Classification of Igneous rocks: Text pp. 118-123 • Lab activity formative assessment: If school has a class set of igneous rocks, do a lab activity where students examine a set of high iron low silica, intermediate, and low iron high silica igneous rocks. Students should be able to tell if the rocks were intrusive or extrusive by the large crystals or lack thereof. They should also be able to tell by the ratio of light and dark minerals which samples are mafic (high iron), which are intermediate, and which are low iron (felsic). • Alternative: (4 days) ○ Use the Concord Consortium Rocks & Tectonics Module (2023-2024) ○ Activities 1, 3, 4 and 5. It is free, you can put your class in and it will grade the units, they are challenging and well thought out.
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	○ <i>The Concord Consortium</i> “Rocks & Tectonics Module” - Earth Science Interactive lessons ● Sedimentary Rocks: (1 day) ○ “Identifying Sedimentary Rocks” (YouTube – Earth Rocks!) ○ 1 Formation of Sedimentary Rocks Text pp. 131-140 ○ 2 Types of Sedimentary Rocks Text pp. 141-144 ● Metamorphic Rocks: (4.0 days) ○ 3 Recognizing Metamorphic Rocks Text pp. 145-150 ○ “Identifying Metamorphic Rocks” (YouTube – Earth Rocks!) ● The Rock Cycle: Text p151 (0.5 days) ○ “Bill Nye the Science Guy – Sea 03 Epis 04 Rocks & Soil” (YouTube - Vern Burn) ○ “The Rock Cycle” (YouTube – Short Simple Science)
Standards List:	HS-ESS2-2, HS-ESS2-3

UNIT 2: SURFACE PROCESSES (Optional)	
Suggested Pacing: 31 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
● Identify the concepts in the model of weathering and erosion in the release of minerals, formation of soils and habitat and the formation of sedimentary rock. ● See the appendix for a detailed explanation of Weathering and Erosion.	● Weathering Erosion & Soil (8.5 days) ○ Weathering Text pp. 164-170 ○ Erosion & Deposition pp. 171-175 ○ Soil Text pp.176-183 ○ Brain Pop Weathering movie & Quiz from the textbook resources ● Mass Movement (Wind & Glaciers) (7.0 days) ○ Landslides Text pp. 194 - 200 ○ Wind Text pp. 201-206 ○ Glaciers Text pp. 207-212 ○ Brain Pop Rock Cycle Movie ○ Brain Pop Erosion movie & Quiz (Choose question set 3, pause points for grades 7&8) ● Surface Water & Groundwater ○ Surface Water Text pp. 224-241 (8 days) ○ Ground Water Text pp. 252-268 (7.5 days) ● “The Water Cycle for Kids” (YouTube – Learn Bright)

	Brain Pop “Water Cycle “Movie & Take Quiz
Standards List:	HE-ESS2-2, HS-ESS2-5

UNIT 3: RESOURCES AND OUR ENVIRONMENT (Optional)	
Suggested Pacing: 36 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
- Identify the concepts related to human use of natural resources. - Model how available resources determine the size of living populations. - Discuss how human use of energy sources, development of technology through applied science, and engineering has solved problems and created environmental impacts (e.g. allowed us to feed the world, as well as side effects such as pollution and global warming). - Describe and compare renewable and non-renewable resources. - See the appendix for a detailed explanation for Energy, Fossil Fuels, and Renewables. - Describe human impacts on land, air, and water resources. - Describe (or design) human conservation efforts regarding land, air, and water resources. - See the appendix for a detailed explanation for Earth’s Resources Extraction and Conservation.	- Earth Resources: - Natural Resources: Text pp. 678-681 (6.0 days) (YouTube Ken ReidUMN) - Resources in Land Text pp. 682- 686 (4.0 days) “What is Mining?” (YouTube Climate and Community) A short film explaining the process of mining to people of the Solomon Islands. “Modern Mining - How Eagle Mine Produces Nickel and Copper” (YouTube – Eagle Mine) A video explaining copper mining in Minnesota on a low grade intrusive body. It is almost identical to the Fort Knox gold mining operation north of Fairbanks, except the intrusion brought gold rather than copper. “Mining” (YouTube – Bozeman Science) A short film, produced by Bozeman Science, explaining mining from prospecting through reclamation, but also explaining the five main types of mines. (Not ocean mining, which is new but has not started at this time.) - Air Resources Text pp. 687-692 (4 days) - Alternative possibility Concord Consortium: High Adventure Science – “Factors that Affect Air Quality” Air Quality Model surface view interactive. Concord Consortium: High Adventure Science – “Movement of Pollutants” - Factors that Affect Air Quality - Aerial View - Water Resources Text pp. 693-697 (5 days) - Alternative possibility: Concord Consortium: High Adventure Science “HASBOT Will There be Enough Fresh Water” - Concord Consortium interactive six lessons - Energy

	○ Conventional Energy Resources Text pp. 708-713 ((2 days) ▪ “Fossil Fuels for Kids Learn All About Fossil Fuels, What They Are, And Where They Come From” (YouTube – Learn Bright) Explanation of their origin, their extraction, and their uses. ○ Alternative Energy Resources Text pp. 714-719 ((1 day) ▪ “What is renewable energy?” (YouTube – The Independent) Seven minute summary. ▪ “Our Mr.Sun 1956- Complete” (YouTube – GBPPR2) Frank Kapra Bell Telephone science special. entertaining science movie for students well done. ○ Conservation of energy Resources Text pp 720-723 (5 days) ▪ “Energy Conservation vs. Energy Efficiency” (YouTube – IGS Energy) ▪ “Energy Conservation for Kids – Insulation” (YouTube – Horizon Utilities) ▪ Watch the first video telling the difference between energy conservation and energy efficiency. Then read pages 720 – 723, and watch the second video for kids on insulating houses. Based in the first video, decide if the book and the second video have correctly labeled what they are discussing. Write up your conclusion as a claim supported by evidence from all of the materials and explain the reasons that the evidence supports your claim. ● Human Impact on Resources: ○ Populations and Use of Resources Text pp 734-736 (1 day) ▪ Concord alternative (See 2,3 & 4 below) ○ Human Impact on Land Resources Text pp 737-742 (5 days) ▪ Concord Alternative: “Can we Feed the Growing Population?” (Concord Consortium High Adventure Science) ○ Human Impact on Air Resources Text pp. 743-747 (2 days) ○ Concord Alternative: “Will the Air be Clean Enough to Breathe?” (Concord Consortium STEM Resource Finder) ○ “Real World: The Carbon Cycle – Essential for Life on Earth” (Youtube – NASA eClips) ○ Carbon Cycle Diagram (Wikimedia) ○ Human Impact on Water Resources Text pp. 748-750 (3 Days)
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	○ Concord Alternative: “HASBOT Will there be Enough Fresh Water?” (Concord Consortium High Adventure Science)
Standards List:	HS-ESS2-2, HS-ESS2-5, HS-ESS3-1, HS-ESS3-2, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6

UNIT 4: DYNAMIC EARTH	
Suggested Pacing: 37 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
• Create models or explanations how Earth’s internal systems drive processes in the geosphere such as plate tectonics, mountain building, volcanism, and earthquakes. • Explain the scientific evidence and historical development of Plate Tectonic Theory. • Describe the causes of plate motion. • Describe the three major plate boundaries and resulting features on Earth’s surface. • See appendix for a detailed explanation for Plate Tectonics. • Create a model or explain how plate tectonics influences the formation of volcanoes and major zones of volcanism. • Explain the relationship between major types of magma and resulting characteristics of an eruption. • Create a model or explain how magma forms geologic features below ground that differ from those formed at the surface by lava. • Describe how faults form at Earth’s surface. • Describe the three types of seismic waves. • Develop a model or explanation of how scientists use seismic waves to determine the structure of Earth’s interior. • Develop a model or explanation of how scientists use seismic waves to measure and locate earthquakes. • Create recommendations regarding preparedness and construction based on an understanding of factors affecting the probability of an earthquake occurring, the amount of damage caused by an earthquake, and how different structures are affected by an earthquake. • See appendix for a detailed explanation of Earthquake Waves Causes and Effects.	• Plate Tectonics ○ Drifting Continents Text pp. 468-472 ▪ “Animated Life: Pangea, Wegener, and Continental Drift” (YouTube, Biointeractive) ▪ Interactive Continent Move Viewer (Biointeractive Earth Viewer website) ▪ “Plate Tectonics: An Introduction” (KUAC PBS) ○ Seafloor Spreading Text pp. 473-479 ▪ Evidence of seafloor spreading – “Plate Tectonics: Evidence of Mid-Ocean Ridges” (KUAC PBS) ▪ “Magnetic Striping and Seafloor Spreading” (YouTube, Science with Thomas Stevenson) ○ Plate Boundaries Text pp. 480-485 ▪ “Tectonic Plate Movement in Alaska” (KUAC PBS) ▪ “Earthquakes and Volcanoes Interactive” (PBS) ○ Causes of Plate Motion pp. 486- 488 ▪ “What will Earth Look Like in 500 Million Years?” (The Concord Consortium) ▪ Interactive types of plate motion simulation and resources for teachers: “Mechanisms of Plate Movement” (KUAC PBS) • Volcanism ○ Volcanoes Text pp. 500-507 ▪ “Volcanism” (PBS) ▪ “Vibrant Volcanos” (KUAC PBS) ▪ Vesuvius cross section video and teacher resources: “Plate Tectonics and Volcanoes: The Next Pompeii” (KUAC PBS) ▪ “Plate Tectonics: The Hawaiian Archipelago” (KUAC PBS) ○ Eruptions Text pp. 508-513 ▪ Types of eruptions and hazards interactive – “Volcanic Eruptions and Hazards” (KUAC PBS)

• Develop models or explanations of orogeny to include mountain formation through plate convergence and alternative processes. • See appendix for a detailed explanation of Mountain Building.	▪ “Mount St. Helens: May 18, 1980” (YouTube, USGS) ▪ Hawaiian effusive eruptions - “Kilauea Volcano Eruption Update; New Eruption Occurs, Expected Length of Eruption” (YouTube, Geology Hub) ○ Intrusive Activity Text pp. 514-517 ▪ “Igneous Intrusions Animation” (YouTube, Metfan869) • Earthquakes ○ Forces Within the Earth Text pp. 528-533 ○ “The Science of Earthquakes” (USGS) ○ Seismic Waves and Earth’s Interior Text pp. 534-538 ○ “Mechanical Waves: Interactive Lesson” (KUAC PBS) ○ “Wave Machine Demonstration” (YouTube, National STEM Centre” ○ “GCSE Physics – Seismic Waves #75” (YouTube, Cognito) ○ Measuring and Locating Earthquakes Text pp. 539-544 ○ Measuring and Locating Earthquakes: PBS Video ○ Earthquakes and Society Text pp. 545-551 ○ “Earthquake and Its Hazards” (YouTube, DOST-PHIVOLCS) • Mountain Building ○ Crust Mantle Relationships Text pp. 562-566 ○ Earth’s Interior and How Seashells get to Mountain Tops – “Mountain Building” (YouTube, Jackson Wheat) ○ Orogeny Text pp. 567-573 ○ Other Types of Mountain Building Text pp. 574-576
Standards List:	HS-ESS1-5, HS-ESS2-1, HS-ESS2-3, HS-ESS2-5

UNIT 5: BEYOND THE EARTH	
Suggested Pacing: 36.5 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
• Demonstrate understanding of how various tools and methods, such as electromagnetic waves, telescopes, gravity waves, and multi-messenger astronomy, are employed to explore and comprehend the universe, including their applications in uncovering celestial phenomena, gravitational interactions, and cosmic events. • See the appendix for a detailed explanation of the Tools of Astronomy.	• The Sun-Earth-Moon System ○ Tools of Astronomy Text pp. 764-769 (1 day) ▪ “Afterschool Universe: Telescope Assembly” (YouTube, AfterschoolUniverse) ▪ “NOTGLaDOS: Electromagnetic Spectrum the Musical” (YouTube, Universe Unplugged) ▪ “Spectroscopy, Explained” (Goddard Media Studios, NASA)

