Alaska Adult Education

Division of Employment
and Training Services
P.O. Box 115509
Juneau, AK
(907) 465-8714

Alaska Adult Education

CONTENT STANDARDS

Content Standards for:
Science

Contents

Overview of the Alaska Adult Education Content Standards

The K–12 Science Standards for Alaska provide a strong foundation for defining what students should know and be able to do regarding scientific knowledge and skills; however, adult learners in Alaska require prioritized competencies to effectively and efficiently gain knowledge and skills to meet the demands of postsecondary training and employment, as well as real-world scientific inquiry and problem-solving. Recognizing this need, Alaska Adult Education contracted with the American Institutes for Research (AIR) to develop science standards tailored to adult learners in Alaska.

These standards do not prescribe specific classroom instruction. Instead, they provide a framework for adult educators to design effective and focused instruction. The goal is to translate the standards into curricula and lesson plans that provide rigorous instruction, enabling students to acquire the knowledge and skills necessary to apply scientific concepts in academic, professional, and personal situations. Educators can use activities, assignments, and formative and summative assessments to evaluate student progress in mastering the essential knowledge and competencies identified in the standards.

The development of these standards began with a thorough analysis of the K–12 Science Standards for Alaska, as well as consultation with the GED Assessment Guide for Educators, Science. These resources provided valuable benchmarks and insights, ensuring that the standards reflect both national high school equivalency exam expectations and Alaska's unique context. This process involved closely examining existing standards to adapt them to the needs of adult learners, paying particular attention to the realities of adult education classrooms in Alaska.

Each component of the K–12 Science Standards for Alaska was carefully reviewed and revised where necessary to ensure relevance and accessibility for adult education instructors. These revisions included refining anchor standards and level-specific standards to align with the knowledge and skills adult learners need for college and career readiness. Special attention was given to incorporating elements of physical sciences, life sciences, earth and space sciences, and engineering and technology within the Alaskan context to ensure scientific practices were both comprehensive and relevant to the local area.

The success of the development process relied heavily on collaboration with Alaska's adult educators. Their contributions, feedback, and expertise were instrumental in shaping the standards to reflect the challenges and opportunities of adult education in Alaska. This partnership ensured that the resulting standards are both rigorous and practical, offering clear pathways for learners from foundational levels through college and career readiness.

The following individuals shared their time and expertise:

Artur Zacarias
Alaska Literacy Program

Bridget Clark
University of Alaska Anchorage
Kenai Peninsula College

Linda Himebloom
University of Alaska Anchorage
Kodiak College Adult Education

List of Adult Education Science Anchor Standards

The standards that resulted from the work described above are presented in this document.

Science and Engineering Practices Standards

The science and engineering practices standards outline a set of skills and behaviors that are essential for students to engage in scientific inquiry and engineering design. They reflect the activities that scientists and engineers use to acquire evidence-based knowledge and solve problems through prototyping. They are designed to be used in concert with the content standards that describe disciplinary core ideas, as applicable. It is crucial that students apply the skills to explore the world and create solutions using these science and engineering practices.

1. Ask questions, define problems, and investigate.
2. Develop and use models.
3. Analyze and interpret data.
4. Use mathematics and computational thinking to explain and design solutions.
5. Obtain, evaluate, and communicate evidence and information.

Physical Sciences Standards

1. Demonstrate an understanding of the structure and properties of matter.
2. Demonstrate an understanding of chemical reactions.
3. Demonstrate an understanding of forces and interactions.
4. Demonstrate an understanding of energy.
5. Demonstrate an understanding of waves and electromagnetic radiation.

Life Sciences Standards

1. Demonstrate an understanding of structure and function.
2. Demonstrate an understanding of matter and energy in organisms and ecosystems.
3. Demonstrate an understanding of interdependent relationships in ecosystems.
4. Demonstrate an understanding of inheritance and variation of traits.
5. Demonstrate an understanding of natural selection and evolution.

Earth and Space Sciences Standards

1. Demonstrate an understanding of space systems.
2. Demonstrate an understanding of Earth's history.
3. Demonstrate an understanding of Earth's systems.
4. Demonstrate an understanding of weather and climate.
5. Demonstrate an understanding of human sustainability.

The Alaska Adult Education Content Standards for Science[1]

Introduction to Science Standards

Adults routinely engage with scientific concepts in areas such as healthcare decision-making, disaster preparedness, environmental concerns, workplace technologies, and climate impacts on regional industries. The Alaska Adult Education Science Standards reflect a commitment to building adult learners' real-world scientific literacy, as well as their college and career readiness. These standards emphasize inquiry, problem-solving, data analysis, and engineering design through the study of physical, life, and earth and space sciences.

The standards represent a meaningful shift in adult education, moving beyond the traditional focus on rote memorization to an emphasis on fostering scientific literacy that is relevant to adult learners' lives, careers, and communities. They are designed to:

1. Encourage deep conceptual understanding through the integration of ***disciplinary core ideas*** with ***science and engineering practices***, including questioning, investigating, evidence-based reasoning, and application to real-world contexts.
2. Build the cognitive structures needed to connect ideas across the science disciplines, using ***crosscutting concepts***—such as patterns, cause and effect, scale, proportion, quantity, systems and system models, energy and matter, structure and function, and stability and change—to guide discussions about phenomena, evidence, and data.
3. Support learning that connects students to their communities and the broader world, preparing them to make informed decisions and solve problems.

These standards set high expectations for adult learners, empowering them to use evidence to make sense of phenomena, analyze experimental designs, evaluate scientific arguments, and apply concepts to new situations and real-world scenarios.

In reading the standards, it is important to keep in mind that they identify the knowledge and skills students can demonstrate ***when they exit or master that level***. In other words, students within that level are not expected to have that knowledge and skill yet; rather, they are working toward acquiring that knowledge and skill, which may involve building some very foundational skills.

In implementing the standards, teachers should apply culturally relevant approaches in their instruction that align with the Cultural Standards for Educators and implement curriculum that meet the Cultural Standards for Curriculum. Resources that may be useful include the Alaska Native Knowledge Network and Indigenous Knowledge Systems/Alaska Native Ways of Knowing.

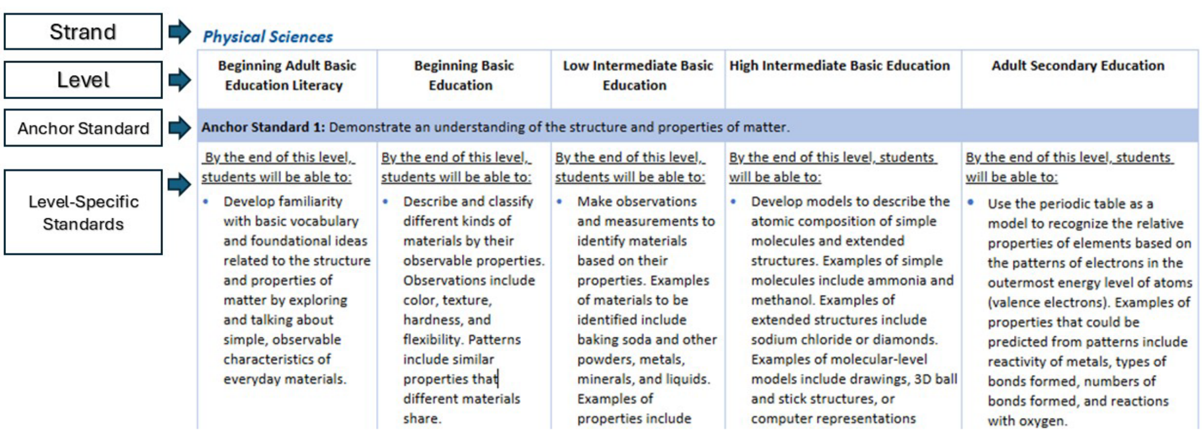
[1] Adapted from the K–12 Science Standards for Alaska.

