2016 Wyoming Science Content & Performance Standards

Symbolizes where the Science Standards Review Committee (SSRC) made the standard more specific to Wyoming, added Wyoming examples, &/or identified an area where educators can incorporate local examples in their lessons.

Science is based on claims and evidence. It is important to understand the differences of the following terms:

Theory – An idea or set of ideas that is intended to explain facts or events. This idea is a well-supported explanation that has not been disproven through time. Scientific theories incorporate facts, laws, and tested hypotheses.
Law – A statement of an order or relations of phenomena that so far, as is known, is invariable under the given conditions. A law is a general relation proved or assumed to hold between mathematical or logical expressions.
Phenomenon – An interesting fact or event that can be observed and studied and that typically is unusual or difficult to understand or fully explain. (e.g., aurora borealis, we get goosebumps when we get cold)
Inquiry – The act of asking questions in order to gather or collect information.

State Assessment Boundary – The state assessment of Wyoming students may not exceed the assessment boundaries set forth in this document.

The eight practices of science and engineering that are essential for all students to learn are listed below:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Crosscutting Concepts

- Patterns
- Cause and effect
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter
- Structure and function
- Stability and change

Grades K-5 – view on pages 3-22
Grades 6-12 – view on pages 23-64

READING THIS DOCUMENT

SCIENCE DOMAIN
GRADE LEVEL
Standard
Grade Level
Code [4-ESS1-1] = Grade 4 – Earth & Space Science, Standard 1 – Benchmark 1 **Performance Expectations (PE) are the benchmarks; the skills and content students should master.** Clarification Statement – provides further explanation or examples for educators State Assessment Boundary (if provided) is to be considered when developing classroom and district assessments and gives limitations to the state assessment. Symbol denotes WY examples are given or can be considered in instruction Engineering, Technology, & Applications of Science Connections (ETS) (found on the page specified) Cross-Curricular Connections to other Wyoming Content & Performance Standards (e.g., ELA, Mathematics, Health, Physical Education, Career & Vocational Education, Fine & Performing Arts, and Social Studies – can be found at edu.wyoming.gov/educators/standards) These are intended to be suggestions and may be relevant depending on curriculum and instruction.

EARTH & SPACE SCIENCE	
ELEMENTARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)	
ESS1: Earth's Place in the Universe	
4th Grade	**5th Grade**
4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. Clarification Statement: Examples of evidence from patterns (may include, but not limited to, Wyoming specific examples) could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock. State Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time. ELA Connections – W.4.7; W.4.8; W.4.9 Mathematics Connections – MP.2; MP.4; 4.MD.A.1 Social Studies Connections – SS5.5.2	**5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.** State Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, and stage). ELA Connections – RI.5.1; RI.5.7; RI.5.8; RI.5.9; W.5.1 Mathematics Connections – MP.2; MP.4; 5.NBT.A.2 **5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months. State Assessment Boundary: Assessment does not include causes of seasons. ELA Connections – SL.5.5 Mathematics Connections – MP.2; MP.4; 5.G.A.2

PHYSICAL SCIENCE

ELEMENTARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

PS1: Matter and Its Interactions

K	1st	2nd Grade	3rd	4th	5th Grade
		2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share. ELA Connections − W.2.7; W.2.8 Mathematics Connections − MP.4;2.MD.D.10			**5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.** Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water. State Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles. ELA Connections – RI.5.7 Mathematics Connections – MP.2; MP.4; 5.NBT.A.1; 5.NF.B.7; 5.NK.B.7; 5.MD.C.3; 5.MD.C.4
		2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency. State Assessment Boundary: Assessment of quantitative measurements is limited to length. Engineering, Technology, & Applications of Science Connections – K-2-ETS1-3 (pg. 22) ELA Connections – RI.2.8;W.2.7; W.2.8 Mathematics Connections − MP.2; MP.4; MP.5;2.MD.D.10			**5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved**. Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances. State Assessment Boundary: Assessment does not include distinguishing mass and weight. ELA Connections − W.5.7; W.5.8; W.5.9 Mathematics Connections – MP.2; MP.4; MP.5; 5.MD.A.1

K	1st	2nd Grade	3rd	4th	5th Grade
		2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects. Engineering, Technology, & Applications of Science Connections – K-2-ETS1-1 (pg. 22) Mathematics Connections – W.2.7; W.2.8			**5-PS1-3. Make observations and measurements to identify materials based on their properties.** Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, luster, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property. State Assessment Boundary: Assessment does not include density or distinguishing mass and weight. ELA Connections – W.5.7; W.5.8; W.5.9 Mathematics Connections – MP.2; MP.4; MP.5
		2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper. ELA Connections – RI.2.1; RI.2.3; RI.2.8; W.2.1 Social Studies Connections – SS2.6.1			**5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.** Clarification Statement: Determination of the new substance is based on the properties of the resulting substance, which could include quantitative (e.g. weight) and qualitative properties (e.g. state of matter, color, texture, and odor). State Assessment Boundary: Assessment does not include identification of the new substance. ELA Connections – W.5.7; W.5.8; W.5.9

PS2: Motion and Stability: Forces and Interactions

Kindergarten	1st	2nd	3rd Grade	4th	5th Grade
K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other. State Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets. ELA Connections – W.K.7 Mathematics Connections – MP.2; K.MD.A.1; K.MD.A.2			**3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all. State Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down. ELA Connections – RI.3.1; W.3.7; W.3.8 Mathematics Connections – MP.2; MP.5; 3.MD.A.2 **3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw. State Assessment Boundary: Assessment does not include technical terms such as period and frequency. ELA Connections – W.3.7; W.3.8		**5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.** Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth. State Assessment Boundary: Assessment does not include mathematical representation of gravitational force. Engineering, Technology, & Applications of Science Connections – 3-5-ETS1-1; 3-5-ETS1-2; 3-5-ETS1-3 (pg. 22) ELA Connections – RI.5.1; RI.5.9; W.5.1

Kindergarten	1st	2nd	3rd Grade	4th	5th Grade
K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull. Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn. State Assessment Boundary: Assessment does not include friction as a mechanism for change in speed. Engineering, Technology, & Applications of Science Connections – K-2-ETS1-1 (pg. 22) ELA Connections – RI.K.1; SL.K.3 Mathematics Connections – K.MD.A.1; K.MD.A.2; K.CC.C.6; K.CC.C.7			**3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force. State Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity. ELA Connections – RI.3.1; RI.3.3; RI.3.8; SL.3.3 **3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.** Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other. Engineering, Technology, & Applications of Science Connections – 3-5-ETS1-1; 3-5-ETS1-2 (pg. 22)		Intentionally Left Blank