• Describe how the interplay of celestial movements within the Earth-Sun-Moon system influences specific phenomena on Earth, including day-night cycles, seasons, lunar phases, tides, and solar and lunar eclipses. • Explain the theory of the formation of our solar system, detailing the key processes, such as nebular hypothesis, planetesimal accretion, and the role of gravity, that led to the creation of our Sun and planetary system. • Explain Kepler's Laws of Planetary Motion, including their fundamental principles and their significance in understanding the motion of celestial bodies within our solar system. • Demonstrate understanding of Newton's Laws of Universal Gravitation, explaining how these laws govern the behavior of objects. • Create a model to demonstrate the scale of the solar system. • Distinguish between inner and outer planets in our solar system, describing their unique characteristics, orbits, and positions. • Analyze the properties, origins, and trajectories of comets and asteroids within our solar system, understanding their roles as remnants of the early solar system and their potential impact. • Differentiate major planets from dwarf planets based on defining features. • Demonstrate understanding of the roles of the Oort Cloud and Kuiper Belt in our solar system. • Explain or model the layers and features of our Sun and the resulting impact on Earth such as space weather, solar cycles, etc. • Explain how parallax, cepheid variable stars, and doppler effect led astronomers to model how the universe works. • Use the H-R Diagram to explain the life cycle of stars including stars on the order of the sun's mass end as white-dwarf stars, while a star an order of magnitude larger than our sun will end as a neutron star, and the most massive stars will end as black-holes. • Explain how nuclear fusion in the core provides the energy source for stars and ultimately creates heavier elements at the end of a star's life. • See the appendix for a detailed explanation of the Evolution of Stars and Gravity Waves. • Describe the size, shape, formation, and evolution of the Milky Way galaxy.	▪ "The Electromagnetic Spectrum" (KUAC PBS) ▪ "Gravitational Wave Discovery Leads to Greater Understanding of the Fabric of our Universe" (YouTube, PBS NewsHour) ▪ "LIGO: Journey of a G-Wave" (YouTube, Caltech) ○ The Moon Text pp. 770-774 (2 days) ▪ "Inside and Out: How did the Moon Form?" (NASA Science) ▪ "Evolution of the Moon" (KUAC PBS) ○ The Sun-Earth-Moon System Text pp. 775-784 (4 days) ▪ Educator Guide: "Moon Phases" (NASA Jet Propulsion Laboratory, California Institute of Technology) ▪ Moon Phases Interactive Lesson with Simulator - "Phases of the Moon: Part 2" (BH) ▪ "Lunar Eclipse 101" (YouTube, National Geographic) ▪ "Solar Eclipse 101" (YouTube, National Geographic) • Our Solar System ○ Formation of the Solar System Text pp. 796-803 (4 days) ▪ "How The Universe Works: Birth of the Earth" video ▪ "NASA - Solar System Dynamics: Orbits and Kepler's Laws" (KUAC PBS) ▪ "Segment F: Gravity" (Georgia Public Broadcasting, PBS, NPR) ▪ "Real World: Scaling the Solar System" (KUAC PBS) ○ The Inner Planets Text pp. 804-810 (1 day) ▪ "The Inner Solar System: Discovering Earth's Neighborhood with Dr. James Garvin" (NASA Goddard Media Studios) ▪ "Mercury 101" (YouTube, National Geographic) ▪ "Venus 101" (YouTube, National Geographic) ▪ "Earth 101" (YouTube, National Geographic) ○ The Outer Planets Text pp. 811-815 (1 day) ▪ "The Outer Planets: Hubble's Continuing Legacy" (NASA Goddard) ▪ "Jupiter 101" (YouTube National Geographic) ▪ "Saturn 101" (YouTube, National Geographic) ▪ "Uranus 101" (YouTube, National Geographic) ▪ "Neptune 101" (YouTube, National Geographic) ○ Other Solar System Objects Text pp. 816-819 (4 days) ▪ Asteroid Belt - "Real World: Small Bodies Orbiting the Sun" (KUAC PBS)
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• Define “galaxy” and classify galaxies based on properties (spiral, barred spiral, elliptical, and irregular). • Explain where the idea of an expanding universe came from and give the supporting evidence. • See the appendix for a detailed explanation of Galaxies, Hubble, and the Expanding Universe.	▪ “Pluto 101” (YouTube, National Geographic) ▪ “What is the Difference Between Asteroids, Comets, and Meteors? We Asked NASA Scientist: Episode 16” (NASA website) ▪ “Kuiper Belt and Oort Cloud Explained” (YouTube, Explified) • Stars ○ The Sun Text pp. 830-836 (2.5 days) ▪ “NOTGLaDOS: Fusion vs. Fission” (YouTube, ExploreAstro) ▪ “Sun 101” (YouTube, National Geographic) ○ Measuring Stars pp. 837-846 (2 days) ▪ “How do we Measure the Distance to Stars? Parallax and Cepheids Explained” (YouTube, AstroNaught) ▪ “The Star that Redefined the Universe” (YouTube, ScienceOnline) ○ Stellar Evolution pp. 847-851 (3 days) ▪ “The Life Cycle of Stars” (YouTube, Institute of Physics) ▪ “Constructing the Hertzsprung-Russell Diagram for Globular Star Cluster Omega Centauri” (YouTube, Hubble Space Telescope) • Galaxies and the Universe ○ The Milky Way Galaxy Text pp. 862-868 (3 days) ○ “What is a Galaxy?” (YouTube, James Webb Space Telescope) ○ Other Galaxies in the Universe Text pp. 869-877 (5 days) ▪ “Galaxies Explained” (YouTube, Astronomic) ▪ “Classroom Aid – Hubble Galaxy Classification” (YouTube, David Butler) ○ Cosmology pp. 878-881 (4 days) ▪ “The Big Bang, Cosmology Part 1: Crash Course Astronomy #42” (YouTube, CrashCourse) ▪ “Origins of the Universe 101” (YouTube, National Geographic)
Standards List:	HS-ESS1-1, HS-ESS1-2, HS-ESS1-4

UNIT 6: EARTH'S ATMOSPHERE, WEATHER, AND CLIMATE	
Suggested Pacing: 34.5 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
- Describe or model the layers, composition, and properties of Earth's atmosphere. - Describe or model how unequal heating of the Earth by the sun transfers energy throughout the atmosphere which drives weather. - See the appendix for a detailed explanation of Properties of the Atmosphere. - Identify cloud types. - See appendix for a detailed explanation of Clouds. - Distinguish between the major storm systems and how they are formed. - Describe how the global conveyor belt and coriolis effect interact to produce three prevailing global wind systems; the polar easterlies, the prevailing westerlies, and the trade winds. - Explain the formation and characteristics of fronts caused by interacting air masses, and high and low pressure systems. - Interpret weather data and isobaric maps to describe weather conditions. - See appendix for a detailed explanation of Weather and its Causes. - Define climate and describe causes of climate on Earth. - Describe the impact of human activities on climate. - Describe the impact of climate on human activities. - See appendix for a detailed explanation of Climate and its Classification.	- Atmosphere: “Resources to Help Integrate NOAA Science into Formal and Informal Education” (National Oceanic and Atmospheric Administration) - Atmosphere Basics Text pp. 282-288 (2.5 days) “Bill Nye Atmosphere” full version (SchoolTube, MrMasin) “How Big is the Atmosphere” (YouTube, Jared Owen) “Mr. Lee – Layers of the Atmosphere Rap” (YouTube, tfashady410) - Properties of the Atmosphere Text pp. 289-296 (2.5 days) “Bill Nye the Science Guy on the Atmosphere” (YouTube, Bill Nye) - Clouds & Precipitation Text pp. 297-303 (4 days) - The first part (Prevailing Winds, Coriolis, Clouds) of “The Unchained Goddess (1958)” (YouTube, Jack Fuller) – This is 70 years old, but essentially accurate and an entertaining story line. “Weather 101: A Tutorial on Cloud Types” (YouTube, NWSAlbuquerque) - Meteorology - The Causes of Weather Text pp. 314-317 (2 days) “Real World: Earth's Energy Balance – Energy In and Energy Out” (NASA eClips) - Weather Systems Text pp. 318-323 (1 day) - The last part of “The Unchained Goddess (1958)” (YouTube, Jack Fuller) “What is the Jet Stream and How Does it Affect the Weather?” (YouTube, Met Office- Learn About Weather) “What are Weather Fronts and How do They Affect our Weather?” (Met Office- Learn About Weather) “Weather for Pilots – 02 – Air Masses and Fronts” (YouTube, ERAU SpecialVRF) - Gathering Weather Data Text pp. 324-328 (1 day)

	▪ “Reading a Weather Station Model” (YouTube, MooMooMath and Science) ▪ “V.53 Isobars and Isotherms” (YouTube, WoodsScience6) ▪ “High and Low Pressure Areas” (YouTube, Physics Channel) ○ Weather Analysis & Precipitation Text pp. 329-332 (3 days) ▪ “The Science Behind Weather Forecasting” (YouTube, Dylan Robichaud) • The Nature of Storms ○ Thunderstorms Text pp. 344-349 (1.5 days) ▪ “How Thunderstorms are Formed” (YouTube, NorCast Weather) ○ Severe Weather Text pp. 350-354 (1 day) ▪ The middle part of “The Unchained Goddess” (YouTube, Jack Fuller) ▪ “The Supercell – Mother of Storms” (YouTube, Pecos Hank) ▪ “The Science Behind a Microburst – Weather Wisdom” (YouTube, The Weather Channel) ○ Tropical Storms Text pp. 355-360 (2 days) ▪ “Water Vapor Fuels Hurricanes” (KUAC PBS) ▪ “Formation of a Tropical Cyclone” (YouTube, ClickView) ○ Recurrent Weather Text pp. 361-365 (4 days) ▪ “Understanding Drought” (YouTube, Bureau of Meteorology) ▪ “Understanding Floods” (YouTube, Bureau of Meteorology) ▪ “Understanding ENSO” (YouTube, Bureau of Meteorology) • Climate ○ Defining Climate Text pp. 376-380 (2 days) ▪ “Weather Versus Climate Change – Cosmos: A Spacetime Odyssey” (YouTube, National Geographic) ▪ <i>Climate Kids</i> “What’s the Difference Between Weather and Climate?” (NASA) ○ Climate Classification Text pp. 381-386 (2 days) ▪ “All About Climate” (National Geographic) ○ Climatic Changes Text pp. 387-392 (2 days) ○ “The Science of Climate Change” (YouTube, Biointeractive)
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	○ The last part of “The Unchained Goddess (1958)” (YouTube, Jack Fuller). Compare the average number of Atlantic hurricanes moving on land in 1958 to now. Compare the annual CO₂ from fossil fuel burning in 1958 to now. ○ Impact of Human Activities Text pp. 393-395 (4 days)
Standards List:	HS-ESS2-2, HS-ESS2-4, HS-ESS3-5

UNIT 7: EARTH’S OCEANS AND THE MARINE ENVIRONMENT	
Suggested Pacing: 15.5 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
• Describe Earth’s ocean system and resulting effects on climate and weather. • Explain how temperature and salinity differences drive currents and the “global conveyor belt” which transfers heat from the equator to the poles, and returns colder water from the poles to the equator. • Model or explain how motions of the oceans such as tides are controlled by the moon and sun. • Distinguish between ocean waves and tsunamis and their causes. • Describe features of the ocean floor, the seawater column, and the associated plants and animals that live in different regions. • Explain how phytoplankton play a vital role in providing oxygen to the Earth’s atmosphere. • See appendix for a detailed explanation of Oceans.	• Earth’s Oceans ○ An overview of oceans Text pp. 406-412 (1.5 days) ▪ “The Ocean: A Driving Force for Weather and Climate” (KUAC PBS) ○ Seawater Text pp. 413-420 (3 days) ▪ “Ocean Water Chemistry” (YouTube, Jenna Francis) ○ Ocean Movements pp. 421-427 (3 days) ▪ “The Gulf Stream Explained” (YouTube, Kurzgesagt – In a Nutshell) ▪ “Surface Ocean Currents and Gyres” (YouTube, EcoDisco) • The Marine Environment ○ Shoreline Features Text pp. 438-446 (3 days) ▪ “Coastal Geological Processes” (KUAC PBS) ▪ “Coastal Geological Materials” (KUAC PBS) ▪ Rocky shorelines and coasts: “Rocky Coasts” (PBS) ▪ “Sandy Coasts” (KUAC PBS) ○ Seafloor Features Text pp. 447-453 (5 days) ▪ “Touring the Ocean Bottom” (YouTube, NOAA Visualizations) ▪ “How Did Hawaii Form?” (YouTube, Scientific American) ▪ “How Studying the Ocean Floor Explains the History of Earth’s Climate” (KUAC PBS) ▪ “Life on Undersea Mountains” (Marine Conservation Institute, ARGIS) • Online Resources: “Mapping the Seafloor” (NOAA National Ocean Service)
Standards List:	HS-ESS2-4, HS-ESS2-5, HS-ESS2-7