Organization of the Science Standards

The charts below contain the science standards, from the earliest levels of learning through Adult Secondary Education. The standards have been bundled into five groups that reflect adult education levels of learning: Beginning Adult Basic Education Literacy, Beginning Basic Education, Low Intermediate Basic Education, High Intermediate Basic Education, and Adult Secondary Education.

The Alaska Science Standards consist of two distinct types: science and engineering practices standards and content anchor standards. The ***science and engineering practices standards*** outline essential skills and behaviors that are necessary for students to engage in scientific inquiry and engineering design. They are designed to be used alongside the content standards, or disciplinary core ideas, throughout the course of study. Students apply the skills to explore the world and create solutions. This encompasses asking questions; defining problems; investigating phenomena; obtaining, analyzing, and communicating evidence; and using models and computational thinking to explain and design solutions.

The ***content anchor standards*** are separated into three disciplinary strands: physical sciences, life sciences, and earth and space sciences. Each strand is headed by a strand-specific set of anchor standards that serve as the goal for all levels of learning. Each *level-specific standard* corresponds to the anchor standard with the same number. In other words, each anchor standard identifying broad science knowledge and skills has corresponding, level-specific standards, illustrating level-appropriate expectations that students at that level are working to acquire and master by the time they complete that level.



Physical Sciences

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
Anchor Standard 1: Demonstrate an understanding of the structure and properties of matter.				
By the end of this level, students will be able to: • Develop familiarity with basic vocabulary and foundational ideas related to the structure and properties of matter by exploring and talking about simple, observable characteristics of everyday materials.	By the end of this level, students will be able to: • Describe and classify different kinds of materials by their observable properties. Observations include color, texture, hardness, and flexibility. Patterns include similar properties that different materials share.	By the end of this level, students will be able to: • Make observations and measurements to identify materials based on their properties. Examples of materials to be identified include baking soda and other powders, metals, minerals, and liquids. Examples of properties include	By the end of this level, students will be able to: • Develop models to describe the atomic composition of simple molecules and extended structures. Examples of simple molecules include ammonia and methanol. Examples of extended structures include sodium chloride or diamonds. Examples of molecular-level models include drawings, 3D ball and stick structures, or computer representations	By the end of this level, students will be able to: • Use the periodic table as a model to recognize the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms (valence electrons). Examples of properties that could be predicted from patterns include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.

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Science and Engineering Practices

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
Anchor Standard 1: Ask questions, define problems, and investigate.				
By the end of this level, students will be able to: • Ask questions based on observations to find more information about the natural and human-designed world. • Make observations (firsthand or from media) to collect data that can be used to make comparisons. • Collaborate to find evidence to answer a question.	By the end of this level, students will be able to: • Ask questions that can be investigated based on patterns such as cause-and-effect relationships. • Define a simple problem that can be solved through observations or discoveries. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	By the end of this level, students will be able to: • Define a simple problem that can be solved through the development of an object, tool, process, or system. • Make observations and measurements to produce data to test a design solution or to serve as the basis for evidence for an explanation of a phenomenon. • Produce or find data to serve as the basis for evidence, ensuring the use of fair tests in which variables are controlled and the number of trials is considered.	By the end of this level, students will be able to: • Ask questions to identify and clarify evidence for an argument. • Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources, and, when appropriate, frame a hypothesis based on observations and scientific principles. • Collect data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.	By the end of this level, students will be able to: • Ask questions that arise from examining models or a theory to clarify relationships. • Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. • Plan and conduct an investigation to produce data to serve as the basis for evidence. Regarding the design, decide on the types of data, how much data, and the accuracy of data needed to produce reliable measurements; consider limitations on the precision of the data (e.g., number of trials, cost, risk, time); and refine the design accordingly. • Analyze complex real-world problems by specifying criteria and constraints for successful solutions.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
Anchor Standard 2: Develop and use models.				
By the end of this level, students will be able to: • Use a model to represent relationships in the natural world.	By the end of this level, students will be able to: • Develop models to describe phenomena.	By the end of this level, students will be able to: • Use models to describe phenomena. • Develop a model using an example to describe a scientific principle.	By the end of this level, students will be able to: • Develop and use a model to predict and/or describe phenomena. • Develop and use a model to illustrate unobservable mechanisms. • Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.	By the end of this level, students will be able to: • Use a model to predict the relationships between systems or between components of a system. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. • Use a computational model or simulation of a phenomenon, process, or system.
Anchor Standard 3: Analyze and interpret data.				
By the end of this level, students will be able to: • Use observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Analyze data from tests of an object or tool to determine if it works as intended.	By the end of this level, students will be able to: • Analyze and interpret data to make sense of phenomena using logical reasoning.	By the end of this level, students will be able to: • Represent data in graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.	By the end of this level, students will be able to: • Analyze and interpret data to determine similarities and differences in findings. • Analyze and interpret data to provide evidence for phenomena. • Construct and interpret graphical displays of data to identify linear and nonlinear relationships.	By the end of this level, students will be able to: • Analyze data using tools, technologies, and/or models to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
Anchor Standard 4: Use mathematics and computational thinking to explain and design solutions.				
By the end of this level, students will be able to: • Use the tools and materials provided to design a device that solves a specific problem.	By the end of this level, students will be able to: • Analyze and interpret data to make sense of phenomena using logical reasoning. • Use evidence (e.g., observations, patterns) to support an explanation. • Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.	By the end of this level, students will be able to: • Measure and graph quantities such as weight to address scientific and engineering questions and problems. • Describe and graph quantities such as area and volume to address scientific questions. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	By the end of this level, students will be able to: • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Construct an explanation that includes qualitative or quantitative relationships between variables that describe or predict phenomena. • Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. • Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each, which can be combined into a new solution to better meet the criteria for success.	By the end of this level, students will be able to: • Construct and/or revise an explanation based on valid and reliable evidence obtained from a variety of sources, with 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. • Apply scientific principles, ideas, and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. • Use mathematical models and/or computer simulations to predict the effects of a design solution on a system and/or interactions between systems.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
Anchor Standard 5: Obtain, evaluate, and communicate evidence and information.				
By the end of this level, students will be able to: • Communicate solutions with others in oral forms using models and/or drawings that provide detail about scientific ideas. • Read level-appropriate texts and use media to obtain scientific information to determine patterns in the natural world.	By the end of this level, students will be able to: • Obtain and combine information from books and other reliable media to explain phenomena. • Support an argument with evidence, data, or a model.	By the end of this level, students will be able to: • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. • Support an argument with evidence, data, or a model.	By the end of this level, students will be able to: • Gather, read, and synthesize information from multiple appropriate sources; assess the credibility and accuracy of each publication and the methods used; and describe how they are supported or not supported by evidence. • Use and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	By the end of this level, students will be able to: • Apply scientific reasoning to link evidence to claims to assess the extent to which the reasoning and data support the explanation or conclusion. • Integrate and communicate scientific and technical information in multiple formats (including orally, graphically, textually, and mathematically). • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations).

