



Prepared Graduates:

3. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how energy is transferred and conserved.

Grade Level Expectation:

1. The faster an object moves the more energy it has.

Evidence Outcomes

Students Can:

- a. Use evidence to construct an explanation relating the speed of an object to the energy of that object. (4-PS3-1) (*Clarification Statement: Examples of evidence relating speed and energy could include change of shape on impact or other results of collisions.*) (*Boundary Statement: Does not include quantitative measures of changes in speed of an object or on any precise or quantitative definition of energy.*)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Use evidence (e.g., measurements, observations, patterns) to construct an explanation (Constructing Explanations and Designing Solutions) (Entrepreneurial: Inquiry/Analysis)

Elaboration on the GLE:

1. Students can answer the questions: What is energy?
2. PS3:A Definitions of Energy: The faster a given object is moving, the more energy it possesses. Energy can be moved from place to place by moving objects or through sound, light or electric currents.

Cross Cutting Concepts:

1. Energy and Matter: Energy can be transferred in various ways and between objects.



Prepared Graduates:

3. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how energy is transferred and conserved.

Grade Level Expectation:

2. Energy can be moved from place to place.

Evidence Outcomes

Students Can:

- a. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat and electric currents. (4-PS3-2)
(Boundary Statement: Does not include quantitative measurement of energy.)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause - and - effect relationships. (Asking Questions and Defining Problems) (Entrepreneurial: Inquiry/Analysis).
2. Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (Planning and Carrying Out Investigations) (Personal: Personal responsibility).

Elaboration on the GLE:

1. Students can answer the questions: What is meant by conservation of energy? How is energy transferred between objects or systems?
2. PS3:B Conservation of Energy and Energy Transfer: Energy is present whenever there are moving objects, sound, light or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. Light also transfers energy from place to place. Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.

Cross Cutting Concepts:

1. Energy and Matter: Energy can be transferred in various ways and between objects



Prepared Graduates:

3. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how energy is transferred and conserved.

Grade Level Expectation:

3. When objects collide contact forces transfer so as to change objects' motion.

Evidence Outcomes

Students Can:

- a. Ask questions and predict outcomes about the changes in energy that occur when objects collide. (4-PS3-3) (*Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.*) (*Boundary Statement: Does not include quantitative measures of energy.*)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause - and - effect relationships (Asking Questions and Defining Problems) (Personal: Personal responsibility).

Elaboration on the GLE:

1. Students can answer the question: How are forces related to energy?
2. PS3:C Relationships Between Energy and Forces: When objects collide, the contact forces transfer energy so as to change the objects' motions.

Cross Cutting Concepts:

1. Energy and Matter: Energy can be transferred in various ways and between objects.



Prepared Graduates:

3. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how energy is transferred and conserved.

Grade Level Expectation:

4. Energy can be produced, used or released by converting stored energy.

Evidence Outcomes

Students Can:

- a. Apply scientific ideas to design, test and refine a device that converts energy from one form to another. (4-PS3-4) (*Clarification Statement: Examples of evidence relating speed and energy could include change of shape on impact or other results of collisions.*) (*Boundary Statement: Does not include quantitative measures of changes in speed of an object or on any precise or quantitative definition of energy.*)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Apply scientific ideas to solve design problems. (Constructing Explanations and Designing Solutions) (Entrepreneurial: Inquiry/Analysis).

Elaboration on the GLE:

1. Students can answer the questions: How do food and fuel provide energy? If energy is conserved, why do people say it is produced or used?
2. PS3:D Energy in Chemical Processes and Everyday Life: The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use.

Cross Cutting Concepts:

1. Energy and Matter: Energy can be transferred in various ways and between objects.
2. Influence of Engineering, Technology and Science on Society and the Natural World: Engineers improve existing technologies or develop new ones.
3. Science is a Human Endeavor: Most scientists and engineers work in teams. Science affects everyday life.

Prepared Graduates:

4. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how waves are used to transfer energy and information.