UNIT 8: GEOLOGIC TIME	
Suggested Pacing: 25 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
• Explain the history and current methods of scientifically dating the age of the Earth. • See appendix for a detailed explanation of the History of Dating Earth. • Describe the methods by which fossils form and are used to interpret Earth's physical and biological history. • See appendix for a detailed explanation of Fossils. • Describe Precambrian time including the formation of the crust and continents, oceans, atmosphere, and early life. • See appendix for a detailed explanation of Precambrian. • Describe the Phanerozoic Eon including distinguishing characteristics of the Paleozoic, Mesozoic, and Cenozoic Eras (which starts when we begin to see multicellular fossils).	• Geologic Time: ○ Grounding Phenomenon: A modern picture of the Siccar point outcrop in Scotland would make a great grounding phenomena. ○ “Siccar Point Hutton’s Unconformity” (International Commission on Geoheritage) ○ Questions like, “How did this happen?” “How long did it take?” “How do we know?” These would be great driving questions to investigate. • Fossils and the Rock Record ○ The Rock Record Text pp. 590-594 (2 days) ▪ “Tiktaalik and the Fossil Record” (YouTube, Biointeractive) ○ Relative Age Dating Text pp. 595- 600 (2 days) ▪ “Relative Dating” (YouTube, Conceptual Academy) ○ Absolute Age Dating Text pp. 601-605 (1 day) ▪ “How Does Radiocarbon Dating Work?” (YouTube, Scientific American) ▪ “The Strange Case of Cosmic Rays (1957)” (YouTube, Jack Fuller) ▪ “Dating Lava Flows on Mauna Loa Volcano, Hawaii” (KUAC PBS) ○ Fossil Remains Text pp. 606-609 (4 days) ▪ What do fossils tells us about evolution? – PBS Video (PBS) ▪ “The Making of a Theory: Darwin, Wallace, and Natural Selection” (YouTube, biointeractive) • The Precambrian Earth ○ Early Earth Text pp. 620-622 (1 day) ○ Formation of the Crust and Continents Text pp. 623-627 (2 days) ○ Formation of the Atmosphere and Oceans Text pp. 628-632 (2 days) ○ “Where did Earth’s Water Come From?” (YouTube, Be Smart) ○ Early Life on Earth Text pp. 633-637 (3 days) ○ “Deep History of Life on Earth” (Howard Hughes Medical Institute, Biointeractive) Click on the images to get explanations or short videos explaining the events in the images. ○ “The Search for the Earliest Life” (KUAC PBS)

	• The Paleozoic, Mesozoic, and Cenozoic Eras (3 days) ○ The Paleozoic Era Text pp. 648-654 ▪ “From the Cambrian Explosion to the Great Dying” (KUAC PBS) ○ The Mesozoic Era Text pp. 655-659 (2 days) ▪ “The Day the Mesozoic Died” (Biointeractive) ○ The Cenozoic Era Text pp. 660-665 (3 days) ▪ “Out of the Ashes: Dawn of the Age of Mammals” (YouTube, Biointeractive)
Standards List:	HS-ESS1-6, HS-ESS2-1,HS-ESS2-7

Environmental Science 1B

Grade(s): 9-11 Length: two semesters Credit: 1 (0.5 life science credit and 0.5 physical science credit) Prerequisites: Teacher recommendation	Course Overview: Students in this course explore systems and the ways in which human systems affect and are affected by environmental systems. Students approach environmental issues by understanding ecological components and human perspectives. Students address bias and misunderstandings to develop their own opinions about environmental issues. This course focuses on climate change, natural resources, pollution, and energy, and uses all fields of sciences to help students form educated opinions and solutions based on evidence about current and future environmental problems facing society. Semester one (1A) fulfills the Life Science graduation requirement and semester (1B) two fulfills the Physical Science requirement. See the semester two curriculum under Environmental Science (page 61) in the Life Science options.
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Geology

Grade(s): 11-12 Length: one semester Credit: 0.5 Prerequisites: Teacher recommendation or one semester of <i>Chemistry</i> or <i>Physical Science</i>	Course Overview: Geology is designed to provide students with a better understanding of geology; it provides an introduction to current events related to geology, and explore the multiple career pathways in the field. Over the course, students will discuss careers, employment, and current issues related to geology. Geology teaches fundamental science techniques and concepts through an exploration of the world around us. Physical concepts, such as density and heat transfer, will be explored through an in-depth study of rocks, geological formations, minerals, volcanoes, earthquakes, aquifers, groundwater pollutants, glaciers, petroleum and natural gas, metals, and mining. Adopted Textbook: None at this time.
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Units (Recommended Order)
• Aquifers and Pollutants in Groundwater • Rock Forming Minerals • Earthquakes and Plate Tectonics • Volcanoes • Metals and Mining • Petroleum and Natural Gas • Glaciers • Independent Student Research Project

UNIT 1: AQUIFERS AND POLLUTANTS IN GROUNDWATER	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
Identify metals and non-metals on the periodic table.	• Flinn Lab Safety Contract and Test. • Lab safety scavenger hunt. • Table-top demo of sand, water, and food coloring to show movement of groundwater. • pH & D.O. measurements. • Septic system design and calculations. • Arsenic in Fairbanks water. • Sulpholane in North Pole water. • DEC (SPAR) plume mapping and predicting. • Superfund sites.
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.	
Identify an aquifer and determine criteria for sustainability.	
Show how pollutants can move into and through an aquifer.	
Analyze geoscience data to make the claim that one-change to the Earth's surface can create feedbacks that cause changes to other Earth systems.	
Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	
Standards List:	PS1.A: Structure & Properties of Matter: HS-PS1.1; ESS2.A: Earth Materials and Systems: HS-ESS2.1, HS-ESS2.2; ESS2.C: The Roles of Water in the Earth's Surface Processes: HS-ESS2.5

UNIT 2: ROCK FORMING MINERALS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
Identify common rock forming minerals.	• Lab: Mineral Identification • Mineral chemical formula matching • Minerals vs. gems • Mineral mines
Identify common rocks.	
Standards List:	ESS2.a: Earth Materials & Systems: HS-ESS2.3; ESS2.C: The Roles of Water in Earth's Surface Processes: HS-ESS2.5; ESS3.A: Natural Resources: HS-ESS3.1, HS-ESS3.2

UNIT 3: EARTHQUAKES AND PLATE TECTONICS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
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.	• Phet plate tectonics. • Examine geologic maps. • Contact/visit the Alaska Earthquake Information Center (AEIC).
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.	
Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.	
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.	
Standards List:	ESS1.C: The History of Planet Earth: HS-ESS1.5; ESS2.B: Plate Tectonics and Large-Scale System Interactions: HS-ESS2.1; ESS2.A: Earth Materials & Systems: HS-ESS2.3; ESS3.A: Natural Resources: HS-ESS3.1

UNIT 4: VOLCANOES	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
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.	• Map the Ring of Fire and explain its origin. • Compare and contrast shield, composite, and cinder volcanoes. • Yellowstone history. • Volcanology on other planets. • Contact/visit the Alaska Volcano Observatory (AVO).
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.	
Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.	
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.	
Standards List:	ESS1.C: The History of Planet Earth: HS-ESS1.5; ESS2.B: Plate Tectonics & Large-Scale System Interactions: HS-ESS2.1; ESS2.A: Earth Materials & Systems: HS-ESS2.3; ESS3.A: Natural Resources: HS-ESS3.1

UNIT 5: METALS AND MINING	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
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.	• Identify metals on the periodic table. • Uses of metals. • Mines in Alaska. • Price of gold history. • Prices of other traded metals. • Recycling costs of metals. • Mining standards in the U.S. vs. other countries.
Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.	
Standards List:	ESS3.A: Natural Resources: HS-ESS3.1, HS-ESS3.2

UNIT 6: PETROLEUM AND NATURAL GAS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
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.	• Geologic Formations: Folds, faults, anticlines, and synclines. • Source, reservoir, and trap rocks. • Stratigraphy/fence mapping.
Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.	
Standards List:	ESS2.B: Plate Tectonics & Large-Scale System Interactions: HS-ESS2.3; ESS3.A: Natural Resources: [HS-ESS3.1] [HS-ESS3.2]

UNIT 7: GLACIERS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	• Identify glacial features using topographic maps and aerial photos. • Glacier ice cream terminology. • Mapping changes in glacier extents.
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Analyze geoscience data 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.	
Standards List:	ESS2.A: Earth Materials & Systems: HS-ESS2.1, HS-ESS2.2, HS-ESS2.3; ESS1.B: Earth & the Solar System: HS-ESS2.4; ESS3.D: Global Climate Change: HS-ESS3.5

UNIT 8: INDEPENDENT STUDENT RESEACH – PAPER AND POSTER PROJECT	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
Choose a research topic appropriate to grade level.	• Invite UAF grad students to share their research with the class. • Develop a list of interests. • Draft proposal for teacher's review. • Students conduct research inside and outside the classroom. • Multiple peer revisions in class. • Research poster presentations.
Review scientific articles and develop background research.	
Write a paper or develop a poster using multiple teacher/mentor-reviewed drafts.	
Present the results of research to the public as scientific paper/poster and oral presentation.	
Standards List:	ETS1.B: Developing Possible Solutions: HS-ESS3.2, HS-ESS3.4

Physical Science

Grade(s): 9-12 Length: two semesters Credit: 1.0 Prerequisites: None	Course Overview: <i>Physical Science</i> provides an introduction to the core concepts of physics and chemistry. Laboratory work is an integral part of the inquiry-based learning process, helping students develop an understanding of the concepts as well as the process of science. The first semester provides an introduction to the core concepts of chemistry (matter and its interactions) with little emphasis on mathematics. The second semester includes an exploration of mechanics (motion, forces, and energy), in addition to the development of important process skills. Adopted Textbook: <i>Physical Science</i>. Glencoe/ McGraw-Hill, 2017.
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Units (Recommended Order)	
Semester 1	Semester 2
• Structure and Properties of Matter • Chemical Reactions • Nuclear Processes, Energy in Chemical Processes, and Engineering Design	• Science Practice and Design • Newton's Law • Electricity and Magnetism • Work and Energy

UNIT 1: STRUCTURE AND PROPERTIES OF MATTER	
Suggested Pacing: 5 weeks	Textbook Chapter(s)/Lessons: Chapter 16
Key Objectives	Suggested Activities & Resources
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.	• Phet simulation: Build an Atom http://phet.colorado.edu. • Black box experiment (for circumstantial evidence). • Adopt an element and present its “life history” in a poster. • Demo: Lithium vs. Sodium in Water. • Lab: Trends Among the Elements. • Periodic chart of objects (i.e., candy, shoes, hats).
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.	
Standards List:	PS1.A: Structure & Properties of Matter: [HS-PS1.1, HS-PS1.2, HS-PS1.3]

UNIT 2: CHEMICAL REACTIONS	
Suggested Pacing: 5 weeks	Textbook Chapter(s)/Lessons: Chapters 15, 19, 21, and 22.
Key Objectives	Suggested Activities & Resources
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.	• Lab: Decompose water by electrolysis, noting volumes and ratios of products. • Lab: Baking Soda and Acid. • Lab: Salts and Solubility. • Lab: pH Scale. • PhET Online Lab: http://phet.colorado.edu. • Lab: Empirical Formula of Zinc Chloride.
Explain how the Law of Conservation of Mass helps to support the atomic model of matter.	
Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	
Balance simple chemical equations.	
Measure solubility of solutes in solutions.	
Discuss the difference between concentration and saturation of solutes in solutions.	
Use power of ten notations to explain pH; explain the difference between acids and bases.	
Identify the range of the pH scale and give examples of strong and weak acids, and bases.	
Standards List:	PS1.B: Chemical Reactions: HS-PS1.2, HS-PS1.7