Physical Sciences

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
Anchor Standard 1: Demonstrate an understanding of the structure and properties of matter.				
By the end of this level, students will be able to: • Demonstrate familiarity with basic vocabulary and foundational ideas related to the structure and properties of matter by exploring and talking about simple, observable characteristics of everyday materials.	By the end of this level, students will be able to: • Describe and classify different kinds of materials by their observable properties. Observable properties include color, texture, hardness, and flexibility. Patterns include similar properties that different materials share. • Develop and use a model to illustrate that matter is made of particles too small to be seen. Examples of evidence supporting a model include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.	By the end of this level, students will be able to: • Make observations and measurements to identify materials based on their properties. Examples of materials to be identified include baking soda and other powders, metals, minerals, and liquids. Examples of properties include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility. Density is not intended to be an identifiable property.	By the end of this level, students will be able to: • Develop models to describe the atomic composition of simple molecules and extended structures. Examples of simple molecules include ammonia and methanol. Examples of extended structures include sodium chloride and diamonds. Examples of molecular-level models include drawings, 3D ball and stick structures, and computer representations showing different molecules with different types of atoms. • Develop a model that predicts and describes changes in particle motion, temperature, and the state of a pure substance when thermal energy is added or removed. The emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases the kinetic energy of particles until a change of state occurs. Examples of models include drawings and diagrams.	By the end of this level, students will be able to: • Use the periodic table as a model to recognize the relative properties of elements, based on the patterns of electrons in the outermost energy level of atoms (valence electrons). Examples of properties that could be predicted from patterns include the reactivity of metals, the types of bonds formed, the number of bonds formed, and reactions with oxygen. • Develop models to illustrate changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. The emphasis is on simple models and nuclear energy scales with applications around dating rocks, carbon dating artifacts, conducting paleoclimate studies, conducting medical imaging, tracking animal migrations via diet, age-dating meteorites, and tracking ground water flow.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
			Examples of particles include molecules or inert atoms. Examples of pure substances include water, carbon dioxide, and helium.	
Anchor Standard 2: Demonstrate an understanding of chemical reactions.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of introductory vocabulary and the main ideas related to chemical reactions.	By the end of this level, students will be able to: • Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. Examples of reversible changes include changes to materials such as water and butter at different temperatures. Examples of irreversible changes include cooking an egg, freezing a plant leaf, and burning wood.	By the end of this level, students will be able to: • 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. Examples include phase changes, dissolving, and mixing that form new substances. • Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	By the end of this level, students will be able to: • Analyze and interpret data on the properties of substances before and after they interact to determine if a chemical reaction has occurred. Examples of reactions include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride. • Develop and use a model to illustrate how the total number of atoms does not change in a chemical reaction and thus mass is conserved. The emphasis is on the law of conservation of matter and on physical models or drawings, including digital forms that represent atoms.	By the end of this level, students will be able to: • Explain 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. Examples of chemical reactions include the reaction of sodium and chlorine, of carbon and oxygen, and of carbon and hydrogen. • Interpret a model illustrating that the release or absorption of energy from a chemical reaction system depends on the changes in total bond energy. The emphasis is on chemical reactions as systems that affect energy change, modeled with molecular-level drawings and diagrams of reactions, energy graphs, and conservation.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
			• Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy through chemical processes. Examples of chemical process designs include dissolving ammonium chloride or calcium chloride and chemical heat packs. Alaskan physical examples include countercurrent exchange in the limbs and surfaces of Arctic animals (e.g., foxes, wolves, and seals) and the difference in the albedo effect of open ocean water (low albedo) versus sea ice (high albedo).	• Use scientific principles and evidence to provide an explanation for the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. The emphasis is on student reasoning focused on the number and energy of collisions between molecules. • Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. For example, use mathematical ideas to show proportional relationships between masses in reactants and products, translate these relationships to the macroscopic scale via the mole, and assess mathematical thinking rather than rote memorization.
Anchor Standard 3: Demonstrate an understanding of forces and interactions.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of introductory vocabulary related to forces and interactions.	By the end of this level, students will be able to: • Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an	By the end of this level, students will be able to: • Ask questions to determine cause-and-effect relationships of electric or magnetic interactions between two objects not in contact with each	By the end of this level, students will be able to: • Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. Examples of practical problems include the impact of collisions between	By the end of this level, students will be able to: • Use 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.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
	object. Examples include that an unbalanced force on one side of a ball can make it start moving, and that balanced forces pushing on a box from both sides will not produce any motion at all. • Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. Examples of motion with a predictable pattern include a child swinging on a swing and a ball rolling back and forth in a bowl.	other. Examples of an electric force include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper. Examples of a magnetic force 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. • Define a simple design problem that can be solved by applying scientific ideas about magnets. Examples of problems include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.	two cars, and between a car and stationary objects. • Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. The emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units. • Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. Examples of devices that use electric and magnetic forces include electromagnets, electric motors, and generators. Examples of data include the effect of the number of turns of wire on the strength of an electromagnet, the effect of increasing the number or strength of magnets on the speed of an electric motor, and a change in the range and intensity of the aurora over time.	Examples of data include tables or graphs showing position or velocity over time for objects under a net force, such as falling objects, sliding objects, or those pulled by a constant force. • Based on observations, draw conclusions to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. The emphasis is on quantitative conservation of momentum in interactions and the qualitative meaning of this principle. • Organize science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. Examples include determining the success of the device at protecting an object from damage and modifying the design to improve it (e.g., a football helmet or a parachute.)