PS3: Energy

Kindergarten	1st	2nd	3rd	4th Grade	5th
K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface. Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water. State Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler. ELA Connections – W.K.7 Mathematics Connections – K.MD.A.2				**4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.** State Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy. ELA Connections – RI.4.1; RI.4.3; RI.4.9; W.4.2; W.4.8; W.4.9	**5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.** Clarification Statement: Examples of models could include diagrams, and flow charts. ELA Connections – RI.5.7; SL.5.5
K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area. Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun. Engineering, Technology, & Applications of Science Connections – K-2-ETS1-1; K-2-ETS1-2 (pg. 22) ELA Connections – W.K.7 Mathematics Connections – K.MD.A.2 Fine & Performing Arts Connections – FPA4.1.A.1; FPA4.1.A.3; FPA4.1.A.5; FPA4.1.A.6				**4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** State Assessment Boundary: Assessment does not include quantitative measurements of energy. Engineering, Technology, & Applications of Science Connections – K-2-ETS1-1; K-2-ETS1-2; K-2-ETS1-3 (pg. 22) ELA Connections – W.4.7; W.4.8 **4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.** Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. State Assessment Boundary: Assessment does not include quantitative measurements of energy. ELA Connections – W.4.7; W.4.8	

Kindergarten	1st	2nd	3rd	4th Grade	5th
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PS4: Waves and Their Applications in Technologies for Information Transfer

K	1st Grade	2nd	3rd	4th Grade	5th
	1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork. ELA Connections – W.1.7; W.1.8; SL.1.1 Fine & Performing Arts Connections – FPA4.1.M.4			**4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves. State Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength. ELA Connections – SL.4.5 Mathematics Connections – MP.4; 4.G.A.1	
	1-PS4-2. Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated. Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light. ELA Connections – W.1.2; W.1.7; W.1.8; SL.1.1			**4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.** State Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works. ELA Connections – SL.4.5 Mathematics Connections – MP.4; 4.G.A.1	
	1-PS4-3. Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror). State Assessment Boundary: Assessment does not include the speed of light. ELA Connections – W.1.7; W.1.8; SL.1.1				

K	1st Grade	2nd	3rd	4th Grade	5th
	1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats. State Assessment Boundary: Assessment does not include technological details for how communication devices work. Engineering, Technology, & Applications of Science Connections – K-2-ETS1-1; K-2-ETS1-2 (pg. 22) ELA Connections – W.1.7 Mathematics Connections – MP.5; 1.MD.A.1; 1.MD.A.2 Fine & Performing Arts Connections – FPA4.1.A.2; FPA4.1.A.4; FPA4.1.A.5; FPA4.1.T.1			**4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.** Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse Code to send text. Engineering, Technology, & Applications of Science Connections – 3-5-ETS1-2 (pg. 22) ELA Connections – RI.4.1; RI.4.9 Mathematics Connections – MP.2	

LIFE SCIENCE

ELEMENTARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

LS1: From Molecules to Organisms: Structure & Processes

K	1st Grade	2nd	3rd Grade	4th Grade	5th Grade
K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive. Clarification Statement: Examples of patterns could include that animals need to take in food but plants make their own food; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water. Engineering, Technology, & Applications of Science Connections – K-2-ETS1-1; K-2-ETS1-2 (pg. 22) ISTE-3 Students apply digital tools to gather, evaluate, and use information. Mathematics Connections – K.MD.A.2 ELA Connections – W.K.7 Fine & Performing Arts Connections – FPA4.1.A.2; FPA4.1.A.5 Health Connections – HE2.3.4	**1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.** Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, pine cone scales, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears. ISTE-3. Students apply digital tools to gather, evaluate, and use information. ELA Connections – W.1.7 Fine & Performing Arts Connections – FPA4.1.A.2; FPA4.1.A.5 Health Connections – HE2.3.4		**3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.** Clarification Statement: Changes organisms go through during their life form a pattern. State Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction. ELA Connections – RI.3.7; SL.3.5 Mathematics Connections – MP.4; 3.NBT; 3.NF	**4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin. State Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems. ELA Connections – W.4.1 Mathematics Connections – 4.G.A.3	**5-LS1-1. Support an argument that plants get the materials they need for growth primarily from air and water.** Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil. ELA Connections – RI.5.1; RI.5.9; W.5.1 Mathematics Connections – MP.2; MP.4; MP.5; 5.MD.A.1

K	1st Grade	2nd	3rd Grade	4th Grade	5th Grade
Intentionally Left Blank	**1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.** Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring). ELA Connections – RI.1.1; RI.1.2; RI.1.10 Mathematics Connections – 1.NBT.B.3; 1.NBT.C.4; 1.NBT.C.5; 1.NBT.C.6 Health Connections – HE2.3.1; HE2.3.4		Intentionally Left Blank	**4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.** Clarification Statement: Emphasis is on systems of information transfer. State Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function. ELA Connections – SL.4.5	Intentionally Left Blank

LS2: Ecosystems: Interactions, Energy, and Dynamics

K	1st	2nd Grade	3rd Grade	4th	5th Grade
		2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow. State Assessment Boundary: Assessment is limited to testing one variable at a time. ELA Connections – W.2.7; W.2.8 Mathematics Connections – MP.2; MP.4; MP.5 **2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.** Clarification Statement: Examples could include the natural structure of an animal that helps it disperse seeds (e.g., hair that snares seeds, squirrel cheek pouches that transport seeds) or that helps it pollinate plants (e.g., bees have fuzzy bodies to which pollen sticks, hummingbirds' bodies transport pollen). Engineering, Technology & Application of Science Connections – K-2 ETS1-2 (pg. 22) ELA Connections – SL.2.5 Mathematics Connections – MP.4; 2.MD.D.10 Fine & Performing Arts Connections – FPA4.1.A.4; FPA4.1.A.5; FPA4.1.A.6	**3-LS2-1. Construct an argument that some animals form groups that help members survive.** State Assessment Boundary: Use WY animals as examples. ELA Connections – RI.3.1; RI.3.3; W.3.1 Mathematics Connections – MP.4; 3.NBT		**5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.** Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth. State Assessment Boundary: Assessment does not include molecular explanations. ELA Connections – RI.5.7; SL.5.5 Mathematics Connections – MP.2; MP.4