UNIT 3: NUCLEAR PROCESSES, ENERGY IN CHEMICAL PROCESSES, AND ENGINEERING DESIGN	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: Chapters 4 and 8.
Key Objectives	Suggested Activities & Resources
Explain the Law of Conservation of Energy as it applies to transfers of energy for physical and chemical changes.	• Lab: Radioactive Decay. • PhET Online Labs: http://phet.colorado.edu. • Videos: Chernobyl: A Taste of Wormwood or the NOVA special Back to Chernobyl. • Activity: Design an electric power system for a small community with a given set of environmental conditions, resources, population, and power needs.
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.	
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	
Discuss the role nuclear power for electrical generation may play in reducing the emission of greenhouse gasses and for smaller Alaskan communities.	
Standards List:	ETS1.C: Optimizing the Design Solution: HS-ETS1.2, HS-PS1.6; PS1.C: Nuclear Processes: HS-PS1.8; PS3.D: Energy in Chemical Reactions: HS-PS3.3

UNIT 4: SCIENCE PRACTICE AND DESIGN	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: Chapter 1
Key Objectives	Suggested Activities & Resources
Recognize that all measurements have some uncertainty.	• Flinn Safety Contract and Test. • Lab safety classroom scavenger hunt. • Graphing skills packet. • Investigation: Graphing Volume of Water in a Test Tube vs. Height of Water.
Make and interpret line graphs and scatter plots.	
Standards List:	ETS1.C: Optimizing the Design Solution: HS-ETS1.2

UNIT 5: NEWTON'S LAW	
Suggested Pacing: 5 weeks	Textbook Chapter(s)/Lessons: Chapters 2 and 3.
Key Objectives	Suggested Activities & Resources
Distinguish between the terms speed, velocity, and acceleration.	• Use sonic rangers (sonars) to match position vs. time; velocity vs. time graphs. • Conduct races with electric cars and fan cars or cars rolling down ramps. • Investigate collisions between spring-loaded cars. • Conduct balloon races. • Design apparatus to protect egg in free-fall using cost-effective approach.
Use and interpret graphs that describe the motion of objects (position-time, velocity-time, acceleration-time).	
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.	
Apply Newton's three laws to explain inertia, acceleration when net force is not zero, and action-reaction forces.	
Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.	
Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	
Standards List:	PS2.A: Forces & Motion: HS-PS2.1, HS-PS2.2, HS-PS2.3 ETS1.A: Defining & Delimiting the Engineering Problem: Secondary to HS-PS2.3; ETS1.C: Optimizing the Design Solution: Secondary to HS-PS2.3

UNIT 6: ELECTRICITY AND MAGNETISM	
Suggested Pacing: 5 weeks	Textbook Chapter(s)/Lessons: Chapters 6 and 7.
Key Objectives	Suggested Activities & Resources
Use mathematical representations of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects.	• Static Electric Forces Activity: Attraction and Repulsion (comparison to gravitational force). • Build a simple circuit. • Build a simple electromagnet. • Build a simple motor.
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.	
Standards List:	PS2.B: Types of Interactions: HS-PS2.4, HS-PS2.5; PS3.A: Definitions of Energy: Secondary to PS2.5

UNIT 7: WORK AND ENERGY	
Suggested Pacing: 6 weeks	Textbook Chapter(s)/Lessons: Chapter 4
Key Objectives	Suggested Activities & Resources
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).	Model dwelling construction and insulation used in traditional Alaskan dwellings before modern insulating materials became available.
Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	
Build and test the efficiency for a simple machine.	
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).	
Standards List:	PS3.A: Definitions of Energy: HS-PS3.1, HS-PS3.2; PS3.B: Conservation of Energy & Energy Transfer: HS-PS3.1, PS3.D: Energy in Chemical Properties: HS-PS3.3, HS-PS3.4

Physics

Grade(s): 10-12 Length: two semesters Credit: 1 Prerequisites: Teacher recommendation or <i>Algebra 2</i> (can be taken concurrently)	Course Overview: Students best learn science when they do science. This physics course is organized around real world experiences (called storylines) that start with an interesting phenomenon leading students to ask questions that they investigate through hands-on activities, labs, and simulations. When they develop models that explain what is going on, they present their conclusions as a claim that is supported with reasoning from the evidence they collected. The teacher, as facilitator of the student research, can insert any questions that cover an aspect of the topic the students did not think of. Adopted Textbook: <i>Experience Physics</i>. Savvas, 2022.
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Units (Recommended Order)	
Semester 1	Semester 2
• Forces and Motion • Forces at a Distance • Conservation of Energy	• Conservation of Energy • Waves and Electromagnetic Radiation • From the Nucleus to the Universe

UNIT 1: FORCES AND MOTION	
Suggested Pacing: approximately 23.5 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Investigation 1: • Distinguish between distance, displacement, speed, velocity and acceleration. Represent their relationships with graphs, diagrams and equations. Free fall acceleration. Use vector representation for displacement, velocity, and acceleration. • Projectile motion involves a horizontal velocity with a perpendicular acceleration superimposed on it. The path is parabolic. Circular orbital motion of a satellite involves a horizontal velocity that is continuously being deflected by an acceleration toward the center of the orbit due to the much larger mass of the body it orbits.	• Anchoring Phenomenon: “How will we get to Mars?” (0.5 days) • Investigation 1 Modeling Motion (10 days) Text pp (4-49) ○ Phenomenon: How does this rock move (0.5 days) ○ Experience 1 Dis[placement & Velocity (2.5 days) ○ Experience 2 Acceleration (2.5 days) ○ Experience 3 Circular & Projectile Motion (3 days) ○ Investigation Assessment (1.5 Days) • Investigation 2 Forces (13 Days) Text pp (50-111) ○ Phenomenon: “How does a self-driving car calculate stopping time?” (0.5 days) ○ Experience 1 Force, Mass, Acceleration (2.5 days) ○ Experience 2 Types of Forces (2.5 days) ○ Experience 3 Forces on Systems (3.0 days) ○ Experience 4 Earth’s Surface Forces (3.0 days) ○ Investigation Assessment • “Staying Fit to Mars and back”. (1.5 days)
Investigation 2: • Newton’s three laws explain the causes of the types of motion in investigation 1. Expand the use of mathematics both graphically and with Algebra to describe forces and motion. Apply these concepts to practical situations like space travel and motions in the Earth’s crust.	
Standards List:	PS2-1, PS2-2, PS2-4, PS2-1, ESS2-1

UNIT 2: FORCES AT A DISTANCE	
Suggested Pacing: approximately 31 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Investigation 3: Expand the concepts developed in the previous storyline to include Newton's law of Universal Gravitation to explain the behavior of planets orbiting the sun and why they obey Kepler's three laws of orbital motion. Gravitation is always attractive between masses and an inverse square law. It is described by vectors.	- Anchoring Phenomenon: "How does the Moon shape our coastline?" (0.5 days) - Investigation 3 Gravitational Forces (10 days) Text pp (112-153) - Phenomenon: What causes the Seasons? (0.5 days) - Experience 1 Universal Gravitation (2.5 days) - Experience 2 Orbital Motion (2.5 days) - Experience 3 Kepler's Laws (3 days) - Investigation Assessment (1.5 Days) - Investigation 4 Electric Forces (9.5 days) Text pp (154-195) - Phenomenon: Why can't people walk through walls? (0.5 days) - Experience 1 Coulomb's Law (2.5 days) - Experience 2 Electric Fields (2.5 days) - Experience 3 Electric current (2.5 days) - Investigation Assessment (1.5 Days) - Investigation 5 Magnetic Forces (11.0 days) Text pp (196-293) - Phenomenon: How does an egg cook on a stove that does not get hot? (0.5 days) - Experience 1 Magnetism (3.0 days) - Experience 2 Magnetic Fields (3.0 days) - Experience 3 Inducing Current (3.0 days) - Investigation Assessment (1.5 days) - Investigation 6 Forces in Materials Text pp (241-277) (14 Days) Skip until the end of 2nd semester, then use Experience 1 "Atoms and Atomic Structure" and Experience 2 "Attractive and Repulsive Forces" to prepare students for Storyline 5 "From the Nucleus to the Universe." The 14 days are needed to complete collisions & conservation of momentum 1st semester, but storyline 5 "nuclear physics" won't make much sense without a background understanding of atoms. So, at least the first two experiences are needed to get students ready for nuclear physics at the end of 2nd semester. - Phenomenon: What happens inside a pole vaulter's pole as it bends and springs back? (0.5 days) - Experience 1 Atoms and Atomic Structure (3.0 days) - Experience 2 Attractive and Repulsive Forces (3.0 days) - Experience 3 Material Properties (3.0 days) - Experience 4 Structure and function (3.0 days) - Investigation Assessment (1.5 days)
Investigation 4 Electric charges are two kinds (+ & -). Likes repel, opposites attract. Charge differences can be caused by transfer during contact or temporarily induced by nearness w/o contact. The force between two point charges follows an inverse square law called Coulomb's law. Electric forces are described by vectors. Gravitational forces are much smaller than electric forces. For example the electric force between a negatively charged electron and a positively charged proton in a hydrogen atom is 10^{29} times larger than the gravitational force between their two masses. Graphic descriptions and calculations are similar to the mathematics used to describe gravity. Electric field and electric potential are useful ways to describe more complicated situations than point charges. Electric currents in circuits obey Ohm's and Kirchoff's laws. Calculations can be done applying these laws to parallel, series, and combined electric circuits.	
Investigation 5 Magnetic fields are caused by moving electrons AND changing magnetic fields can cause electrons to move. Students will be able to use the right hand rule and mathematics to calculate the strength and direction of fields created by permanent magnets and current carrying loops. They connect magnetic flux and electromotive force to induction and calculate the relationships represented by Biot-Savart's and Faraday's Laws. Electric current loops in spinning Earth at the boundary between the liquid and solid core generates the magnetic field around us that protects us from charged particle radiation from the solar wind. Throughout this investigation students will model systems and solve problems related to electromagnetic induction.	
Standards List:	PS2-4, ESS1-4, PS1-3, PS2-4, PS2-6, PS3-5, PS2-4, PS2-5, PS3-5, PS1-3, PS2-4, PS2-6

UNIT 3: CONSERVATION OF ENERGY (PART ONE - SEMESTER ONE)	
Suggested Pacing: Approximately 22 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Investigation 7: Differentiating work (positive, negative and zero work) and energy, kinetic energy, and the work energy theorem. Differentiate between work and power. Mechanical energy, kinetic energy and gravitational potential energy. Elastic potential energy. Friction conversion of mechanical energy into heat. Conservation of energy. Use equations to model the kinetic energy converted into heat energy during the K-T Boundary asteroid impact that caused many extinctions sixty million years ago. Swinging pendulums and vertical and horizontal oscillating masses on springs and conservation of mechanical energy in those systems. Also oscillation decay and where that energy goes. The energy changes during a rocket launch. Energy and work are not vectors.	- Anchoring Phenomenon: “How does this machine transfer energy?” (0.5 days) - Investigation 7 Energy (8.5 days) Text pp (278-319) - Phenomenon: “Why does a bungee jumper bounce up and down?” (0.5 days) - Experience 1: Classifying Energy and Work (2.5 days) - Experience 2: Mechanical Energy (2.0 days) - Experience 3: Conservation of Energy (2.0 days) - Investigation Assessment (1.5 days) - Investigation 8 Collisions (13.0 days) Text pp (320-363) - Phenomenon: “Why do car brakes use a pedal instead of an on off switch?” (0.5 days) - Experience 1: Momentum and Impulse (3.0 days) - Experience 2: Conservation of Momentum (4.0 days) - Experience 3: Collisions in Earth’s Crust (4.0 days) - Investigation Assessment (1.5 days)
Investigation 8: Defining momentum. The relationship between the change in momentum of an object and the force applied to it and the length of time the force is applied. (The impulse-momentum equation). Momentum, Force and Impulse are all vectors. Elastic and Inelastic collisions. Kinetic energy and collisions. Collisions in the Earth’s crust result in Earthquakes, moving crustal plates with spreading centers causing new sea floor with associated underwater volcanoes and earthquakes, converging plates with associated mountain building, volcanoes and earthquakes, and transform faults like in California with associated earthquakes.	
Standards List:	PS3-1, PS3-2, PS3-3, PS2-2, PS2-3, ESS2-1