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
			• Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. Examples of evidence for arguments include data generated from simulations or digital tools; and charts displaying mass, strength of the interaction, distance from the Sun, and orbital periods of objects within the solar system. • Evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other, even though the objects are not in contact. Examples of this phenomenon include the interactions between magnets, electrically charged strips of tape, and electrically charged pith balls.	• Interpret the cause and effect of mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. The emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields. • Explain that an electric current can produce a magnetic field, and that a changing magnetic field can produce an electric current.
Anchor Standard 4: Demonstrate an understanding of energy.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of the introductory	By the end of this level, students will be able to: • Use evidence to construct an explanation relating the speed of an object	By the end of this level, students will be able to: • Ask questions and predict outcomes about the changes in energy that occur when objects collide.	By the end of this level, students will be able to: • Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. The emphasis	By the end of this level, students will be able to: • Assess a model demonstrating the change in energy of one component in a system when the change in energy of the other component(s) and energy

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
vocabulary related to energy.	to the energy of that object. • Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.	The emphasis is on the change in energy due to the change in speed (not on the forces) as objects interact. Examples may be at different scales, such as bouncing balls, car crashes, and plate tectonics (e.g., collisions of land to land, ice to ice, and ice to land). • Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. Examples of devices 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 include the materials, cost, and time to design the device.	is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a whiffle ball versus a tennis ball. • Develop a model to illustrate that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. The emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances include the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models include representations, diagrams, pictures, and written descriptions of systems.	flows in and out of the system are known. The emphasis is on explaining the meaning of mathematical expressions used in the model (e.g., different insulation types or windows). • Use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects). For example, macroscopic phenomena include kinetic-to-thermal energy conversion, energy stored due to the position of an object above the Earth, and energy between two electrically charged plates. Models include diagrams, drawings, descriptions, and computer simulations. • Modify a device that works within given constraints to convert one form of energy into another form of energy. The emphasis is on qualitative and quantitative evaluations of devices such as Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators, considering

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
		• Obtain and combine information to describe that energy and fuels are derived from natural resources, and that their uses affect the environment. Examples of renewable energy resources include wind energy, water behind dams, tidal energy, geothermal energy, and sunlight. Non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from the burning of fossil fuels.	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. Examples of devices include an insulated box, a solar cooker, a Styrofoam cup, or traditional seasonal clothing or dwellings. • Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles, as measured by the temperature of the sample. Examples of experiments include comparing final water temperatures after different masses of ice are melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added. • Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is	constraints like renewable energy use and efficiency. • Identify patterns demonstrating the transfer of thermal energy when two components of different temperatures are combined within a closed system, resulting in a more uniform energy distribution among the components in the system (Second Law of Thermodynamics). Focus on analyzing data from student investigations and using mathematical thinking to describe energy changes both quantitatively and conceptually (e.g., mixing liquids at different temperatures or adding objects of varying temperatures to water). • Interpret a model of two objects interacting through electrical or magnetic fields to illustrate the forces between objects and changes in the energy of the objects due to the interaction (Coulomb's Law). Example models include drawings, diagrams, and texts.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
			transferred to or from the object. Examples of empirical evidence used in arguments include an inventory or other representation of energy before and after the transfer in the form of temperature changes or motion of the object.	
Anchor Standard 5: Demonstrate an understanding of waves and electromagnetic radiation.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of introductory vocabulary and ideas related to waves and electromagnetic radiation.	By the end of this level, students will be able to: • Plan and conduct investigations to provide evidence that vibrating materials can make sound, and that sound can make materials vibrate. Examples of vibrating materials that make sound include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork or a person making a hunting call.	By the end of this level, students will be able to: • Develop and use a model of waves to describe patterns in terms of amplitude and wavelength, and that waves can cause objects to move. Examples of models include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves. • Generate and compare multiple solutions that use patterns to transfer information. Examples of solutions include drums sending coded information through	By the end of this level, students will be able to: • Qualitatively and quantitatively describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. Examples include waves modeled with a jump rope, a slinky, water, seismic activity, and sound. • Develop and use a model to illustrate that waves are reflected, absorbed, or transmitted through various materials. The emphasis is on both light and mechanical waves (including sound). Examples of models include drawings, simulations, and written descriptions. Alaskan examples include whale echolocation and sonar	By the end of this level, students will be able to: • Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. Examples of data include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth. • Interpret models (a wave model or a particle model, recognizing that in some situations one model is more useful than the other) describing electromagnetic radiation. The emphasis is on how experimental evidence supports the claim and how a theory is

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
	• Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated. Examples of observations include those made in a completely dark room or a pinhole box, or a video of a cave explorer with a flashlight. • Determine the effect of placing objects made with different materials in the path of a beam of light. Examples of materials include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror). • Use tools and materials to design and build a device that uses light or sound to solve the	sound waves, using a grid of 1s and 0s representing black and white to send information about a picture, and using Morse code to send text.	projections of the sea floor and fish populations.	generally modified in light of new evidence (e.g., phenomena include resonance, interference, diffraction, and photoelectric effect.) • Summarize evidence of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. The emphasis is on photons associated with different frequencies of light with different energies and the damage to living tissue caused by electromagnetic radiation. Published materials include trade books, magazines, web resources, videos, and other passages that may reflect bias. • Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. Examples include solar cells capturing light and converting it to electricity, medical imaging, and communications technology.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
	problem of communicating over a distance. Examples of devices include a light source to send signals, paper cup and string "telephones," and a pattern of drumbeats. Explain how the device works.			

What It Looks Like in Practice

In the following scenario, an Adult Basic Education instructor designs a lesson that aligns with the standards in both physical sciences strands and earth and space sciences strands for her multilevel class (Beginning-High Intermediate Level). The class includes students with varying literacy development levels. The lesson also aligns with Science and Engineering Practices Standard, Anchor 1. The instructor introduces students to the aurora borealis through the lens of a few crosscutting concepts in science, such as cause and effect, patterns, and systems.

Implementing the Alaska Adult Education Science Standards to Support Adult Basic Education Learners

Selected Physical Sciences Standards:

- Anchor 3: Demonstrate an understanding of forces and interactions. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. (High-Intermediate Basic Education)

Selected Earth and Space Sciences Standards:

- Anchor 1: Demonstrate an understanding of space systems.
    - Use observations of the Sun, Moon, stars, and tides to describe patterns that can be predicted. (Beginning Basic Education).
    - Use evidence to explain . . . how stars send energy to Earth as radiation throughout their life cycles. (Adult Secondary Education)

Selected Science and Engineering Practices Standards:

- Anchor 1: Ask questions, define problems, and investigate. Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources, and, when appropriate, frame a hypothesis based on observations and scientific principles. (High-Intermediate Basic Education)

To activate prior knowledge, Bridget, the instructor, asks students what they know about auroras (the aurora borealis or northern lights), including cultural stories or Indigenous knowledge about the northern lights. Then, she invites students to generate investigable questions such as “Why do they appear more often in winter?” and “What causes the aurora borealis to develop?” After brainstorming with students, she introduces the concept of **cause and effect**, explaining that “causation describes a direct relationship where one event or condition (the cause) directly leads to another (the effect).”

To begin their investigation, students collaboratively record conditions when they observed auroras on a chart (**patterns**). The chart includes information such as colors of the aurora, time of year, month, time of day, and weather conditions. Bridget also invites students to share photos they’ve taken as part of the data. The class then predicts and lists the possible environmental factors (the causes) that lead to an aurora (the effect). Bridget provides sentence starters (“I noticed that…” and “A possible cause is…”) for beginning students so they can participate in the discussion.

Next, the class watches a video titled, “Northern Lights 2025: NASA Explains the Stunning Aurora Phenomenon” at https://www.youtube.com/watch?v=UY5S9N5O9Lc, explaining how charged particles from the Sun collide with gases like oxygen and nitrogen in Earth’s upper atmosphere (**systems**). Students discover that Earth’s magnetic field pushes these particles towards the poles, and the collision moves the atmospheric atoms, causing a release of energy as colorful photons or light, seen as the movement of green, pink, blue, purple, and red in the evening sky. Students add this information to their data table.