LS3: Inheritance & Variation of Traits

K	1st Grade	2nd	3rd Grade	4th	5th
	1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same. State Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids. ELA Connections – RI.1.1; W.1.7;W.1.8 Mathematics Connections – MP.2; MP.5; 1.MD.A.1		**3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.** Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans. State Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples. ELA Connections – RI.3.1; RI.3.2; RI.3.3; W.3.2; SL.3.4 Mathematics Connections – MP.3; MP.4; 3.MD.B.4 **3-LS3-2. Use evidence to support the explanation that observable traits can be influenced by the environment.** Clarification Statement: Environmental factors that vary for organisms of the same type (e.g., amount of food, amount of water, and amount of exercise an animal gets, chemicals in the water) may influence organisms' observable traits. ELA Connections – RI.3.1; RI.3.2; RI.3.3; W.3.2; SL.3.4 Mathematics Connections – MP.2; MP.4; 3.MD.B.4		

LS4: Biological Evolution: Unity & Diversity

K	1st	2nd Grade	3rd Grade	4th	5th
		2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats. Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats. State Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats. ELA Connections – W.2.7; W.2.8 Mathematics Connections – MP.2; MP.4; 2.MD.D.10	**3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.** Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms. State Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages. ELA Connections – RI.3.1; RI.3.2; RI.3.3; W.3.1; W.3.2; W.3.9 Mathematics Connections – MP.2; MP.4; MP.5; 3.MD.B.4		
			3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring. ELA Connections – RI.3.1; RI.3.2; RI.3.3; W.3.2; SL.3.4 Mathematics Connections – MP.2; MP.4; 3.MD.B.3		
			3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. Clarification Statement: Examples of evidence could include needs and traits of the organisms and characteristics of the habitats involved. The organisms and their habitat make up a system in which the parts depend on each other. ELA Connections – RI.3.1; RI.3.2; RI.3.3; W.3.1; W.3.2; SL.3.4 Mathematics Connections – MP.2; MP.4; 3.MD.B.3 Social Studies Connections – SS5.5.4		

K	1st	2nd Grade	3rd Grade	4th	5th
			3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms. State Assessment Boundary: Assessment is limited to a single environmental change. Engineering, Technology, & Applications of Science Connections – 3-5-ETS1-1;3-5-ETS1-2 (pg. 22) ELA Connections – RI.3.1; RI.3.2; RI.3.3; W.3.1; W.3.2; SL.3.4 Mathematics Connections – MP.2; MP.4 Social Studies Connections – SS5.5.4		

EARTH & SPACE SCIENCE

ELEMENTARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

ESS1: Earth's Place in the Universe

K	1st Grade	2nd Grade	3rd	4th Grade	5th Grade
	1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted. Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day. State Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day. ELA Connections – W.1.7; W.1.8	**2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.** Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly. State Assessment Boundary: Assessment does not include quantitative measurements of timescales. ISTE-3. Students apply digital tools to gather, evaluate, and use information. ELA Connections – RI2.2; RI.2.3; W.2.6; W.2.7; W.2.8 SL.2.2 Mathematics Connections – MP.4; 2.NBT.A Social Studies Connections – SS2.6.1		**4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** Clarification Statement: Examples of evidence from patterns (may include, but not limited to, Wyoming specific examples) could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock. State Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time. ELA Connections – W.4.7; W.4.8; W.4.9 Mathematics Connections – MP.2; MP.4; 4.MD.A.1 Social Studies Connections – SS5.5.2	**5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.** State Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, and stage). ELA Connections – RI.5.1; RI.5.7; RI.5.8; RI.5.9; W.5.1 Mathematics Connections – MP.2; MP.4; 5.NBT.A.2
	1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year. Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall. State Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight. ELA Connections – W.1.7; W.1.8 Mathematics Connections – MP.2;MP.4; MP.5; 1.OA.A.1; 1.MD.C.4				**5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months. State Assessment Boundary: Assessment does not include causes of seasons. ELA Connections – SL.5.5 Mathematics Connections – MP.2; MP.4; 5.G.A.2

ESS2: Earth's Systems

Kindergarten	1st	2nd Grade	3rd Grade	4th Grade	5th Grade
K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time. Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months. State Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler. ELA Connections – W.K.7 Mathematics Connections – MP2; MP.4; K.CC.A; .MD.A.1;K.MD.B.3		**2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.** Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land. ISTE-3. Students apply digital tools to gather, evaluate, and use information. Engineering, Technology, & Applications of Science Connections – K-2-ETS1-3 (pg. 22) ELA Connections – RI.2.3; RI.2.9 Mathematics Connections – MP.2; MP.4; MP.5; 2.MD.B.5; Social Studies Connections – SS2.5.4 **2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.** State Assessment Boundary: Assessment does not include quantitative scaling in models. ELA Connections – SL.2.5 Mathematics Connections – MP.2; MP.4; 2.NBT.A.3 Social Studies Connections – SS2.5.1 FPA Connections – FPA4.1.A.4; FPA4.1.A.5; FPA4.1.A.6	**3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction. State Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change. Mathematics Connections – MP.2; MP.4; MP.5; 3.MD.A.2; 3.MD.B.3	**4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow. State Assessment Boundary: Assessment is limited to a single form of weathering or erosion. ELA Connections – W.4.7; W.4.8 Mathematics Connections – MP.2; MP.4; 4.MD.A.1; 4.MD.A.2	**5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system. State Assessment Boundary: Assessment is limited to the interactions of two systems at a time. Engineering, Technology, & Applications of Science Connections – 3-5-ETS1-1; 3-5-ETS1-2; 3-5-ETS1-3 (pg. 22) ELA Connections – RI.5.7; SL.5.5 Mathematics Connections – MP.2; MP.4; 5.G.A.2

Kindergarten	1st	2nd Grade	3rd Grade	4th Grade	5th Grade
K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete. ELA Connections – RI.K.1; W.K.1; W.K.2 Mathematics Connections – K.MD.A.1		**2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid, liquid, or gas.** ISTE-3 Students apply digital tools to gather, evaluate, and use information. ELA Connections – W.2.6; W.2.8 Social Studies Connections – SS2.6.1; SS2.5.1	**3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.** ELA Connections – RI.3.1; RI.3.9; W.3.9 Mathematics Connections – MP.2; MP.4	**4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.** Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes. ELA Connections – RI.4.7 Mathematics Connections – 4.MD.A.2	**5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** State Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere. ELA Connections – RI.5.7; W.5.8; SL.5.5 Mathematics Connections – MP.2; MP.4