Grade Level Expectation:

5. Waves are regular patterns of motion.

Evidence Outcomes

Students Can:

- a. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. (4-PS4-1)
(Clarification Statement: Examples of models could include diagrams, analogies and physical models using wire to illustrate wavelength and amplitude of waves.) (Boundary Statement: Does not include interference effects, electromagnetic waves, non-periodic waves or quantitative models of amplitude and wavelength.)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Develop a model using an analogy, example or abstract representation to describe a scientific principle. (Developing and Using Models) ((Personal: Initiative/Self-direction).

Elaboration on the GLE:

1. Students can answer the question: What are the characteristic properties and behaviors of waves?
2. PS4:A Wave Properties: Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets the beach. Waves of the same type can differ in amplitude (height of waves) and wavelength (spacing between wave peaks).

Cross Cutting Concepts:

1. Patterns: Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.



Prepared Graduates:

4. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how waves are used to transfer energy and information.

Grade Level Expectation:

6. An object can be seen when light reflected from its surface enters the eyes.

Evidence Outcomes

Students Can:

- a. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (4-PS4-2) (*Boundary Statement: Does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision or how the retina works.*)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Develop a model to describe phenomena. (Developing and Using Models) (Personal: Initiative/Self-direction).

Elaboration on the GLE:

1. Students can answer the questions: What is light? How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there?
2. PS4:B Electromagnetic Radiation: An object can be seen when light reflected from its surface enters the eyes.

Cross Cutting Concepts:

1. Cause and Effect: Cause - and - effect relationships are routinely identified.



Prepared Graduates:

4. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how waves are used to transfer energy and information.

Grade Level Expectation:

7. Patterns can encode, send, receive and decode information.

Evidence Outcomes

Students Can:

- a. Generate and compare multiple solutions that use patterns to transfer information. (4-PS4-3) *(Clarification Statement: Examples of solutions could include drums sending coded information through 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.)*

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (Constructing Explanations and Designing Solutions) (Entrepreneurial: Inquiry/Analysis).

Elaboration on the GLE:

1. Students can answer the question: How are instruments that transmit and detect waves used to extend human senses?
2. PS4:C Information Technologies and Instrumentation: Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information – convert it from digitized form to voice – and vice versa.

Cross Cutting Concepts:

1. Patterns: Similarities and Differences in patterns can be used to sort and classify designed products.
2. Interdependence of Science and Engineering, and Technology: Knowledge of relevant scientific concepts and research findings is important in engineering.



Prepared Graduates:

5. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how individual organisms are configured and how these structures function to support life, growth, behavior and reproduction.

Grade Level Expectation:

1. Organisms have both internal and external structures that serve various functions.

Evidence Outcomes

Students Can:

- a. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior and reproduction. (4-LS1-1) (*Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lungs, brain and skin.*) (*Boundary Statement: Stress at this level is on understanding the macroscale systems and their functions, not the microscopic scale.*)
- b. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. (4-LS1-2) (*Clarification Statement: Emphasis is on systems information transfer.*) (*Boundary Statement: Does not include the mechanisms by which the brain stores and recalls information or the mechanism of how sensory receptors function.*)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Construct an argument with evidence, data, and/or a model. (Engaging in Argument from Evidence) (Personal: Initiative/Self-direction)
2. Use a model to test interactions concerning the functioning of a natural system (Engaging in Argument from Evidence) (Personal: Initiative/Self-direction)

Elaboration on the GLE:

1. Students can answer the question: How do internal and external structures support the survival, growth, behavior and reproduction of plants and animals?
2. LS1:A Structure and Function: Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior and reproduction.
3. LS1:D Information Processing: Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.

Cross Cutting Concepts:

1. Systems and System Models: A system can be described in terms of its components and their interactions.



Prepared Graduates:

11. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how human activities and the Earth's surface processes interact.

Grade Level Expectation:

1. Earth has changed over time.

Evidence Outcomes

Students Can:

- a. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. (4-ESS1-1) *(Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.) (Boundary Statement: Does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers, and should only include relative time.)*

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Identify the evidence that supports particular points in an explanation. (Constructing Explanations and Designing Solutions) (Entrepreneurial: Creativity and Innovation)

Elaboration on the GLE:

1. Students can answer the question: How can water, ice, wind and vegetation change the land?
2. ESS1:C The History of the Planet Earth: Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers.