Finally, students use information from the Aurora Forecast from the Geophysical Institute at https://www.gi.alaska.edu/monitors/aurora-forecast to determine the next time the aurora would be visible in their area for real-world application.

Bridget ends the lesson by asking students to reflect on their learning by completing the following sentences on an exit ticket:

- One new cause of auroras I learned today is…
- One question I still have is…

Life Sciences

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
Anchor Standard 1: Demonstrate an understanding of structure and function.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of the introductory vocabulary and main ideas related to structure and function in life science.	By the end of this level, students will be able to: • Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. Examples of human problems that can be solved by mimicking plant or animal solutions include designing clothing or equipment to protect bicyclists by mimicking turtle shells.	By the end of this level, students will be able to: • Construct an argument that plants and animals have internal and external structures that support survival, growth, behavior, and reproduction. Examples of structures include thorns, stems, roots, colored petals, heart, stomach, lungs, brain, skin, gills, scales, and bones.	By the end of this level, students will be able to: • Find evidence that living things are made of cells, either one cell or many different numbers and types of cells. The emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells. • Use a model to illustrate the function of a cell as a whole and how the parts of cells contribute to the function. The emphasis is on the cell functioning as a whole system and on the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.	By the end of this level, students will be able to: • Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells. • Use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. For example, organism system levels include nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery, elastic tissue, or muscle within the circulatory system. • Analyze evidence that feedback mechanisms maintain homeostasis. For example, heart rate

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
			• Use an argument supported by evidence to explain how the body is a system of interacting subsystems composed of groups of cells. The emphasis is on a conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples include the interaction of subsystems within a system and the normal functioning of those systems. • Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.	response to exercise, stomate response to moisture and temperature, and root development in response to water levels.
Anchor Standard 2: Demonstrate an understanding of matter and energy in organisms and ecosystems.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of the introductory vocabulary related to matter and energy in	By the end of this level, students will be able to: • Use observations to describe patterns in what plants and animals (including humans) need to survive. Examples of patterns include that	By the end of this level, students will be able to: • Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the	By the end of this level, students will be able to: • 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	By the end of this level, students will be able to: • Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. Models include diagrams, chemical

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
organisms and ecosystems.	animals need to take in food, while plants do not; different kinds of animals need different kinds of food; plants require light; and all living things need water.	Sun. Examples of models include diagrams and flow charts. • Support an argument that plants get the materials they need for growth chiefly from air and water. The emphasis is on the idea that plant matter comes mostly from air and water, not from the soil. • Develop and describe a model that illustrates the movement of matter among plants, animals, decomposers, and the environment. The 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 include organisms, ecosystems, and the Earth.	organisms. The emphasis is on tracing the role of vegetation in the movement of matter and flow of energy. Alaskan examples include caribou eating lichen through the winter, forests and other ecosystems thriving with the contribution of decaying salmon, and the role of phytoplankton and seaweed in the marine food chain. • Develop a model to illustrate how food is rearranged through chemical reactions, forming new molecules that support growth and/or release energy as this matter moves through an organism. The emphasis is on describing that molecules are broken apart and put back together, and that energy is released in this process. • Analyze and interpret data to provide evidence of the effects of resource availability on organisms and populations of	equations, and conceptual models. • Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. The emphasis is on using evidence from models and simulations to support explanations. • 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. • Identify the cycling of matter and flow of energy in aerobic and anaerobic conditions. The emphasis is on a conceptual understanding of the role of aerobic and anaerobic respiration in different environments.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
			organisms in an ecosystem. The emphasis is on cause-and-effect relationships between resources and the growth of individual organisms and the number of organisms in ecosystems during periods of abundant and scarce resources. This emphasis should include local ecosystem processes and traditional native ways of knowing. • Develop a model to illustrate the cycling of matter and flow of energy among living and non-living parts of an ecosystem. The emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system. Examples should include the food web, energy pyramid, and cycles of water, oxygen, nitrogen, and carbon. Alaska references include	• Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. Examples of models include simulations and mathematical models.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
			animal scat/droppings contributing nutrients to tundra and other ecosystems. • Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. The emphasis is on recognizing patterns in data, evaluating the validity of and analyzing the evidence, and making logical inferences that explain or predict changes in population based on physical or biological changes.	
Anchor Standard 3: Demonstrate an understanding of interdependent relationships in ecosystems.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of introductory vocabulary and main ideas related to interdependent relationships in ecosystems.	By the end of this level, students will be able to: • Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. Examples of relationships include that deer eat buds and leaves and therefore usually live in forested	By the end of this level, students will be able to: • Construct an argument that some animals form groups that help members survive. Alaska examples may include wolves, musk ox, caribou, and schools of fish.	By the end of this level, students will be able to: • Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. The emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between	By the end of this level, students will be able to: • Use mathematical and/or computational representations to support explanations of factors that affect the carrying capacity of ecosystems at different scales, as well as biodiversity and populations in ecosystems