ESS3: Earth and Human Activity

Kindergarten	1st	2nd	3rd Grade	4th Grade	5th Grade
K-ESS3-1. Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested and rangeland areas; and, grasses need sunlight so they often grow in meadows and prairies. Plants, animals, and their surroundings make up a system. ELA Connections – SL.K.5 Mathematics Connections – MP.2; MP.4; K.CC Fine & Performing Arts Connections – FPA4.1.A.4; FPA4.1.A.5; FPA4.1.A.6			**3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.** Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods. Engineering, Technology, & Applications of Science Connections – 3-5-ETS1-1; 3-5-ETS1-2 (pg. 22) ELA Connections – W.3.1; W.3.7 Mathematics Connections – MP.2; MP.4 Social Studies Connections – SS5.6.2	**4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from renewable and non-renewable resources and how their uses affect the environment.** Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources could include fossil fuels and fissile materials. ELA Connections – W.4.7; W.4.8; W.4.9 Mathematics Connections – MP.2; MP.4; 4.OA.A.1	**5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to conserve Earth's resources and environment.** Engineering, Technology, & Applications of Science Connections – (pg. 22) 3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3 ELA Connections **–** RI.5.1; RI.5.7; RI.5.9; W.5.8; W.5.9 Mathematics Connections – MP.2; MP.4 Social Studies Connections – SS5.3.3
K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. Clarification Statement: Emphasis is on local forms of severe weather. Engineering, Technology, & Applications of Science Connections – K-2-ETS1-1 (pg. 22) ELA Connections – RI.K.1; SL.K.3 Mathematics Connections – MP.4; K.CC Health Connections – HE2.1.4; HE2.3.3				**4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.** Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity. State Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, landslides, *or* volcanic eruptions. Engineering, Technology, & Applications of Science Connections – 3-5-ETS1-2 (pg. 22) ELA Connections – RI.4.1; RI.4.7 Mathematics Connections – MP.2; MP.4; 4.OA.A.1 Social Studies Connections – SS.5.4.2	

Kindergarten	1st	2nd	3rd Grade	4th Grade	5th Grade
K-ESS3-3. Communicate solutions that will manage the impact of humans on the land, water, air, and/or other living things in the local environment. Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles. Engineering, Technology, & Applications of Science Connections – K-2-ETS1-2 (pg. 22) ELA Connections – W.K.2 Health Connections – HE2.3.4; HE2.4.2; HE2.4.3			Intentionally Left Blank	Intentionally Left Blank	Intentionally Left Blank

Engineering, Technology, & Applications of Science

ELEMENTARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Science Standards Connections
K-ESS3-2; K-PS2-2; K-PS3-2; 1-LS1-1; 1-PS4-4; 2-PS1-3

ELA Connections
RI.2.1
W.2.6
W.2.8

Mathematics Connections
MP.2
MP.4
MP.5
2.MD.D.10

Social Studies Connections
SS2.4.2
SS2.5.3
SS2.5.4

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

Science Standards Connections
3-ESS3-1; 3-LS4-4; 3-PS2-4; 4-PS3-4; 5-ESS2-1; 5-ESS3-1; 5-PS2-1

Social Studies Connections
SS5.4.2
SS5.6.2

Career & Vocational Education Connections
CV5.5.1.4

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Science Standards Connections
K-ESS3-3; K-PS3-2; 1-LS1-1; 1-PS4-4; 2-LS2-2

ELA Connections
SL.2.5

Fine & Performing Arts Connections
FPA4.1.A.4
FPA4.1.A.5
FPA4.1.A.6

Social Studies Connections
SS2.4.2

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Science Standards Connections
3-ESS3-1; 3-LS4-4; 3-PS2-4; 4-ESS3-2; 4-PS3-4; 4-PS4-3; 5-ESS2-1; 5-ESS3-1; 5-PS2-1

Social Studies Connections
SS5.6.2

Career & Vocational Education Connections
CV5.5.1.4

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Science Standards Connections
2-ESS2-1; 2-PS1-2

ELA Connections
W.2.6
W.2.8

Mathematics Connections
MP.2
MP.4
MP.5
2.MD.D.10

Social Studies Connections
SS2.3.3
SS2.4.2

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Science Standards Connections
4-PS3-4; 5-ESS2-1; 5-ESS3-1; 5-PS2-1

Social Studies Connections
SS5.6.2

Career & Vocational Education Connections
CV5.5.1.4

PHYSICAL SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

PS1: Matter and Its Interactions

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms. State Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required. ELA Connections – RST.6-8.7 Mathematics Connections – MP.2; MP.4; 6.RP.A.3; 8.EE.A.3	**HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.** Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen. State Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends. ELA Connections – RST.9-10.7 Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride. State Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor. ELA Connections – RST.6-8.1; RST.6-8.7 Mathematics Connections – MP.2; 6.RP.A.3; 8.SP.B.4; 8.SP.B.5	**HS-PS1-2. Construct an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties, and revise, as needed.** Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen. State Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions. ELA Connections – WHST.9-12.5 Mathematics Connections – HSN-Q.A.1; HSN.Q.A.3
MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels. Wyoming examples could include, but are not limited to, changing oil into plastic or fibers, trona into synthetic rubber, etc. State Assessment Boundary: Assessment is limited to qualitative information. Engineering, Technology, & Applications of Science Connections – MS-ETS2-1; MS-ETS2-2 (pg. 64) ELA Connections – RST.6-8.1; WHST.6-8.8 Career & Vocational Education Connections – CV8.3.1; CV8.4.2; CV8.4.4	**HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the macroscopic scale to infer the strength of electrical forces between particles.** Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of macroscopic properties of substances could include the melting point and boiling point, vapor pressure, and surface tension. State Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure. ELA Connections – RST.11.12.1; WHST.9-12.7; WHST.11-12.8; WHST.9-12.9 Mathematics Connections – HSN-Q.A.1; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium. ELA Connections – WHST.6-8.7 Mathematics Connections – 6.NS.C.5	**HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.** Clarification Statement: Emphasis is on the idea that a chemical reaction, as a system, affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved. State Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products. ELA Connections – SL.11-12.5 Mathematics Connections – MP.4; HSN.Q.A.1; HSN.Q.A.2; HSN-Q.A.3
MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms that represent atoms. State Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces. ELA Connections – WHST.6-8.7 Mathematics Connections – MP.2; MP.4; 6.RP.A.3	**HS-PS1-5. Apply scientific principles and use evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.** Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules. State Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature. ELA Connections – RST.11.12.1; WHST.9-12.2 Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride. State Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device. Engineering, Technology, & Applications of Science Connections – MS-ETS1– 1; MS-ETS1-2; MS-ETS1-3; MS-ETS1-4 (pp. 62-63) ELA Connections – RST.6-8.3; WHST.6-8.7 Mathematics Connections – 8.SP	**HS-PS1-6. Evaluate the design of a chemical system by changing conditions to produce increased amounts of products at equilibrium, and refine the design, as needed.** Clarification Statement: Emphasis is on the application of Le Chatelier's Principle by evaluating and refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products. State Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations. ELA Connections – WHST.9-12.7 Mathematics Connections – MP.2; MP.4
	HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Clarification Statement: Emphasis is on using mathematical ideas, beyond memorization and rote application of problem solving techniques, to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. State Assessment Boundary: Assessment does not include complex chemical reactions. Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
No Standard – Intentionally Left Blank	**HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.** Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations. State Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays. Mathematics Connections – MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