UNIT 4: CONSERVATION OF ENERGY (PART TWO - SEMESTER TWO)	
Suggested Pacing: approximately 26.5 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Investigation 9 Energy flow in both open and closed systems. Thermal energy on a microscopic scale is related to the total kinetic energy in a material, while the temperature is related to the average kinetic energy of the molecules in a material. Two objects of different temperature in contact transfer energy by conduction of motion from the fast molecules to the slow molecules. The transferring energy is called heat. The final temperature of both is in between the starting temperature. The three laws of thermal energy dynamics are Law 1: The best one could ever do is have energy in equal energy out, conservation of energy. Law 2: random motion always tends to increase over time so that some mechanical energy gets converted to thermal energy and you never get perfect conservation. The measure of increasing disorder is called entropy and it usually increases. Law 3: Increasing disorder slows down as the temperature approaches absolute zero (0°K). The Zeroth Law: Temperatures may approach absolute zero but can never get there. Compare temperature vs energy graphs will show they are not linear. The relationship between temperature, pressure and volume for gasses can be described by Boyle's Law, Charles Law, and Guy-Lussac's Law or they can be combined into the Ideal Gas Law. Specific heat describes how temperature in materials that are in the same phase respond to changes in thermal energy. Latent heat describes the heat necessary to change a material from one phase to another, liquid to gas for example, before the temperature will change. Heat is also transferred by convection and radiation. All three methods transfer heat from the hot core of the Earth into cold outer space. These processes, conduction from the core to the mantle, convection in the mantle breaking the crust into moving plates and radiation into space, drive plate tectonics. This results in seafloor spreading, mountain building, subduction zones, earthquakes at plate boundaries and volcanoes of various kinds on the surface of our planet. From Investigation 4 we know electric charges are two kinds (+ & -). Likes repel, opposites attract. Charge differences can be caused by transfer during contact or temporarily induced by nearness w/o contact. The force between two point charges follows an inverse	• Anchoring Phenomenon: "How does this machine transfer energy?" (0.5 days) • Investigation 9 Thermal Energy (11.0 days) Text pp (364-407) ○ Phenomenon: "How does a blanket keep you warm?" (0.5 days) ○ Experience 1: Temperature (3.0 days) ○ Experience 2: Thermal Equilibrium and Heat Flow (3.0 days) ○ Experience 3: Heat Flow within the Earth (3.0 days) ○ Investigation Assessment: (1.5 days) • Investigation 10 Electromagnetic Energy (15.0 days) Text pp (408-461) ○ Phenomenon: "How do we sustainably generate electricity for our lives?" (0.5 days) ○ Experience 1: Electric Potential (3.0 days) ○ Experience 2: Energy in Electric Circuits (3.0 days) ○ Experience 3: Power Generation (3.0 days) ○ Experience 4: Energy Resources and Conservation (4.0 days) ○ Investigation Assessment (1.5 days)

square law called Coulomb's law. Electric forces are described by vectors. Gravitational forces are much smaller than electric forces. For example the electric force between a negatively charged electron and a positively charged proton in a hydrogen atom is 10^{29} times larger than the gravitational force between their two masses. Graphic descriptions and calculations are similar to the mathematics used to describe gravity. Electric field and electric potential are useful ways to describe more complicated situations than point charges.

Electric force and electric potential energy equations can be made into very useful functions called electric field and electric potential. The electric field equation tells what force a complicated assembly of charges would have on a small charge at different distances from them. The electric potential equation tells what potential energy they would give the small charge at that spot. If you know the electric field and the electric potential it is much easier to predict what will happen than trying to grind through Coulomb's law for many charges. The electric field can also be represented as a picture. For example, the field around a positive charge is a plus sign with straight line arrows pointing out from it in all directions. The place where the lines are really close together the force is stronger and where they are far apart it is weaker. A negative charge would have converging arrows.

Electric potential is very useful in explaining how batteries push electrons through wires. In circuits the difference in electric potential (V) between the positive and negative end of the battery pushes electrons in a wire. The metal the wire is made of determines how easily the electrons move. Resistance (R) is how these differences are described. The flowing electrons in the wires are called the current (I). Power is the rate at which electrical energy is used. The different devices in an electrical circuit can be in series or parallel. The way the current moves will differ depending on how the circuits are built. The main equations are Ohm's Law $V=I \cdot R$, the power law $P = I^2 \cdot R$, or $P = I \cdot V$, also

Total resistance for series $R = R_1 + R_2 + R_3$ etc and

Total resistance for parallel $1/R = 1/R_1 + 1/R_2 + 1/R_3$ ETC

Changing magnetic fields can move electrons in conductors. This electromagnetic induction can be used to make electric motors and also electric generators. Finally, how the spinning magnets in the generators are turned relates to our climate. If water or steam turns them, the way the steam is made has different impacts on global warming. Steam from geothermal hot water sources near volcanoes does not produce greenhouse gasses. Heat from burning methane, petroleum, or coal does. Heat from nuclear fission does not. Heat from concentrated sunlight does not.	
Standards List:	PS3-2, PS3-4, ESS2-3, PS2-5, PS3-3, PS3-5, ESS3-2, ESS3-3

UNIT 5: WAVES AND ELECTROMAGNETIC RADIATION	
Suggested Pacing: approximately 27.5 days	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Waves carry energy as a disturbance traveling through a medium. Waves have amplitude, frequency, wavelength, height, and can be longitudinal, transverse, or torsional. The medium can be solid, liquid, or gas; it can also be electric and magnetic fields. The electromagnetic field model assumes charged particles have associated electric fields that extend from each one out through all space. When they accelerate, they generate ripples along their field lines and also associated magnetic field ripples that travel away from them at the speed of light. These electromagnetic waves are what we call light. This range has wavelengths between 780 nanometers (red) and 390 nanometers (purple), but any other wavelengths are possible. There can be wavelengths from kilometers (radio waves) to wavelengths less than one hundredth of a nanometer (gamma rays). These electromagnetic waves are transverse waves that can be circularly, elliptically, or linearly polarized. The electromagnetic field model breaks down at very small distances, like the atomic level. Here quantum effects become dominant. At this level light can behave either as a wave or a particle depending on what it interacts with. One can transmit information from one place to another by modulating the waves either by changing the amplitude (amplitude modulation) or by changing the wavelength (frequency modulation). One can also interrupt the wave to create on and off conditions. If on is ONE and off is ZERO, binary number codes can transmit information. Information carried by electromagnetic waves can be transmitted through glass fiber cables, through outer space, and through Earth's atmosphere. There are also proposals to capture solar energy with large satellites in space and broadcast it down to Earth's surface as diffuse microwaves (which go through clouds) to be concentrated at the surface receiving power station. It must be designed well and diffuse coming down, otherwise people, birds, plants in it or passing through it might get cooked like in a microwave oven. Also, planes flying through it might have their instruments melted like a piece of aluminum foil in a microwave.	• Anchoring Phenomenon: "How do waves transfer energy?" (0.5 days) • Investigation 11 Waves (8.5 days) Text pp (462-509) ○ Phenomenon: "How do waves change coastlines?" (0.5) ○ Experience 1: Wave Properties (2.0 days) ○ Experience 2: Wave Behavior and Energy (2.5 days) ○ Experience 3: Wave Optics (2.0 days) ○ Investigation Assessment (1.5 days) • Investigation 12 Electromagnetic Radiation (9.0 days) Text pp (510-537) ○ Phenomenon: "How does this 'polaroid' lens remove glare? (0.5 days) ○ Experience 1: Electromagnetic Waves and their properties (2.0 days) ○ Experience 2: Particle-Wave Duality (2.0 days) ○ Experience 3: Electromagnetic Radiation and Matter (2.0 days) ○ Investigation assessment (1.5 days) • Investigation 13 Information & Instrumentation (9.5 days) Text pp (538-565) ○ Phenomenon: "How does a mobile device transmit information?" (0.5 days) ○ Experience 1: Digital Information (2.5 days) ○ Experience 2: Capturing and Transmitting Information (2.5 days) ○ Experience 3: Capturing and Transmitting Energy (2.5 days) ○ Investigation Assessment (1.5 days)
Standards List:	PS3-3, PS4-1, PS4-3, PS4-5, PS4-3, PS4-4, PS4-2, PS4-5

UNIT 6: FROM THE NUCLEUS TO THE UNIVERSE

Suggested Pacing:	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
From Investigation The atomic model of matter is powerful and eventually leads to the periodic table of elements, which enables us to predict what will happen when atoms of elements interact. The negative electrons in clouds around the tiny and massive positively charged nucleus of an atom, which is made of positive protons and neutral neutrons (that hold it together); has its electrons in different energy levels associated with how many protons are in the nucleus. The electrons in the outermost energy level of one atom can interact with the outermost electrons of another atom resulting in forces between the atoms. This produces situations where the two atoms get close together and share pairs of electrons. This bonding is called “covalent bonding”. In a different situation, one outer electron may be pulled from one atom to another. The element that lost the electron has a positive charge. The element that took the electron has a negative charge. The two atoms are pulled together by their opposite charges. This type of bonding is called “ionic bonding”. A third possibility is that a large number of atoms of the same metal element, such as copper, are all together and the outer electrons slosh between identical atoms making the net positive inner parts somewhat like positive islands surrounded by a sea of electrons that keep them inside. This type of bonding is called “metallic bonding” The nucleus of all atoms, except for the hydrogen with only one proton in its nucleus, is made of positive protons held together by neutral neutrons. Protons that close together have VERY strong electric force pushing them apart. The neutrons are mediators on the much larger strong nuclear force. Without that it would be impossible to have atoms more complex than one proton and one electron. Mass and energy are interchangeable as denoted by the famous equation $E = MC^2$. When you compare the mass of a helium atom’s nucleus to the total mass of the four particles that made it (2 protons and 2 neutrons), the nucleus doesn’t have as much mass as the total mass of its parts. Why? The missing mass was released as light energy during the formation of the nucleus. The apparent missing mass is called the mass deficit of the nucleus. When you look at the other elements’ nuclei iron has the highest mass deficit. This means that you	• Present background information on atoms using the first two Experiences from Investigation 6 “Forces in Materials”, that was skipped, to prepare students to start Investigation 14 “Nuclear Physics” Then do investigation 15 Experience 1 “Radioactive Decay”. (6.5 days) • If there is extra time, one could teach two or more experiences that there was not time to cover, of the teacher’s choice, such as: ○ Radiometric Dating and Geologic Time would apply to the Age of Rocks, Investigation 15. ○ The Sun and Stars would apply to The Universe, Investigation 16. ○ Material Properties and Structure and Function would apply to Forces in Materials, Investigation 6 • Storyline 5: Anchoring Phenomenon: “How did the atoms that make up your body form?” (0.5 days) • Investigation 14 Nuclear Physics (11 days) Text pp (566-607) ○ Phenomenon: “How can your electricity come from the fusion of atoms?” (0.5 days) ○ Experience 1: Nuclear Particles (3.0 days) ○ Experience 2: Nuclear forces (3.0 days) ○ Experience 3: Fission and Fusion (3.0) ○ Investigation Assessment (1.5 days) • Investigation 15 Ages of Rocks (11 days) Text pp (608-651) ○ Phenomenon: “How did Earth Form?” (0.5 days) ○ Experience 1: Radioactive Decay (3.0 days) ○ Experience 2: Radiometric Dating (3.0 days) ○ Experience 3: Geologic Time (3.0) ○ Investigation Assessment (1.5 days) • Investigation 16 The Universe (11 days) Text pp (652-691) ○ Phenomenon: “How will the sun change over time?” (0.5 days) ○ Experience 1: The Sun (3.0 days) ○ Experience 2: Stars (3.0 days) ○ Experience 3: The Big Bang (3.0)

can combine nuclei of the lighter elements up to iron and squeeze some energy out. This is nuclear fusion. On the other side of iron, the more massive elements can, in principle, be split into smaller pieces to get out some energy. This is nuclear fission. For practical purposes, the only fusion human beings can do at this time is heavier isotopes of hydrogen fused into helium releasing large amounts of energy. The only fission we can do is creating conditions where Uranium 233, Uranium 235, or Plutonium 239 atoms can spontaneously split, releasing energy for our purposes.