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
	areas; and grasses need sunlight, so they often grow in meadows. Plants, animals, and their surroundings make up a system. An Alaskan example is the return of salmon to streams and rivers as part of an ecosystem that includes bears, birds, other fish, insects, and streamside plants. Explain the characteristics of the model and the relationships. • Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. Examples of human impacts on the land include cutting trees to produce paper and using resources to produce bottles. Examples of solutions include reusing paper and recycling cans and bottles.		organisms and abiotic components of ecosystems. Examples of types of interactions include competitive, predatory, and mutually beneficial interactions. • Evaluate competing design solutions for maintaining biodiversity and ecosystem services. Examples of ecosystem services include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints include scientific, economic, and social considerations.	of different scales. The emphasis is on quantitative analysis and the comparison of relationships among interdependent factors (such as boundaries, resources, climate, and competition), using models like graphs, charts, histograms, and population data to identify trends and averages. Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data. • Evaluate evidence and reasoning on how ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, and how ecosystems adapt to change. Design practical strategies to reduce human impact on the environment and biodiversity.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
				• Evaluate evidence on the impact of group behavior on individuals' and species' chances of surviving and reproducing. The emphasis is on (1) distinguishing between group and individual behavior; (2) identifying evidence of group outcomes; and (3) developing logical arguments using examples of group behaviors, like flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming. • Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. The emphasis is on testing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
Anchor Standard 4: Demonstrate an understanding of inheritance and variation of traits.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of introductory vocabulary related to the inheritance and variation of observable traits (e.g., size, color, or shape).	By the end of this level, students will be able to: • Examine data to provide evidence that plants and animals have traits inherited from parents, and that variation in these traits exists in a group of similar organisms. Patterns are similarities and differences in traits shared between offspring and their parents, or among siblings. The emphasis is on organisms other than humans. • Use evidence to support the explanation that traits can be influenced by the environment. Examples of the environment affecting a trait include that normally tall plants grown with insufficient water are stunted; a pet dog that is given too much food and too little exercise may become overweight; and plants and animals differ in Arctic regions versus non-Arctic regions.	By the end of this level, students will be able to: • Develop models to describe that organisms have unique and diverse life cycles, but all have in common birth, growth, reproduction, and death. Changes that organisms, such as salmon, wooly bear caterpillars, and frogs, go through during their life form a pattern.	By the end of this level, students will be able to: • Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. Examples of local environmental conditions include the availability of food, light, space, and water. Examples of genetic factors include large breed cattle and species of grass affecting the growth of organisms. Examples of evidence include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds. Alaskan examples include fish sizes/populations in freshwater versus salt water or varying water temperatures, deer size	By the end of this level, students will be able to: • Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. • Ask questions to clarify relationships regarding the role of DNA and chromosomes in coding instructions for characteristic traits passed from parents to offspring. • Develop and justify a conclusion using evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. The emphasis is on using data to support arguments for the way variation occurs.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
	• Use evidence to construct an explanation for how variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. Examples of cause-and-effect relationships could be that plants with larger thorns than other plants may be less likely to be eaten by predators, and that animals with better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.		and color (Sitka blacktail deer), and bear size and color. • Develop and use a model to illustrate why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects on the structure and function of the organism. The emphasis is on a conceptual understanding that changes in genetic material may result in making different proteins, and that the changes can have far-reaching effects. • Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms. The emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection	• Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. The emphasis is on using mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
			(such as genetic modification, animal husbandry, gene therapy) and the impact these technologies have on society, as well as the technologies leading to these scientific discoveries.	
Anchor Standard 5: Demonstrate an understanding of natural selection and evolution.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of the introductory vocabulary related to natural selection and evolution.	By the end of this level, students will be able to: • Discover and discuss evidence that in a particular habitat, some organisms can survive well, some survive less well, and some cannot survive at all. Organisms and their habitat make up a system in which the parts depend on each other. • Analyze and discuss 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. Examples of environmental changes include changes in land characteristics, water	By the end of this level, students will be able to: • Analyze and interpret data from fossils to provide evidence of organisms and the environments in which they lived long ago. Examples of fossils and environments include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.	By the end of this level, students will be able to: • Analyze and interpret data on 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. The emphasis is on finding patterns in changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers. • Apply scientific ideas to construct an explanation for the anatomical	By the end of this level, students will be able to: • Analyze and communicate scientific evidence for biological evolution supported by multiple factors such as (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. The emphasis is on a conceptual

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
	distribution, temperature, food, and other organisms. Solutions may be created or provided. Students describe how well the proposed solution meets the given criteria and constraints to reduce the impact of the problem created by the environmental change in the system.		similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. The emphasis is on comparing anatomical differences, such as field experiences using dichotomous and other types of keys, in order to explain evolutionary relationships among organisms in terms of similarities or differences in the gross appearance of anatomical structures. • Analyze displays of pictorial data to compare patterns in similarities in embryological development across multiple species to identify relationships not evident in the fully formed anatomy. The emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.	understanding of how each line of evidence supports common ancestry and biological evolution, using examples such as DNA sequence similarities, anatomical structures, and order of appearance of structures in embryological development. • Analyze data using statistical and probabilistic methods and explain how natural selection favors advantageous heritable traits, resulting in adaptations within populations over time. The emphasis is on analyzing shifts in the numerical distribution of traits and using these shifts as evidence to support explanations. • Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
			• Construct and present an evidence-based explanation of how genetic variations in traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. The emphasis is on using simple probability statements and proportional reasoning to construct explanations. • Use mathematical representations to support explanations of how natural selection may lead to increases and decreases in specific traits in populations over time. The emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.	over time, and (3) the extinction of other species. The emphasis is on determining cause-and-effect relationships between environmental changes such as deforestation, fishing, pollution, erosion, permafrost thawing, changes in sea ice, invasive species, land level changes due to earthquakes, and other factors, and their impact on the distribution or disappearance of species' traits.

Earth and Space Sciences

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
Anchor Standard 1: Demonstrate an understanding of space systems.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of the introductory vocabulary related to space systems and their patterns, such as the Sun and Moon moving across the sky and stars appearing at night.	By the end of this level, students will be able to: • Use observations of the Sun, Moon, stars, and tides to describe patterns that can be predicted. Examples of patterns 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. • Make and graph observations at different times of year to relate the amount of daylight to the time of year, and graph findings. The emphasis is on relative comparisons between the amount of daylight in the winter and the amount in the spring or fall. For example, discuss Earth's axial tilt and the high variability of daylight hours in Alaska compared to the average in the lower 48 locales.	By the end of this level, students will be able to: • Support an argument that the gravitational force exerted by Earth on objects is directed toward the center of the Earth. "Down" is a local description of the direction that points toward the center of the spherical Earth. • Support an argument that differences in the apparent brightness of the Sun compared to other stars are due to their relative distances from the Earth. • Represent data in graphical displays to reveal patterns in daily changes in the length and direction of shadows, day and night, the daily appearance of the Moon, and the seasonal appearance of some stars in the night sky. Examples of patterns include the position and motion of	By the end of this level, students will be able to: • Develop and use a model to explain how the positions of the Earth, Sun, and Moon in a system and the cyclic patterns of each cause lunar phases and eclipses of the Sun and Moon. Models can be physical, graphical, or conceptual. • Develop and use a model to explain how the seasons occur. Reference Alaskan community latitudes and how their position on Earth affects the severity of seasons for different regions in Alaska. Compare and describe the seasons of the northern hemisphere and the southern hemisphere. • Develop and use a model to illustrate the role of gravity in the motions within galaxies and the solar system. The emphasis for the model is on gravity as the force	By the end of this level, students will be able to: • Use evidence to explain how the Sun's life span is driven by nuclear fusion in its core, and how stars send energy to Earth as radiation throughout their life cycles. The emphasis is on how nucleosynthesis and element formation vary with a star's mass and life stage, and how energy transfers from nuclear fusion in the Sun's core to reach Earth, with applications such as solar flares, auroras, and the 11-year sunspot cycles. • Construct an explanation of the Big Bang theory using computational representations to analyze astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. The emphasis is on the astronomical evidence