PHYSICAL SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

PS2: Motion and Stability: Forces and Interactions

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle. State Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension. Engineering, Technology, & Applications of Science Connections – MS-ETS1-1; MS-ETS1-2; MS-ETS1-3; MS-ETS1-4; MS-ETS2-2 (pp. 62-64) ELA Connections – RST.6-8.1; RST.6-8.3; WHST.6-8.7 Mathematics Connections – MP.2; 6.NS.C.5; 6EE.A.2; 7.EE.B.3; 7.EE.B.4 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.4.3; CV8.4.4	**HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.** Clarification Statement: Examples of data could come from lab experiments or include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. State Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds. ELA Connections – RST.11-12.1; RST.11-12.7; WHST.9-12.9 Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3; HSA-SSE.A.1; HSA-SSE.B.3; HSA-CED.A.1; HSA-CED.A.2; HSA-CED.A.4; HSF-IF.C.7; HSS-ID.A.1

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units. State Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry. ELA Connections – RST.6-8.3; WHST.6-8.7 Mathematics Connections – MP.2; 6.EE.A.2; 7.EE.B.3; 7.EE.B.4	**HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.** Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. State Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension. Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-QA.3; HSA-CED.A.1; HSA-CED.A.2; HSA-CED.A.4
MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor. State Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking. ELA Connections – RTS.6-8.1 Mathematics Connections – MP.2 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.4.3; CV8.4.4	**HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.** Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute. State Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations. Engineering, Technology, & Applications of Science Connections – HS-ETS1-2; HS-ETS1-3; HS-ETS1-4 (pp. 62-63) ELA Connections – WHST.9-12.7 Mathematics Connections – MP.2; MP.4

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system. State Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws. ELA Connections – WHST.6-8.1 Mathematics Connections – MP.2 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.4.2; CV8.4.3	**HS-PS2-4. Use mathematical representations to predict the gravitational and/or electrostatic forces between objects using Newton's Law of Gravitation and/or Coulomb's Law, respectively.** Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and/or electric fields. State Assessment Boundary: Assessment is limited to systems with two objects. Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3; HSA-SSE.A.1; HSA-SSE.B.3
MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations. State Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields. ELA Connections – RST.6-8.3; WHST.6-8.7	**HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.** State Assessment Boundary: Assessment is limited to designing and conducting investigations with common materials and tools. ELA Connections – WHST.9-12.7; WHST.11-12.8; WHST.9-12.9 Mathematics Connections – HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
No Standard – Intentionally Left Blank	**HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of materials.** Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include: why electrically conductive materials are often made of metal; flexible but durable materials are made up of long chained molecules; and pharmaceuticals are designed to interact with specific receptors. Engineering, Technology, & Applications of Science Connections – HS-ETS1-1; HS-ETS1-4; HS-ETS1-5 (pp. 62-64) ELA Connections – RST.11-12.1; WHST.9-12.2 Mathematics Connections – HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

PHYSICAL SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

PS3: Energy

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a whiffle ball versus a tennis ball. ELA Connections – RST.6-8.1; RST.6-8.7 Mathematics Connections – MP.2; 6.RP.A.1; 6.RP.A.2; 7.RP.A.2; 8.EE.A.1; 8.EE.A.2; 8.F.A.3 Career & Vocational Education Connections – CV8.3.3; CV8.4.3; CV8.4.4; CV8.5.3	**HS-PS3-1. Create or apply a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.** Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model. State Assessment Boundary: Assessment is limited to basic algebraic expressions or computations, to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields. Engineering, Technology, & Applications of Science Connections – HS-ETS1-4 (pg. 63) ELA Connections – SL.11-12.5 Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems. State Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions. ELA Connections – SL.8.5 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.4.3; CV8.4.4; CV8.5.3	**HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).** Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations. ELA Connections – SL.11-12.5 Mathematics Connections – MP.2; MP.4
MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. Clarification Statement: Examples of devices could include an insulated box, a natural system (e.g., a compost bin), a solar cooker, and a Styrofoam cup. State Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred. Engineering, Technology, & Applications of Science Connections – MS-ETS1-1; MS-ETS1-2; MS-ETS1-3 (pp. 62-63) ELA Connections – RST.6-8.3; WHST.6-8.7 Mathematics Connections – 6.EE.C.9; 6.G.G Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.4.2; CV8.4.3; CV8.4.4; CV8.5.4	**HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.** Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include high- efficiency hydrocarbon engines, Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of a variety of energy forms and efficiency. State Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with common materials. Engineering, Technology, & Applications of Science Connections – HS-ETS1-2; HS-ETS1-4 (pp. 62-63) ELA Connections – WHST.9-12.7 Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3 Social Studies Connections – SS12.3.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added. State Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred. ELA Connections – RST.6-8.3; WHST.6-8.7 Mathematics Connections – MP.2; 6.SP.B.5 Career & Vocational Education Connections – CV8.3.3; CV8.4.2; CV8.4.3; CV8.4.4; CV8.5.4	**HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system.** Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water. State Assessment Boundary: Assessment is limited to investigations based on common materials and tools. ELA Connections – RST.11-12.1; WHST.9-12.7; WHST.11-12.8; WHST.9-12.9 Mathematics Connections – MP.2; MP.4 Social Studies Connections – SS12.3.3
MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object. State Assessment Boundary: Assessment does not include calculations of energy. ELA Connections – RST.6-8.1; WHST.6-8.1 Mathematics Connections – MP.2; 6.RP.A.1; 7.RP.A.2; 8.F.A.3 Career & Vocational Education Connections – CV8.3.1; CV8.3.3	**HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.** Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other. State Assessment Boundary: Assessment is limited to systems containing two objects. ELA Connections – WHST.9-12.7; WHST.11-12.8; WHST.9-12.9; SL.11-12.5 Mathematics Connections – MP.2; MP.4; HSN-Q.A.2