An exploding star going supernova sent a shock wave through a massive cloud of interstellar dust, left over from previous stars exploding. causing eddies that were swirling solar systems in the making. Most of the mass in this swirling cloud was concentrated at the center (called a protostar) and as the gravitational compression at the center became greater and greater as mass accreted, the core became dense and hot enough for the fusion of hydrogen into helium to begin. The sun was born. As long as the inward pressure from gravity balances the outward pressure from nuclear fusion in the core our sun will be a stable star. Earth and the other planets formed in the surrounding eddies orbiting the sun as static electricity first turned the dust into clumps and the lightning in the dust melted the clumps into rocks that collided to become planetesimals and eventually proto planets that smashed into each other until only five terrestrial planets remained in the inner solar system and the two gas giants and two ice giants were left in the outer solar system. One mars sized inner planet hit the Earth with a glancing blow that vaporized it and a good part of the upper mantle and crust producing a ring of hot debris that coalesced into the moon.

Radioactive decay is the natural process in which unstable nuclei emit ionizing radiation to eventually turn into stable non radioactive elements. Alpha particles are pieces consisting of two protons and two neutrons (essentially a helium nucleus), beta particles are electrons emitted when neutrons turn into protons while forming an electron and throwing it out so total charge remains the same. (Other things are conserved besides energy) Each radioactive element has its own pattern that is not affected by heat, chemical reactions or anything else outside the atom's nucleus. The amount of time for half the original amount of material to change is called the "half-life". In that amount of time half of the material will change. In that amount of time again half of what remains will change, and so in. It takes about TEN half lives for the starting amount of

○ Investigation Assessment (1.5 days)

radioactive material to be one thousandth of the starting amount. It takes TWENTY half lives to drop to one millionth of the starting amount. The graph of material versus time is an exponential decay curve that can be used to predict remaining amounts at a given time or time to get to a particular amount. This makes it great for dating if you know how much material there was at the start. For example cosmic rays smash into oxygen and nitrogen atoms at the top of our atmosphere destroying them sending showers of protons and neutrons down into the lower atmosphere. If a neutron hits a nitrogen 14 nucleus and replaces the proton that it knocked out, you now have a carbon 14 atom. It is radioactive with a half life of 5700 years. When it goes through beta decay and a neutron becomes a proton turning it back into N14. Plants pull carbon from the air and put it in their bodies during photosynthesis. Animals eat plants etc. So living things have the same level of C14 in their bodies as is found naturally in the atmosphere. When they die, replacement stops. So comparing the C14 left in the body to the regular carbon in it one can calculate how long since it died. These are very small ratios so the method is not practical beyond 50,000 years or about ten half lives.

Using uranium to lead radioactive dating the age of the earth is Four and a half billion years.

The sun is one of the types of star that lives for about ten billion years. It is presently around five billion years old. As the hydrogen in the core gets used up as it is converted into helium. When the hydrogen is used up, the burned out core will collapse until it's hot enough to fuse helium into heavier elements such as carbon through iron. The new outward heat pressure will push the red outer layers out until it is a red giant. So about five billion years in the future, as the red giant stage ends, the outer gasses will expand away from the core leaving a dense hot white dwarf star that will cool by radiation over billions of years.

How do we know the behavior and history of stars since they live so much longer than human beings? Our telescopes let us observe stars near and far and we see them in all stages of their development. This is similar to a family photo album for human beings. It shows babies, young people, adults and old people. Also we use Newton's and Kepler's Laws on binary star orbits to determine their masses, we use their electromagnetic spectra to find out what elements are in them and how fast they are moving and in what direction (the Doppler effect), and we apply the mathematics of nuclear fusion physics to figure out what is going on

inside. It is all applied physics. The easiest way to visualize what is happening is with the Hertzsprung-Russell diagram which plots the brightness of stars on the vertical axis (from dimmest to brightest) and the temperature of stars (from hottest to coldest) on the horizontal axis. Stars start out as protostars that begin fusion at their cores when they get massive enough. They become adult stars whose temperature, brightness and lifetimes are determined by their initial mass. A star that is less than eight times the mass of the sun will go through its adult main sequence stage and end as a white dwarf star. A star that is between eight and twenty times the mass of the sun will end with a supernova explosion (creating many of the elements heavier than helium and through carbon) blowing all the outer layers into space leaving a neutron star behind in the middle. A star that is more than twenty times the mass of the sun will experience a supernova explosion leaving a black hole behind.

In the early twentieth century Hubble observed that the spectra of hydrogen and helium from stars in nearby galaxies were slightly longer wavelengths than found in a lab. The farther away the galaxies were in all directions from us the worse it got. Waves generated by a source moving away from an observer get slightly longer. The shift can be used to calculate the speed of motion. Hubble had found that all galaxies were moving away from us and the farther away they were the faster they were going. Either we were the center of the universe (unlikely) or the universe was expanding similar to bread dough full of raisins expanding before it gets baked. From the standpoint of any raisin, the others will be moving away and the farther away they are the faster they will be moving. Fred Hoyle, an astronomer who did not support the expanding universe model, coined the term “Big Bang” during a talk in 1949 to help the general audience visualize the model he was attacking. The name stuck. The Big Bang event is a physical theory that describes how the universe expanded from an initial state of high density and temperature to what it is now.

Standards List:

PS1-3, PS2-4, PS2-6, PS1-8, PS1-8, ESS1-5, ESS1-6, ESS2-1, ESS1-1, ESS1-2, ESS1-3

Science Elective Options

Astronomy

Grade(s): 10-12 Length: one semester Credit: 0.5 credit Prerequisites: Teacher recommendation or <i>Geometry</i>	Course Overview: <i>Astronomy</i> is an introductory course, which will educate students about ancient and modern astronomical knowledge and research methods to build a strong foundation for college-level courses in science. Mathematics and science concepts as well as ancient and modern technology will be used to help students explore and understand the universe they live in. Astronomy focuses on historical development of astronomical knowledge, the solar system, and an introduction to modern research methods. Additional topics could include life cycles of stars, properties of star groupings and galaxies, and the use of modern research methods. Adopted Textbook: <i>Astronomy: Journey to the Cosmic Frontier</i>. McGraw-Hill, 2008
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Units (Recommended Order)
• Classical Astronomy • The Solar System • Using Light and the Electromagnetic Spectrum to Study Space • Stars and their Life (time permitting) • Star Groupings and Galaxies (time permitting) • Cosmology (time permitting) Pacing may be adjusted to account for teacher expertise and current events.

UNIT 1: CLASSICAL ASTRONOMY	
Suggested Pacing: 1 – 2 weeks	Textbook Chapter(s)/Lessons: Chapters 3, 4, 7, 8, 9, and 17.
Key Objectives	Suggested Activities & Resources
Be able to predict solar positions during the seasons.	• The effect of solar altitude on insolation. • Use Stonehenge to predict moon phases and eclipses. • Using Aristarchus' method for measuring Earth-Moon-Sun distance ratios. • Using Eratosthenes' method of measuring the Earth.
Model how eclipses occur.	
Explain early experiments to measure the size of the Earth.	
Standards List:	ESS1.B: Earth and the Solar System: HS-ESS2.4

UNIT 2: THE SOLAR SYSTEM	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: Chapters 5, 7, 14, 15, and 18.
Key Objectives	Suggested Activities & Resources
Explain how tides work.	• Determine the orbit of Mars using a cross-staff and quadrant for astronomical observations. • Use a pinhole projection to measure the size of the sun.
Explain how Copernicus' findings drastically changed the understanding of the universe.	
Use Newton's law of universal gravitation to calculate forces on bodies in the solar system.	
Discuss the theories of the formation of the solar system.	
Explain the existence of comets, meteors, and asteroids.	
Standards List:	ESS1.A: The Universe and Its Stars: HS-ESS1.1; ESS1.B: Earth and the Solar System: HS-ESS1.4 PS2.B: Types of Interactions: HS-PS2.4, HS-PS2.5

UNIT 3: USING LIGHT AND THE ELECTROMAGNETIC SPECTRUM TO STUDY SPACE	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: Chapter 6, 16, 19, 20, and 21.
Key Objectives	Suggested Activities & Resources
Compare and contrast the wave and particle nature of light.	• Examine the factors related to the operation of a telescope. • Lab: Wien's Law.
Discuss factors affecting angular resolution.	
Explain what the emission and absorption spectra tell scientists about the composition of stars.	
Explain what an optical telescope is and how it works.	
Describe how a radio telescope works.	
Standards List:	PS4.A: Wave Properties: HS-PS4.1, HS-PS4.2, HS-PS4.5; PS4.B: Electromagnetic Radiation: HS-PS4.3

UNIT 4: STARS AND THEIR LIFE	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: Chapters 17, 18, 19, 20, and 21.
Key Objectives	Suggested Activities & Resources
Describe the sun's composition and internal structure.	• Lab: The Doppler Effect. • Lab: The Stefan-Boltzmann Law. • Lab: The Zeeman Effect. • Search for Novae.
Explain how scientists measure the basic properties of stars.	
Use the Hertzsprung-Russell Diagrams to explain the main sequence and classification of stars.	
Describe stellar evolution and the factors which contribute to a star's demise.	
Explain how the aurora works.	
Standards List:	ESS1.A: The Universe and Its Stars: HS-ESS1.1, HS-ESS1.2, HS-ESS1.3

UNIT 5: STAR GROUPINGS AND GALAXIES	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons: Chapters 2, 21, 22, 23, 24, and 25.
Key Objectives	Suggested Activities & Resources
Describe different types of interstellar regions.	• Examine interstellar materials and reddening. • Examine open clusters in the Milky Way Galaxy. • Use spectroscopy to examine active galactic nuclei.
Compare and contrast methods for determining binary and multiple star systems.	
State the structure and theories of formation of galaxies.	
Describe mapping methods for galaxies.	
Classify galaxies and explain population distributions.	
Discuss the expansion of the universe.	
Standards List:	ESS1.A: The Universe and Its Stars: HS-ESS1.2, HS-ESS1.3; PS2.B: Types of Interactions: HS-PS2.4

UNIT 6: COSMOLOGY	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: Chapters 26 and 27.
Key Objectives	Suggested Activities & Resources
Learn about early cosmologies.	• Simulate sending and receiving messages to and from extraterrestrials.
Explain Olbers' paradox.	
Examine modern mathematical cosmologies.	
Discuss SETI: the search for extraterrestrial life.	
Standards List:	ESS1.A: The Universe and Its Stars: HS-ESS1.2; PS2.B: Types of Interactions: HS-PS2.4; PS4.C: Information Technologies and Instrumentation: HS-PS4.5

Forensic Science 1

Grade(s): 11-12 Length: one semester Credit: 0.5 Prerequisites: Teacher recommendation or <i>Biology</i> and <i>Chemistry</i>	Course Overview: <i>Forensic Science</i> explores the principles & techniques of science and analyzing crime scene evidence. Emphasis is placed on laboratory techniques, scientific inquiry, communication skills, as well as aspects of the criminal justice system and the admissibility of evidence. Prior knowledge of human genetics and chemistry is preferred. Adopted Textbook: <i>Forensic Science Fundamentals and Investigations</i>. Cengage.
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Units (Recommended Order)
• Crime Scene Investigation and Documentation • Forensic Pathology • Forensic Serology • Fingerprints and Other Impressions • Forensic Anthropology