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
		Earth with respect to the Sun and selected stars that are visible only in particular months.	that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models are physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) and conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state.) • Analyze data to determine the scale properties of objects in the solar system. The emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital	for the universe's expansion, including red-shifted light from galaxies, cosmic microwave background radiation, and the observed matter composition (¾ hydrogen, ¼ helium) matching Big Bang predictions. • Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. The emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
			radius. Examples of data include statistical information, drawings and photographs, and models	
Anchor Standard 2: Demonstrate an understanding of Earth's history.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of the introductory vocabulary and observe changes to the Earth over time—erosion, weathering, or seasonal changes.	By the end of this level, students will be able to: • Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. Examples of variables to test include the angle of the 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. • Analyze and interpret data from maps to describe patterns of Earth's features. Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental	By the end of this level, students will be able to: • Construct and present an evidence-based explanation of how geoscience processes have changed Earth's surface at varying time and spatial scales. The emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) are usually gradual but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition	By the end of this level, students will be able to: • Construct and explain, using evidence from rock strata, how the geologic time scale is used to organize Earth's 4.6-billion-year history. The emphasis is on how analyses of rock formations and the fossils they contain are used to establish the relative ages of major events in Earth's history. Examples of Earth's major events range from the very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living	By the end of this level, students will be able to: • Evaluate evidence of past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. The emphasis is on the ability of plate tectonics to explain the ages of crustal rocks, using evidence such as oceanic crust increasing with distance from mid-ocean ridges, and the ages of North American continental crust decreasing with distance away from a central ancient core of the continental plate. • Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
	boundaries, volcanoes, and earthquakes.	by the movements of water, ice, and wind. The emphasis is on geoscience processes that shape local geographic features, where appropriate. Alaskan examples should include locally significant landforms such as coastal or ocean sea floor structures.	organisms, or significant volcanic eruptions. • Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions. Examples of data include the similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).	early history. Examples of evidence include the absolute ages of ancient materials, the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces. • Draw conclusions using a model, illustrations, or a diagram to explain how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. The emphasis is on how landforms (mountains, valleys, and plateaus) and sea floor features (trenches, ridges, and seamounts) result from constructive forces (volcanism, tectonic uplift, and orogeny) and destructive mechanisms (weathering, mass wasting, and coastal erosion).

Beginning Adult Basic Education Literacy	Beginning Basic Education	Low Intermediate Basic Education	High Intermediate Basic Education	Adult Secondary Education
Anchor Standard 3: Demonstrate an understanding of Earth's systems.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of the introductory vocabulary and concepts related to Earth's systems such as land, water, air, and living things.	By the end of this level, students will be able to: • Use information from several sources to provide evidence that Earth events can occur quickly or slowly. Examples of events and timescales include volcanic explosions, earthquakes, tsunamis, avalanches, and landslides, which happen quickly; and events such as the erosion of rocks and movement of glaciers, which occur slowly. Alaska has more than 130 volcanoes and had one of the largest earthquakes in history. The 1964 Alaska Earthquake caused significant tsunamis and damage. • Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. Examples of solutions include different designs of dikes and windbreaks to hold back wind and water; and different designs for using	By the end of this level, students will be able to: • Develop a model using an example to describe how the geosphere, biosphere, hydrosphere (water), cryosphere (ice), and/or atmosphere interact. Examples 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. For Alaska, collision between the Pacific Plate and the North American Plate causes frequent earthquakes and volcanic activity (geosphere) and builds mountains that dictate wind patterns (atmosphere) and create diverse river and stream habitats (hydrosphere) essential for the genetic diversity of salmon populations (biosphere).	By the end of this level, students will be able to: • Develop a model to illustrate the cycling of Earth's materials and the flow of energy that drives this process. The emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycle of Earth's materials. • Develop a model to illustrate the cycling of water through Earth's systems, driven by energy from the Sun and the force of gravity. The emphasis is on how water changes its state as it moves through the multiple pathways of the hydrologic cycle. Models can be conceptual or physical. • Construct an evidence-based explanation for how uneven distributions of	By the end of this level, students will be able to: • Analyze geoscience data to evaluate claims that one change to Earth's surface creates feedback that causes changes to other Earth systems. The emphasis is on climate and system feedback, such as greenhouse gas–driven warming that accelerates ice melt and reduces reflectivity, and other interactions like permafrost thawing, vegetation loss increasing runoff and erosion, dammed rivers altering groundwater and sediment transport, and wetland loss reducing local humidity. • Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. The emphasis is on Earth models: a one-dimensional radial structure based on density and a 3D model driven by mantel convection and

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	shrubs, grass, and trees to hold back the land. Discuss the solutions for controlling erosion. • Develop a model to represent the shapes and kinds of land and bodies of water in an area. Discuss the features of the models. • Obtain information to identify where water is found on Earth and that it can be solid or liquid.	• Describe and graph the amounts of salt water and freshwater in various reservoirs to provide evidence about the distribution of water on Earth. Examples include lakes, rivers, glaciers, sea ice, oceans, groundwater, and polar ice caps. Interpret the data represented by the graphical displays. Alaska holds the majority of the glaciers in the United States. • Obtain and combine information about how individual communities use science ideas to protect the Earth's resources and environment.	Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. The emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of unevenly distributed resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).	plate tectonics, supported by evidence such as seismic wave maps, magnetic field change records, and high-pressure experiments on layer composition. • Illustrate the properties of water and its effects on Earth materials and surface processes. The emphasis is on mechanical and chemical investigations with water and solids to show connections between hydrologic and rock cycles, using examples like stream transport, beach erosion, frost wedging, chemical weathering, recrystallization, and melt generation. • Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. The emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil,

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				permafrost, and biosphere (including humans), providing the foundation for living organisms. • Develop a claim based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. The emphasis is on how interactions between the biosphere and Earth's systems drive evolutionary change and reshape the planet, such as oxygen production altering the atmosphere, microbes forming soil for plants, and corals creating reefs that influence coastlines and biodiversity
Anchor Standard 4: Demonstrate an understanding of weather and climate.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of the introductory vocabulary related to weather and climate; and describe everyday weather and basic weather patterns over time.	By the end of this level, students will be able to: • Make observations to determine the effect of sunlight on Earth's surface. Examples of Earth's surfaces include sand, soil, rocks, and water. • Use tools and materials to design and build a structure that will reduce	By the end of this level, students will be able to: • Collect data to provide evidence on how the motions and complex interactions of air masses result in changes in weather conditions. The emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather	By the end of this level, students will be able to: • Develop and use a model to illustrate how unequal heating and rotation of the Earth cause patterns in atmospheric and oceanic circulation that determine regional climates. The emphasis is on how patterns vary by latitude, altitude, and	By the end of this level, students will be able to: • Use a model to illustrate how variations in the flow of energy into and out of Earth's systems result in changes in climate. For example, causes of climate change differ by timescale: 1-10 years – large volcanic eruption, ocean circulation; 10s to 100s of

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	the warming effect of sunlight on an area. Examples of structures include umbrellas, canopies, and tents that minimize the warming effect of the Sun. Explain the characteristics of the structure and their effect on the temperature. • Use and share observations of local weather conditions to describe patterns over time. Examples of qualitative observations include descriptions of the weather (such as sunny, cloudy, rainy, and warm). Examples of quantitative observations include the number of sunny, windy, and rainy days in a month. Examples of patterns include that it is usually cooler in the morning than in the afternoon, and that there are different numbers of sunny days versus cloudy days in different months. • Ask questions to obtain information about the purpose of weather	(defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can occur when different air masses collide. The emphasis is also on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).	geographic land distribution. For atmospheric circulation, the emphasis is on sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds. For ocean circulation, the emphasis is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models include diagrams, maps and globes, and digital representations. • Ask questions to clarify evidence on the factors that have caused the rise in global temperatures over the past century. Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of	years – human activity, solar output; 10s of thousands to 100s of thousands of years – Earth's orbit and axis orientation; and 10s of millions to 100s of millions of years – atmospheric composition. • Analyze geoscience data and the results from global climate models to make an evidence-based forecast of global or regional climate change and associated future impacts on Earth's systems. Examples of evidence include climate changes (such as changes in precipitation and temperature) and their associated impacts (for example, on sea levels, glacial ice volumes, and physical and chemical characteristics of the atmosphere and ocean).