PHYSICAL SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

PS4: Waves and their Applications in Technologies for Information Transfer

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS4-1. Use mathematical representations to describe a simple model for waves, which includes how the amplitude of a wave is related to the energy in a wave. Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking. State Assessment Boundary: Assessment is limited to standard repeating waves. ELA Connections – SL.8.5 Mathematics Connections – MP.2; MP.4; 6.RP.A.1; 6.RP.A.3; 7.RP.A.2; 8.F.A.3 Fine & Performing Arts Connections – FPA8.4.M.2	**HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.** Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum or glass, sound waves traveling through air or water, and seismic waves traveling through the Earth. State Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively. Engineering, Technology, & Applications of Science Connections – HS-ETS1-2; HS-ETS1-4; HS-ETS1-5 (pp. 62-64) ELA Connections – RST.11-12.7 Mathematics Connections – MP.2; MP.4; HSA-SSE.A.1; HSA-SSE.B.3; HSA-CED.A.4
MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. Clarification Statement: Emphasis is on both electromagnetic and mechanical waves. Examples of models could include drawings, simulations, and written descriptions. State Assessment Boundary: Assessment is limited to qualitative applications pertaining to electromagnetic and mechanical waves. ELA Connections – SL.8.5 Career & Vocational Education Connections – CV8.3.3	**HS-PS4-2. Evaluate the advantages and disadvantages of using digital transmission and storage of information.** Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft. Engineering, Technology, & Applications of Science Connections – HS-ETS1-1; HS-ETS1-3; HS-ETS1-5 (pp.62-64) ELA Connections – RST.9-10.8; RST.11-12.1; RST.11-12.8 Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2 Social Studies Connections – SS12.3.2; SS12.3.3; SS12.6.1

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversion of stored binary patterns to make sound or text on a computer screen. State Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device. ELA Connections – RST.6-8.1; RST.6-8.2; RST.6-8.9; WHST.6-8.9 Mathematics Connections – MP.6 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.4.3; CV8.4.4; CV8.5.4	**HS-PS4-3. Evaluate the evidence behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.** Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect. State Assessment Boundary: Assessment does not include using quantum theory. ELA Connections – RST.9-10.8; RST.11-12.1; RST.11-12.8 Mathematics Connections – MP.2; HSA-SSE.A.1; HSA.SSE.B.3; HSA-CED.A.4
	HS-PS4-4 was removed. The evaluated validity and reliability of claims in a variety of materials. * See HS-ETS1-5 pg. 64.
No Standard – Intentionally Left Blank	**HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.** Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology. State Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory. Engineering, Technology, & Applications of Science Connections –HS-ETS1-1; HS-ETS1-3 (pp.62-63) ELA Connections – WHST.9-12.2 Mathematics Connections – MP.2; MP.4; HSA-SSE.B.3 Social Studies Connections – SS12.6.2

LIFE SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

LS1: From Molecules to Organisms: Structure & Processes

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells. ELA Connections – WHST.6-8.7 Mathematics Connections – 6.EE.C.9	**HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.** Clarification statement: Explanations emphasize basic DNA replication, transcription, and translation. State Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis. ELA Connections – RST.11-12.1; WHST.9-12.2; WHST.9-12.9 Mathematics Connections – MP.2; MP.4
MS-LS1-2. Develop and use models to describe the parts, functions, and basic processes of cells. Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. Basic processes of a cell should include, but are not limited to, cell growth and reproduction. State Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells, cell parts, or specific stages of the cell cycle. ELA Connections – SL.8.5 Mathematics Connections – 6.EE.C.9	**HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system. State Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level. ELA Connections – SL.11-12.5 Mathematics Connections – MP.2; MP.4

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems. State Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems. ELA Connections – RST.6-8.1; RI.6.8; WHST.6-8.1 Mathematics Connections – 6.EE.C.9	**HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.** Clarification Statement: Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels. State Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism. ELA Connections – WHST.9-12.7; WHST.11-12.8 Mathematics Connections – MP.2; MP.4; HSF-BF.A.1
MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury. ELA Connections – RST.6-8.1; RI.6.8; WHST.6-8.1 Mathematics Connections – 6.SP.A.2; 6.SP.B.4 Career & Vocational Education Connections – CV8.3.1; CV8.4.3; CV8.4.4; CV8.5.4	**HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.** Clarification Statement: Cellular division should include a description of the entire cell cycle along with the phases of mitosis. State Assessment Boundary: Assessment does not include specific gene control mechanisms. ELA Connections – SL.11-12.5 Mathematics Connections – MP.4; HSF-IF.C.7; HSF-BF.A.1

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds. State Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes. ELA Connections – RST.6-8.1; RST.6-8.2; WHST.6-8.2; WHST.6-8.9 Mathematics Connections – 6.SP.A.2; 6.SP.B.4 Career & Vocational Education Connections – CV8.3.1	**HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.** Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models. State Assessment Boundary: Assessment does not include specific biochemical steps. ELA Connections – SL.11-12.5 Mathematics Connections – MP.2; MP.4; HSF-IF.C.7
MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. Clarification Statement: Emphasis is on tracing movement of matter and flow of energy. State Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis. *aligns with HS-LS1-5* ELA Connections – RST.6-8.1; RST.6-8.2; WHST.6-8.9 Mathematics Connections – 6.EE.C.9	**HS-LS1-6. Construct explanations and revise, as needed, based on evidence for 1) how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules, and 2) how other hydrocarbons may also combine to form large carbon-based molecules.** Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations. Other hydrocarbons should include, but are not limited to: lipids, carbohydrates, and proteins. State Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecule subgroups, such as saturated vs. unsaturated fats or identification of specific amino acids. ELA Connections – RST.11-12.1; WHST.9-12.2; WHST.9-12.5; WHST.9-12.9 Mathematics Connections – MP.2; MP.4; HSF-IF.C.7

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS1-7. Develop a model to describe how food molecules (sugar) are rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released. State Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration. ELA Connections – SL.8.5	**HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of sugar molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.** Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration. The term “molecules” is synonymous with “food” in other grade level bands. State Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration. ELA Connections – SL.11-12.5 Mathematics Connections – MP.2; MP.4
MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. State Assessment Boundary: Assessment does not include mechanisms for the transmission of this information. ELA Connections – WHST.6-8.8	No Standard - Intentionally Left Blank