UNIT 1: CRIME SCENE INVESTIGATION AND DOCUMENTAION	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons: Chapters 1 and 2.
Key Objectives	Suggested Activities & Resources
Define forensic science.	• Mock crime scene to show how crime scenes are properly sketched, photographed, and how evidence is collected. • Digital camera to practice taking overall, medium, and close-up pictures with placards, scales, and using a photo page/photolog. • Faces computer identification software.
Demonstrate understanding of Locard's Principle of Exchange.	
Develop observation skills and understand their importance to forensic science.	
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.	
Define and provide examples of physical evidence, circumstantial evidence, and trace evidence.	
Discuss the responsibilities of law enforcement at crime scenes.	
Describe the responsibilities of expert witnesses in the judicial system.	
Standards List:	ETS1.B: Developing Possible Solutions: HS-ETS1.3, HS-ETS1.4 HS-ESS3.2, HS-ESS3.4

UNIT 2: FORENSIC PATHOLOGY	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons: Chapter 12
Key Objectives	Suggested Activities & Resources
Determine time of death using various methods including insect life cycle, livor, algor, and rigor mortis.	• Set up entomology experiments outside, using meat samples to attract insects and document decay processes. • Lab: Blunt and Sharp Force Trauma. • Post-mortem interval determination. • Guest Speakers: Handlers of search and rescue dogs.
Investigate autopsy procedures through simulation.	
Be familiar with the training and usefulness of search and rescue dogs.	
List job descriptions and training required for coroners and medical examiners.	
Identify various wounds as blunt force, sharp force, and high velocity.	
Standards List:	LS1.A. Structure & Function: HS-LS1-1, HS-LS1-2; LS1.B: HS-LS1-7, HS-LS2-3, HS-LS2-4, HS-LS2-5, LS2.A: HS-LS2-1, HS-LS2-6, HS-LS2-8

UNIT 3: FORENSIC SEROLOGY	
Suggested Pacing: 3-4 weeks	Textbook Chapter(s)/Lessons: Chapter 7
Key Objectives	Suggested Activities & Resources
Explain the antigen/antibody system of blood typing in humans. [SC.2]	• Lab: Saliva and Secretions. • Lab: Blood Splatter. • Lab: Electrophoresis. • Lab: Presumptive Fluids.
Describe the use of saliva, blood, semen, and vaginal fluid to identify and eliminate individuals from suspicion.	
Analysis of Alaska based statistics involving body fluid analysis (such as Homicide, Burglary, Sexual Assault, Kidnapping, and Substance related crimes).	
Demonstrate understanding of presumptive tests.	
Explain the difference between a secretor and non-secretor.	
Experiment with and analyze blood splatter patterns.	
Experiment with an analyze genetic profiling.	
Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	
Explain the principles behind the polymerase chain reactions.	
Explain how DNA techniques such as DQ alpha, restriction length polymorphism, short tandem repeats, and PCR can be used to narrow the list of suspects.	
Detail the advantages and disadvantages of mitochondrial and nuclear DNA for use in forensic analysis.	
Standards List:	LS1.A: Structure and Function: HS-LS1.1, LS3.A: Inheritance of Traits: HS-LS3.1

UNIT 4: FINGERPRINTS AND OTHER IMPRESSIONS	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons: Chapter 6 and 16
Key Objectives	Suggested Activities & Resources
Explain why a fingerprint is a permanent feature of human anatomy.	• Use a variety of powders to collect fingerprints on porous and non-porous surfaces. • Iodine, ninhydrin, super-glue lifts. • Cast tire tracks or shoe prints using dental stone. • http://www.scafo.org.
Classify a set of fingerprints.	
Identify ridge characteristics (minutiae) in fingerprints.	
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	
Define latent, patent, and plastic and patent prints.	
Describe the chemistry of different techniques for developing latent fingerprints.	
Practice collecting fingerprints from a variety of surfaces.	
Describe the process of casting shoe and tire-track impressions.	
Analyze impressions in dental stone.	
Standards List:	PS1.A: Structure and Properties of Matter: HS-ETS1.2; ETS1.B: Developing Possible Solutions: HS-ETS1.4, HS-ESS3.2, HS-ESS3.4

UNIT 5: FORENSIC ANTHROPOLOGY	
Suggested Pacing: 3-4 weeks	Textbook Chapter(s)/Lessons: Chapter 14
Key Objectives	Suggested Activities & Resources
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	• Bone Lab: Determine gender, height, age, and general health. • Facial reconstruction project.
Identify characteristics of a crime victim by using bones.	
Describe how a victim is identified through forensic odontology. Give examples of how forensic anthropologists can assist in crime solving.	
Participate in the art and science of facial reconstruction.	
Standards List:	ETS1.B: Developing Possible Solutions: HS-ESS3.2, HS-ESS3.4; ETS1.C: Optimizing the Design Solution: HS-ETS1.2

Forensic Science 2

Grade(s): 11-12 Length: one semester Credit: 0.5 Prerequisites: • Teacher recommendation, or • Forensic Science 1 and Geometry	Course Overview: <i>Forensic Science 2</i> is intended for the more serious forensic science students. They will build upon their forensic knowledge by investigating advanced forensic science techniques. Students will continue to apply the principles and techniques of science to analyzing crime scene evidence. Emphasis will be placed on both qualitative and quantitative engineering design, as well as aspects of the criminal justice system and the admissibility of evidence. Being familiar with human genetics and chemistry is preferred. Adopted Textbook: <i>Forensic Science Fundamentals and Investigations</i>. Cengage.
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Units (Recommended Order)
• Forensic Psychology • Questioned Documents • Forensic Toxicology • Fire Science/ Investigation • Tool Marks and Firearms/ Ballistics • Trace Evidence Analysis • Advanced DNA Analysis • Accident Reconstruction

UNIT 1: FORENSIC PSYCHOLOGY	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
- Define and apply common legal terms. - Identify the roles of prosecuting and defense attorneys in court cases.	Guest Speaker: Lawyer.
- Explain how criminal profiling can be helpful in solving crimes. - Use an understanding of brain development, genetics, and environmental factors to explain risk factors of criminal behavior.	- Watch/discuss videos on serial killers' behaviors. - Serial Killer Box Profile Gallery
Identify behaviors associated with lying and truth-telling.	Play Malarky and other lying behavior games.
Standards List:	LS1.A: Structure and Function, HS-LS2: Ecosystems: Interactions, Energy, and Dynamics LS2.D: Social Interactions and Group Behavior, GLEs: SA.1-3; SC.1-2; SF.1-3; SG.1-4

UNIT 2: QUESTIONED DOCUMENTS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: Chapter 10
Key Objectives	Suggested Activities & Resources
- Describe and demonstrate handwriting exemplars. - List some important guidelines to be followed in collecting known writing samples for use as comparisons with a questioned document. - Identify the major goals of a forensic handwriting analysis.	Handwriting Analysis Lab
- Identify several ways in which businesses prevent check forgery. - Identify real and counterfeit U.S. money.	- Microscopic Examination of Currency - Expert Analysis of Representation in Media - Catch Me If You Can - Film/Book
Standards List:	ETS1.A: Defining and Delimiting Engineering Problems, GLEs: SA.1-3; SF.1-3; SG.1-4

UNIT 3: FORENSIC TOXICOLOGY	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: Chapter 9
Key Objectives	Suggested Activities & Resources
- Identify common drugs of abuse by description. - Describe the proper collection and preservation of drug evidence.	- Guest Presenter: State Troopers & Fairbanks PD Officer - Flipbook of controlled substances
Describe the chemistry behind various ways of identifying and quantifying chemicals and drugs.	Identify (unknown) over-the-counter drugs using chemical and physical characteristics.
Explain the Controlled Substances Act.	
Standards List:	HS-LS1: From Molecules to Organisms: Structures and Processes, LS1.A: Structure and Function, HS-LS3: Heredity: Inheritance and Variation of Traits, LS3.A: Inheritance of Traits, GLEs: SA.1-3; SB.1-2; SF.1-3; SG.1-4

UNIT 4: FIRE SCIENCE/ INVESTIGATION	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Define the heat of combustion and ignition temperature.	Testing the Fire Triangle.
- Use the fire triangle to explain what elements are required for combustion. - Describe the characteristics and effects of Alaskan wildfires.	- Lab: Matchstick Forest. - Lab: Dollhouse Arson
- Identify the types of evidence left in a fire. - Describe how physical evidence is collected at the scene of a suspected arson.	Guest Speaker: Fire Marshal
Standards List:	HS-PS1: Matter and Its Interactions, PS1.B: Chemical Reactions, GLEs: SA.1-3; SB.1; SF.1-3; SG.1-4

UNIT 5: TOOL MARKS & FIREARMS/ BALLISTICS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: Chapter 18
Key Objectives	Suggested Activities & Resources
- Describe and identify types of tool mark impressions. - Explain how bullets are test-fired and matched.	Lab: Match twist patterns of Bullets
- Describe the characteristic of handguns, rifles, and shotguns and their ammunition. - List procedures for the proper collection and preservation of firearm and tool mark evidence.	Basics of Ballistics Booklet
- Determine the position of the shooter based on bullet trajectory. - Describe the rifling on a gun barrel and how it affects the flight of projectiles.	Lab: NERF Dart Gun Ballistics
Standards List:	HS-PS1: Matter and Its Interactions, PS1.B: Chemical Reactions

UNIT 6: TRACE EVIDENCE ANALYSIS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Describe the properties of fibers that are most useful for forensic comparisons.	- Fiber identification using chemical and physical properties. - Fiber identification using microscopy.
- List the important forensic properties of soil. - Describe the chemical components of paint. - Determine how density can help identify substances. - Describe the behavior of light as it travels through various substances.	- Soil collections. - Glass density experiments. - Glass impact patterns. - Patterns of bullet holes. - Refractive index.
Practice analyzing trace evidence including hairs, fibers, paints, coating, explosive, fire residues, glass, and soil.	
Standards List:	HS-PS1: Matter and Its Interactions, PS1.A: Structure and Properties of Matter, GLEs: SA.1-3; SB.1-2; SF.1-3; SG.1-4

UNIT 7: ADVANCED DNA ANALYSIS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
- Explain the differences between nuclear DNA and mitochondrial DNA. - 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.	- Study how mitochondrial DNA was used to solve the Anny Anderson/Princess Anastasia mystery. - Apply the mitochondria DNA technique to Argentina's missing children situation of the 1980's.
Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	
Explain the training and technology required to carry out current DNA analysis.	- Isolate DNA from bone and/or plant material. - Use pollen analysis to identify its source.
Standards List:	HS-LS1: From Molecules to Organisms: Structures and Processes , LS1.A: Structure and Function, HS-LS3: Heredity: Inheritance and Variation of Traits , LS3.A: Inheritance of Traits, GLEs: SA.1-3; SC.1; SF.1-3; SG.1-4

UNIT 8: ACCIDENT RECONSTRUCTION	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: Chapter 16
Key Objectives	Suggested Activities & Resources
Use physics to analyze the dynamics of a collision.	Analysis of Skid Marks
- Use measurements, sketches, after-accident diagrams and photographs to systematically investigate traffic collisions. - Make scale drawings of the accident scene.	- Measure an accident scene and make a scale drawing. - Lab: Mario Kart Accident Reconstruction
Determine blood alcohol content (BAC) from suspect's drinking history.	Determine a suspect's BAC using drinking history and math formulas.
Standards List:	HS-ETS1: Engineering Design , ETS1.B: Developing Possible Solutions , GLEs: SA.1-3; SB.4; SF.1-3; SG.1-4

Introduction to Basic Pathophysiology

Grade(s): 11-12 Length: one semester Credit: 0.5 Prerequisites: Teacher recommendation or <i>Biology</i> and <i>Human Anatomy and Physiology</i>	Course Overview: <i>Intro to Basic Pathophysiology</i> applies knowledge of normal human anatomy and physiology to promote a clear understanding of common disease processes. The course will review basic cellular function, tissue types, and body systems to compare to the body's response to injury or illness. This course is highly recommended for students interested in pursuing a career in health science. Adopted Textbook: <i>Human Disease</i>. Delmar, 2015
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Units (Recommended Order)
• Introduction to Basic Pathophysiology and Mechanism of Disease • Neoplasms/ Cancer • Heart Disease – Cardiovascular System • Immune Systems – Our Body's Defense and Treatment • Microorganisms as Infectious Agents • Pharmacology and Drug Development • Hereditary/ Genetic Disorders