Cross Cutting Concepts:

1. Patterns: Patterns can be used as evidence to support an explanation.
2. Scientific Knowledge Assumes an Order and Consistency in Natural Systems: Science assumes consistent patterns in natural systems.



Prepared Graduates:

11. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how human activities and the Earth's surface processes interact.

Grade Level Expectation:

2. Four major earth systems interact.

Evidence Outcomes

Students Can:

- a. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. (4-ESS2-1) (*Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling and volume of water flow.*) (*Boundary Statement: Limited to a single form of weathering or erosion.*)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomena. (Planning and Carrying out Investigations) (Entrepreneurial: Inquiry/Analysis)

Elaboration on the GLE:

1. Students can answer the questions: What patterns of Earth's features can be determined with the use of maps? How do living organisms alter Earth's processes and structures?
2. ESS2:A Earth Materials and Systems: Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms and gravity break rocks, soils and sediments into smaller particles and move them around.
3. ESS2:E Biogeology: Living things affect the physical characteristics of their regions.

Cross Cutting Concepts:

1. Cause and Effect: Cause - and - effect relationships are routinely identified, tested, and used to explain change.



Prepared Graduates:

11. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how human activities and the Earth's surface processes interact.

Grade Level Expectation:

3. Earth's physical features occur in patterns.

Evidence Outcomes

Students Can:

- a. Analyze and interpret data from maps to describe patterns of Earth's features. (4-ESS2-2) (*Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes and earthquakes.*)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Analyze and interpret data to make sense of phenomena using logical reasoning. (Analyze and Interpret Data) (Entrepreneurial: Critical thinking/Problem solving)

Elaboration on the GLE:

1. Students can answer the question: Why do the continents move, and what causes earthquakes and volcanoes?
2. ESS2.B: Plate Tectonics and Large-Scale System Interactions: The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.

Cross Cutting Concepts:

1. Patterns: Patterns can be used as evidence to support an explanation.



Prepared Graduates:

11. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how human activities and the Earth's surface processes interact.

Grade Level Expectation:

4. Energy and fuels that humans use are derived from natural sources and their use affects the environment in multiple ways.

Evidence Outcomes

Students Can:

- a. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. (4-ESS3-1) (*Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.*)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Obtain and combine information from books and other reliable media to explain phenomena (Obtaining, Evaluating, and Communicating Information) (Entrepreneurial: Critical thinking/Problem solving)

Elaboration on the GLE:

1. Students can answer the question: How do humans depend on Earth's resources?
2. ESS3.A: Natural Resources : Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.

Cross Cutting Concepts:

1. Cause and Effect: Cause - and - effect relationships are routinely identified and used to explain change.
2. Interdependence of Science, Engineering and Technology: Knowledge of relevant scientific concepts and research findings is important in engineering.
3. Influence of Science, Engineering and Technology on Society and the Natural World: Over time, people's needs and wants change, as do their demands for new and improved technologies.

Prepared Graduates:

11. Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how human activities and the Earth's surface processes interact.

Grade Level Expectation:

5. A variety of hazards result from natural process; humans cannot eliminate natural hazards but can reduce their impacts' effect.

Evidence Outcomes

Students Can:

- a. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. (4-ESS3-2) (*Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.*)(*Boundary: Limited to earthquakes, floods, tsunamis, and volcanic eruptions.*)

Academic Context and Connections

Colorado Essential Skills and Science and Engineering Practices:

1. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (Constructing Explanations and Designing Solutions) (Entrepreneurial: Critical Thinking/Problem solving)

Elaboration on the GLE:

1. Students can answer the question: How do natural hazards affect individuals and societies?
2. ESS3.B: Natural Hazards: A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts.

Cross Cutting Concepts:

1. Interdependence of Science, Engineering and Technology: Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks and to meet societal demands.
2. Cause and Effect: Cause - and - effect relationships are routinely identified, tested, and used to explain change.