LIFE SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

LS2: Ecosystems: Interactions, Energy, and Dynamics

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources. Emphasis should include, but is not limited to, Wyoming ecosystems and examples, such as native trout populations, deer and antelope populations, wolf populations, bitterroot, sagebrush, Indian Paintbrush, macroinvertebrates, etc. ELA Connections – RST.6-8.1; RST.6-8.7 Mathematics Connections – MP.4 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.4.2; CV8.4.3; CV8.4.4	**HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.** Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition in the Rocky Mountain region. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical, regional, or current data sets. State Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons. Engineering, Technology, & Applications of Science Connections – HS-ETS1-4 (pg. 63) ELA Connections – RST.11-12.1; WHST.9-12.2 Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3
MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial. ELA Connections – RST.6-8.1; WHST.6-8.2; WHST.6-8.9; SL.8.1; SL.8.4 Mathematics Connections – 6.SP.B.5 Social Studies Connections – SS8.5.1	**HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.** Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data. Revision refers to the scientific practice of modifying explanations using additional data analysis and/or research. State Assessment Boundary: Assessment is limited to provided data. Engineering, Technology, & Applications of Science Connections – HS-ETS1-4 (pg. 62) ELA Connections – RST.11-12.1; WHST.9-12.2 Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system. State Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes. ELA Connections – SL.8.5 Mathematics Connections – 6.EE.C.9 Social Studies Connections – SS8.5.1	**HS-LS2-3. Construct an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions, and revise as needed.** Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments. Examples could include bioremediation of hydrocarbons or other materials, sewage / waste treatment, or decomposition. State Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration. ELA Connections – RST.11-12.1; WHST.9-12.2; WHST.9-12.5 Mathematics Connections – MP.2; MP.4
MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems. Wyoming examples could include, but are not limited to, mountain pine beetles, excess precipitation, drought and fires, invasive species, Wyoming species, habitat change, etc. ELA Connections – RST.6-8.1; RI.8.8; WHST.6-8.1; WHST.6-8.9 Mathematics Connections – MP.7	**HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.** Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen, and nitrogen being conserved as they move through an ecosystem. State Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy. Mathematics Connections – MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services. Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and societal considerations. Engineering, Technology, & Applications of Science Connections – MS-ETS1-2; MS-ETS1-3; MS-ETS1-4; MS-ETS2-2 (pp. 62-64) ELA Connections – RST.6-8.8; WHST.6-8.9 Mathematics Connections – MP.4; 6.RP.A.3 Social Studies Connections – SS8.3.3; SS8.3.5 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.5.2	**HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.** State Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration. Mathematics Connections – MP.2; MP.4
No Standard - Intentionally Left Blank	**HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex biotic and abiotic interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a modified ecosystem.** Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise. Engineering, Technology, & Applications of Science Connections – HS-ETS1-5 (pg. 64) ELA Connections – RST.9-10.8; RST.11-12.1; RST.11-12.7; RST.11-12.8 Mathematics Connections – MP.2; HSS.ID.A.1; HSS.IC.A.1; HSS.IC.B.6

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
No Standard - Intentionally Left Blank	**HS-LS2-7. Evaluate and assess impacts on the environment and biodiversity in order to refine or design a solution for detrimental impacts or enhancement for positive impacts.** Clarification Statement: Examples of impacts could include urbanization, reclamation projects, building dams, habitat restoration, and dissemination of invasive species. Engineering, Technology, & Applications of Science Connections – HS-ETS1-1; HS-ETS1-2; HS-ETS1-3; HS-ETS1-4 (pp.62-64) ELA Connections – RST.9-10.8; RST.11-12.7; WHST.9-12.7 Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3
No Standard - Intentionally Left Blank	**HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.** Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming. ELA Connections – RST.9-10.8; RST.11-12.1; RST.11-12.7; RST.11-12.8 Mathematics Connection – MP.2; MP.4

LIFE SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

LS3: Heredity Inheritance and Variations of Traits

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins. State Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations. ELA Connections – RST.6-8.1; RST.6-8.4; RST.6-8.7; SL.8.5 Mathematics Connections – MP.2	**HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.** State Assessment Boundary: Assessment does not include the biochemical mechanism of specific steps in the process. ELA Connections – RST.11-12.1; RST.11-12.9 Mathematics Connections – MP.2; MP.4

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation. State Assessment Boundary: Assessment is limited to monohybrid crossing. ELA Connections – RST.6-8.1; RST.6-8.4; RST.6-8.7; SL.8.5 Mathematics Connections – MP.4; 6.SP.B.5 Career & Vocational Education Connections – CV8.3.3; CV8.4.4	**HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.** Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs. State Assessment Boundary: Assessment does not include the biochemical mechanism of specific steps in the process. Engineering, Technology, & Applications of Science Connections – HS-ETS1-5 (pg. 64) ELA Connections – RST.11-12.1; WHST.9-12.1 Mathematics Connections – MP.2
No Standard - Intentionally Left Blank	**HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.** Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits. State Assessment Boundary: Assessment does not include Hardy-Weinberg calculations. Mathematics Connections – MP.2

LIFE SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

LS4: Biological Evolution: Unity & Diversity

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers. State Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record. ELA Connections – RST.6-8.1; RST.6-8.7 Mathematics Connections – 6.EE.B.6	**HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.** Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, biochemical similarities, and order of appearance of structures in embryological development. ELA Connections – RST.11-12.1; WHST.9-12.2; WHST.9-12.9; SL.11-12.4 Mathematics Connections – MP.2
MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures. ELA Connections – RST.6-8.1; WHST.6-8.2; WHST.6-8.9; SL.8.1; SL.8.4 Mathematics Connections – 6.EE.B.6	**HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.** Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning. State Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution. ELA Connections – RST.11-12.1; WHST.9-12.2; WHST.9-12.9; SL.11-12.4 Mathematics Connections – MP.2; MP.4