UNIT 1: INTRODUCTION TO BASIC PATHOPHYSIOLOGY AND MECHANISM OF DISEASE	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons: Chapter 1
Key Objectives	Suggested Activities & Resources
Review A&P body systems, tissue types, homeostasis, and medical terminology	• Create and label a life size body poster • Research diseases of the tissue types • Use prefix, root words, and suffixes to build medical terms
Understand Pathology: acute vs chronic disease, signs vs symptoms, etiology, pathogenesis, morphology, and prognosis	• Define and practice terms with case studies • Choose a system (ex: skeletal system) and disease of that system and research the pathology • Practice application of terms with case studies
Mechanisms of Disease: heredity, trauma, infection/inflammation, hyperplasias/neoplasms, nutritional imbalance, and impaired immunity	• Practice application of terms with case studies • Case study: When eating makes you sick (Inflammatory Bowel Syndrome) • Scientific Process of Diagnosis Lab • This Podcast Will Kill You
Standards List:	Structure and Function: HS-LS1-1, HS-LS1-2, HS-LS1-3

UNIT 2: NEOPLASMS/ CANCER	
Suggested Pacing: 1-2 weeks	Textbook Chapter(s)/Lessons: Chapter 2
Key Objectives	Suggested Activities & Resources
What is cancer, how are cancer cells different than normal cells, causes, statistics, and treatments (current and future)	• Cancer stations (explore different topics)
Types of cancer and current cancer research	• Independent research and presentations • TED Talk and partner share
Cancer risk factors and preventative measures	• Interactive website • Cancer sniffing dogs and ants
Standards List:	Structure and Function: HS-LS1-1, HS-LS1-2, HS-LS1-3; Inheritance and Variation of Traits: HS-LS1-4, HS-LS3-1, HS-LS3-2, HS-LS3-3; Natural Selection and Evolution: HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5

UNIT 3: HEART DISEASE – CARDIOVASCULAR SYSTEM	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons: Chapter 8
Key Objectives	Suggested Activities & Resources
Review Cardiovascular system anatomy and physiology	- Heart and blood flow stop motion video - Build a heart model from clay
Heart disease is the number 1 killer. Learn the signs, symptoms, risk factors and treatments.	- Case studies of risk factors - Read ECGs - Virtual Cardiology Lab- HHMI Biointeractive - Live from the Heart (case study and open heart surgery video)
Standards List:	Structure and Function: HS-LS1-1, HS-LS1-2, HS-LS1-3; Inheritance and Variation of Traits: HS-LS1-4, HS-LS3-1, HS-LS3-2, HS-LS3-3; Natural Selection and Evolution: HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5

UNIT 4: IMMUNE SYSTEM – OUR BODY’S DEFENSE AND TREATMENT	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: Chapters 4 and 5
Key Objectives	Suggested Activities & Resources
Understand the inflammatory response, and innate vs adaptive immunity including the cells of the immune system (neutrophil, macrophage, T-cells, B-cells, antibodies, memory B-cells)	- Sutures and wound healing - Immune system comic - Blood typing simulation lab
Diseases of the immune system	- Research and presentations - Case study
Standards List:	Structure and Function: HS-LS1-1, HS-LS1-2, HS-LS1-3; Interdependent Relationships in Ecosystems: HS-LS2-7, HS-LS3-1, HS-LS3-2, HS-LS3-3; Natural Selection and Evolution: HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5

UNIT 5: MICROORGANISMS AS INFECTIOUS AGENTS	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Bacteria as an infectious agent: structure, reproduction, size, mode of transmission, types of diseases	• Research specific disease, presentation (Battle of Infectious Diseases in March Madness format) • Culture bacterial plates
Viruses as an infectious agent: structure, reproduction, size, mode of transmission, types of diseases	
Protozoans as an infectious agent: structure, reproduction, size, mode of transmission, types of diseases	
Fungi as an infectious agent: structure, reproduction, size, mode of transmission, types of diseases	
Helminths as an infectious agent: structure, reproduction, size, mode of transmission, types of diseases	
Standards List:	Structure and Function: HS-LS1-1, HS-LS1-2, HS-LS1-3; Matter and Energy in Organisms and Ecosystems: HS-LS1-6, HS-LS1-7, HS-LS2-4; Inheritance and Variation of Traits: HS-LS1-4, HS-LS3-1, HS-LS3-2, HS-LS3-3; Interdependent Relationships in Ecosystems: HS-LS2-7, HS-LS3-1, HS-LS3-2, HS-LS3-3; Natural Selection and Evolution: HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5

UNIT 6: PHARMACOLOGY AND DRUG DEVELOPMENT	
Suggested Pacing: 2-3 weeks	Textbook Chapter(s)/Lessons:
Key Objectives	Suggested Activities & Resources
Development and types of vaccines. How do vaccines work and what diseases do we have vaccines for?	• NOVA- Vaccines, Calling the Shots • Research the diseases vaccines prevent
Antibiotics- how they work, antibiotic resistance, replacing antibiotics with bacteriophage therapy	• On cultured bacteria, place antibiotic discs and view zone of inhibition • Antibiotic Resistance Simulation: http://antibiotics.inquiry-hub.net • Gram positive vs gram negative bacteria
Drug Development- the process of clinical trials, and the careers associated with the development of new pharmaceuticals	• HIV Drug Development role play
Standards List:	Structure and Function: HS-LS1-1, HS-LS1-2, HS-LS1-3; Matter and Energy in Organisms and Ecosystems: HS-LS1-6, HS-LS1-7, HS-LS2-4; Inheritance and Variation of Traits: HS-LS1-4, HS-LS3-1, HS-LS3-2, HS-LS3-3; Interdependent Relationships in Ecosystems: HS-LS2-7, HS-LS3-1, HS-LS3-2, HS-LS3-3; Natural Selection and Evolution: HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5

UNIT 7: HEREDITARY/ GENETIC DISORDERS	
Suggested Pacing: 1 week	Textbook Chapter(s)/Lessons: Chapter 19
Key Objectives	Suggested Activities & Resources
Understand the pathogenesis of congenital, chromosomal, and genetic diseases/disorders.	• Case studies • Karyotype lab (chromosomal disorders) • Research genetic disorder, present or share
Standards List:	Inheritance and Variation of Traits: HS-LS1-4, HS-LS3-1, HS-LS3-2, HS-LS3-3; Natural Selection and Evolution: HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5

Paleontology

Grade(s): 11-12 Length: one semester Credit: 0.5 Prerequisites: Teacher recommendation or <i>Biology</i> and <i>Chemistry</i>	Course Overview: <i>Paleontology</i> is designed to provide students an opportunity to further investigate and describe the temporal and spatial changes in Earth's flora and fauna within the context of geological processes, stratigraphy, and evolution. Another goal of the course is to demonstrate the interdependence of scientific disciplines in any investigation of large-scale patterns and events in the natural world. Consequently, the study of paleontology requires a working knowledge of more than one discipline. The course will be reading intensive with advanced articles on the subject of paleontology. Adopted Textbook: None at this time.
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Units (Recommended Order)
• Geologic Time • Precambrian Time • Paleozoic Time • Mesozoic Time • Cenozoic Time • Independent Student Research Paper and Poster Project

UNIT 1: GEOLOGIC TIME AND EXTINCTIONS	
Suggested Pacing: 2 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
Review scientific articles and develop background research.	• Measure out geologic time to scale. • Analyze Jurassic Park movie for scientific accuracy. • Compare extinction events. • Examine claims of current extinction event. • Examine geologic maps.
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.	
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.	
Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	
Construct an explanation based on evidence that the process of evolution primarily results from four factors: • The potential for a species to increase in number. • The heritable genetic variation of individuals in a species due to mutation and sexual reproduction. • Competition for limited resources. • The proliferation of those organisms that are better able to survive and reproduce in the environment.	
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.	
Standards List:	ESS1.C: The History of Planet Earth: HS-ESS1.6; ESS2.A: Earth Materials & Systems: HS-ESS1.1, HS-ESS2.2; HS-ESS2.4; ESS2.D: Weather & Climate: HS-ESS2.7; LS4.A: Evidence of Common Ancestry & Diversity: HS-LS4.1, HS-LS4-2; LS2.C: Exosystem Dynamics, Functioning, and Resilience: HS-LS2-6

UNIT 2: PRECAMBRIAN TIME	
Suggested Pacing: 1 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
Review scientific articles and develop background research.	• PhET Online Lab: http://phet.colorado.edu/en/simulation/redating-game. • Lab: Invertebrate Fossil Identification. • Mollusk dissection. • Gastropod dissection. • Use microscopes to examine microfossils. • Lab: Vertebrate Fossil Identification. • Making molds and casts of fossils. • UAF Museum tour. • Video: What killed the Dinosaurs. • Video: Making the Baby Mammoth.
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.	
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	
Review scientific articles and develop background research.	
Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in: • Increases in the number of individuals of some species. • The emergence of new species over time. • The extinction of other species.	
Standards List:	

UNIT 3: PALEOZOIC TIME	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
Review scientific articles and develop background research.	• PhET Online Lab: http://phet.colorado.edu/en/simulation/redating-game. • Lab: Invertebrate Fossil Identification. • Mollusk dissection. • Gastropod dissection. • Use microscopes to examine microfossils. • Lab: Vertebrate Fossil Identification. • Making molds and casts of fossils. • UAF Museum tour. • Video: What killed the Dinosaurs. • Video: Making the Baby Mammoth.
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.	
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	
Review scientific articles and develop background research.	
Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in: • Increases in the number of individuals of some species. • The emergence of new species over time. • The extinction of other species.	
Standards List:	

UNIT 4: MESOZOIC TIME	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
Review scientific articles and develop background research.	• PhET Online Lab: http://phet.colorado.edu/en/simulation/redating-game. • Lab: Invertebrate Fossil Identification. • Mollusk dissection. • Gastropod dissection. • Use microscopes to examine microfossils. • Lab: Vertebrate Fossil Identification. • Making molds and casts of fossils. • UAF Museum tour. • Video: What killed the Dinosaurs. • Video: Making the Baby Mammoth.
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.	
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	
Review scientific articles and develop background research.	
Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in: • Increases in the number of individuals of some species. • The emergence of new species over time. • The extinction of other species.	
Standards List:	

UNIT 5: CENOZOIC TIME	
Suggested Pacing: 4 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
Review scientific articles and develop background research.	• PhET Online Lab: http://phet.colorado.edu/en/simulation/redating-game. • Lab: Invertebrate Fossil Identification. • Mollusk dissection. • Gastropod dissection. • Use microscopes to examine microfossils. • Lab: Vertebrate Fossil Identification. • Making molds and casts of fossils. • UAF Museum tour. • Video: What killed the Dinosaurs. • Video: Making the Baby Mammoth.
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.	
Analyze geoscience data to make the claim that one-change to Earth's surface can create feedbacks that cause changes to other Earth systems.	
Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	
Review scientific articles and develop background research.	
Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	
Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	
Evaluate the evidence supporting claims that changes in environmental conditions may result in: • Increases in the number of individuals of some species. • The emergence of new species over time. • The extinction of other species.	
Standards List:	

UNIT 6: INDEPENDENT STUDENT RESEARCH PAPER AND POSTER PROJECT	
Suggested Pacing: 3 weeks	Textbook Chapter(s)/Lessons: N/A
Key Objectives	Suggested Activities & Resources
Choose a research topic appropriate to grade level.	• Invite UAF grad students to share their research with the class. • Develop a list of interests. • Draft proposal for teacher's review. • Students conduct research inside and outside the classroom. • Multiple peer revisions in class. • Research poster presentations.
Review scientific articles and develop background research.	
Write paper or develop poster using multiple teacher/mentor-reviewed drafts.	
Present the results of research to the public as scientific paper/poster and oral presentation.	
Standards List:	ETS1.B: Developing Possible Solutions: HS-ESS3.2, HS-ESS3.4



The Fairbanks North Star Borough School District is an equal employment and educational opportunity institution, as well as tobacco and nicotine-free learning and work environment.

Fairbanks North Star Borough School District
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