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	forecasting (rain, snow, ice, sleet, and hail) to prepare for, and respond to, severe weather.		evidence include tables, graphs, and maps of global and regional temperatures and chemistry (both ocean and land surface), sea ice cover, permafrost, glacial change, atmospheric levels of gases such as carbon dioxide and methane, food availability locally and worldwide, and rates of human activities. The emphasis is on the major role that human activities play in causing the rise in global temperatures.	
Anchor Standard 5: Demonstrate an understanding of human sustainability.				
By the end of this level, students will be able to: • Demonstrate, with support, an understanding of the introductory vocabulary related to human sustainability in a local environment (e.g., reducing waste, saving water, or keeping outdoor spaces clean).	By the end of this level, students will be able to: • Communicate solutions that will reduce the impact of humans on land, water, air, and/or other living things in the local environment. Examples of human impact on the land include cutting trees to produce paper and using resources to produce bottles. Examples of solutions include reusing	By the end of this level, students will be able to: • Obtain and combine information on how individual communities use science ideas to protect the Earth's resources and environment. • Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate	By the end of this level, students will be able to: • Apply scientific principles to design a method for monitoring and minimizing human impact on the environment. Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions	By the end of this level, students will be able to: • Construct an explanation based on evidence for how the availability of natural resources, the occurrence of natural hazards, and changes in climate have influenced human activity. Examples include access to freshwater, regions of fertile soil, and high concentrations of minerals, wildlife, fish,

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	paper and recycling cans and bottles.	their effects. The emphasis is on how some natural hazards (such as volcanic eruptions and severe weather) are preceded by phenomena that allow for reliable predictions, while others (such as earthquakes) occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass waste and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data include the locations, magnitudes, and frequencies of natural hazards. Examples of technologies include global technologies (such as satellite systems to monitor hurricanes or forest fires) and local technologies (such as building basements in tornado-prone regions or reservoirs to mitigate	that reduce that impact. Examples of human impacts include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land). • Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. Examples of evidence include grade-appropriate databases on human populations and rates of consumption of food and natural resources (such as freshwater, minerals, and energy). Examples of impacts include changes to the appearance, composition, and structure of Earth's systems, as well as the	trees, and fossil fuels; natural hazards (volcanic all types of mining, the eruptions and earthquakes); surface processes (tsunamis, mass waste, and soil erosion); and severe weather (hurricanes, floods, storm surges, etc.). Results of climate change include mass migrations, changes in sea levels, changes in regional patterns of temperature and precipitation, changes in stream or ocean water temperatures and/or chemistry, and changes in the types of food that are accessible. • Compare and contrast competing design solutions for developing, managing, and using energy and mineral resources based on cost-benefit ratios. The emphasis is on conserving, recycling and reusing resources (minerals and metals) where possible, and minimizing impacts where it isn't possible.

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		droughts). Alaskan examples should include but are not limited to tsunamis, storm surges, landslides, volcanic eruptions, and earthquakes.	rates at which they change. The consequences of increases in human populations and the consumption of natural resources are described by science, but science does not make decisions about the actions society takes.	Examples include developing best practices for agricultural soil use, all types of mining, the extraction of fossil fuels, and the collection of renewable resources. • Use a computational simulation to evaluate relationships among the management of natural resources, the sustainability of human populations, and biodiversity. Examples of factors influencing resource management include extraction costs, waste handling, consumption, and technology. Examples of factors influencing human sustainability include agricultural efficiency, conservation, and urban planning. • Evaluate or refine a technological solution that reduces the impacts of human activities on natural systems. Examples of data capturing human impact include changes in

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				pollutant levels, biomass, species diversity, and land use. Limitations on future impacts range from local efforts (reducing, reusing, and recycling resources)to large-scale geoengineering design solutions (alteration of global temperatures by making large changes to the atmosphere or ocean). • Use a computational representation to illustrate relationships among Earth systems and how those relationships are being modified due to human activity. Examples of human activities that can impact multiple Earth systems (hydrosphere, atmosphere, cryosphere, geosphere, biosphere) include increased CO_2, boosting land biomass while causing ocean acidification that harms marine life.

What It Looks Like in Practice

In the following scenario, Adult Secondary Education students investigate the scientific principles that explain orbital motion, while also learning to evaluate the credibility of scientific claims. The lesson begins by responding to a student's question about the Moon landing, prompting the class to examine how evidence, source reliability, and scientific reasoning support accepted explanations. Students then explore Newtonian gravitational laws through computational models to understand how planets, moons, and satellites maintain their orbits. By connecting these concepts to real-world satellite applications in Alaska, the lesson integrates critical thinking with foundational space science understanding.

Implementing the Alaska Adult Education Science Standards to Support Adult Secondary Education Learners

Selected Earth and Space Sciences Standards:

- Anchor 1: Demonstrate an understanding of space systems. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. (Adult Secondary Education)

Selected Science and Engineering Practices Standards:

- Anchor 5: Obtain, evaluate, and communicate evidence and information. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (Adult Secondary Education)

In Linda's Adult Secondary Education class, a student asks, "What about the Moon landing? Did it really happen? My friend said the footprint wasn't real." Linda decides to use the moment to reinforce the idea of evaluating claims, evidence, and reasoning, emphasizing the importance of identifying credible sources when examining scientific explanations.

Linda asks students to compare a few websites related to the Moon landing. Students examine domain names, publication dates, and site ownership to determine the credibility of each source. As a class, they compare information from those websites with information from https://www.nasa.gov/, noting the differences in purpose, reliability, and evidence provided. On the NASA page, students explore high resolution images from the Apollo missions and recorded observations about the physical evidence supporting lunar exploration, including astronaut footprints, mission timelines, and returned lunar rock samples.

Next, Linda connects space travel to the laws of orbital motion or orbital mechanics. She asks the class if they know how rockets get satellites into orbit, what an orbit is, and how spacecraft stay in orbit around planets and moons. The discussion covers Newton's gravitational law, how gravitational force and velocity interact to produce orbital motion, and how the laws of orbital motion apply to the Moon orbiting the Earth. Students note these concepts in https://spaceplace.nasa.gov/launching-into-space/en/ and part of a video discussion on satellites, https://www.youtube.com/watch?v=DVHVc9Td580, where an astronomer mentions LEO (Low Earth Orbit). Then, using a simple computational simulation, such as the one from the University of Colorado at https://phet.colorado.edu/en/simulations/gravity-and-orbits, students explore how changes in mass, distance, and speed affect whether an object maintains orbit or not.

Finally, to connect the uses of satellites to the local environment, Linda introduces examples of satellites used to collect data and monitor conditions in Alaska at https://avo.alaska.edu/. The class ends with students discussing what they have learned about the laws of orbital motion and how they know the information is credible.