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
Rationale for removal of MS-LS4-3: • The Recapitulation Theory (Biogenetic Principle) is no longer scientifically valid. (http://evolution.berkeley.edu/evolibrary/article/history_15). • The standard was written in a way that overlapped with curricular decisions. • Developmental appropriateness for younger middle-school students is questionable. • Removal does not affect the learning progressions.	**HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.** Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations. Further development may include allele frequency calculations. State Assessment Boundary: Assessment is based on statistical and graphical analysis. ELA Connections – RST.11-12.1; WHST.9-12.2; WHST.9-12.9 Mathematics Connections – MP.2
MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population affect individuals' probability of surviving and reproducing in a specific environment. Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations. It is important to look at both positive and negative effects that variations of traits may have on individuals. ELA Connections – RST.6-8.1; RST.6-8.9; WHST.6-8.2; WHST.6-8.9; SL.8.1; SL.8.4 Mathematics Connections – 6.RP.A.1; 6.SP.B.5; 7.RP.A.2 Career & Vocational Education Connections – CV8.3.1; CV8.3.3	**HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.** Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term change in climate, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations. ELA Connections – RST.11-12.1; WHST.9-12.2; WHST.9-12.9 Mathematics Connections – MP.2

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the positive and negative impacts these technologies have on society as well as the technologies leading to these scientific discoveries. Engineering, Technology, & Applications of Science Connections – MS-ETS2-1; MS-ETS2-2 (pg. 64) ELA Connections – RST.6-8.1; WHST.6-8.8 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.4.3	**HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.** Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species. Engineering, Technology, & Applications of Science Connections – HS-ETS1-5 (pg. 64) ELA Connections – RST.11-12.8; WHST.9-12.9 Mathematics Connections – MP.2
MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time. State Assessment Boundary: Assessment does not include Hardy Weinberg calculations. Mathematics Connections – MP.4; 6.RP.A.1; 6.SP.B5; 7.RP.A.2	**HS-LS4-6. Create and/or use a simulation to evaluate the impacts of human activity on biodiversity.** Clarification Statement: Emphasis is on examining positive and negative impacts of human activity. Examples could include cost benefit analysis of proposed actions, protection for threatened or endangered species, reclamation projects and/or efforts to maintain biodiversity. Engineering, Technology, & Applications of Science Connections – HS-ETS1-1; HS-ETS1-2; HS-ETS1-3; HS-ETS1-4 (pp. 62-63) ELA Connections – WHST.9-12.5; WHST.9-12.7 Mathematics Connections – MP.2; MP.4

EARTH & SPACE SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

ESS1: Earth's Place in the Universe

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. Clarification Statement: Examples of models can be physical, graphical, or conceptual. ELA Connections – SL.8.5 Mathematics Connections – MP.4; 6.RP.A.1; 7.RP.A.2	**HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.** Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11- year sunspot cycle, and non-cyclic variations over centuries. State Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion. ELA Connections – RST.11-12.1 Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3; HSA-SSE.A.1; HSA-CED.A.2; HSA-CDE.A.4

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state). State Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth. ELA Connections – SL.8.5 Mathematics Connections – MP.4; 6.RP.A.1; 6.EE.B.6; 7.RP.A.2; 7.EE.B.4	**HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.** Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium). ELA Connections – RST.11-12.1; WHST.9-12.2 Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3; HSA-SSE.A.1; HSA-CES.A.2; HSA-CED.A.4
MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system. Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models. State Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies. Engineering, Technology & Application of Science Connections – MS-ETS2-1 (pg. 64) ELA Connections – RST.6-8.1; RST.6-8.7 Mathematics Connections – MP.2; 6.RP.A.1; 7.RP.A.2	**HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.** Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime. State Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed. ELA Connections – WHST.9-12.2;SL.11-12.4 Mathematics Connections – MP.2

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS1-4 can be found below for HS alignment	**HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.** Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as natural solar system objects. State Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus. Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3; HSA-SSE.A.1; HSA-CED.A.2; HSA.CED.A.4
	HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust decreasing with distance away from a central ancient core (a result of past plate interactions). ELA Connections – RST.11-12.1; RST.11-12.8; WHST.9-12.2 Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS1-4. Construct a scientific explanation based on evidence from rocks and rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions. State Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them. ELA Connections – RST.6-8.1; WHST.6-8.2 Mathematics Connections – 6.EE.B.6; 7.EE.B.4	**HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.** Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest rocks), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces. ELA Connections – RST.11-12.1; RST.11-12.8; WHST.9-12.1 Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.2; HSF-IF.B.5; HSS-ID.B.6

EARTH & SPACE SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

ESS2: Earth's Systems

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials. State Assessment Boundary: Assessment does not include the identification and naming of minerals. ELA Connections – SL.8.5 Mathematics Connections – MP.2 Fine & Performing Arts Connections – FPA8.4.A.1	**HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.** Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion). Focus on the varying rates of process. State Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface. ELA Connections – SL.11-12.5 Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate. ELA Connections – RST.6-8.1; WHST.6-8.2; SL.8.5 Mathematics Connections – MP.2; 6.EE.B.6; 7.EE.B.4 Social Studies Connections – SS8.5.4	**HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.** Clarification Statement: Examples of system interactions could include how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; how a decrease in greenhouse gases contributes to a decrease in global surface temperature which leads to an increase in glacial ice, or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent. Engineering, Technology, & Applications of Science Connections – HS-ETS1-5 (pg. 64) ELA Connections – RST.11-12.1; RST.11-12.2 Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.3
MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches). State Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed. ELA Connections – RST.6-8.1; RST.6-8.7; RST.6-8.9 Mathematics Connections – MP.2; 6.EE.B.6; 7.EE.B.4	**HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.** Clarification Statement: Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments. ELA Connections – RST.11-12.1; SL.11-12.5 Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical. State Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed. Mathematics Connections – MP.2	**HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.** Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition. State Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution. Engineering, Technology, & Applications of Science Connections – HS-ETS1-4; HS-ETS1-5 (pp. 63-64) ELA Connections – SL.11-12.5 Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3
MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation). State Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations. ELA Connections – RST.6-8.1; RST.6-8.9; WHST.6-8.8 Mathematics Connections – MP.2; 6.NS.C.5 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.4.2; CV8.4.3; CV8.4.4; CV8.5.4	**HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.** Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids). Emphasis could be on local, regional and Wyoming state hydrological resources and features. ELA Connections – WHST.9-12.7 Mathematics Connections – HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations. State Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect. ELA Connections – SL.8.5 Mathematics Connections – MP.4	**HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.** Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms. Engineering, Technology, & Applications of Science Connections – HS-ETS1-4 (pg. 63) Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3
No Standard - Intentionally Left Blank	**HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.** Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms. State Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems. Engineering, Technology, & Applications of Science Connections – HS-ETS1-5 (pg. 64) ELA Connections – WHST.9-12.1 Mathematics Connections – MP.2; MP.4

EARTH & SPACE SCIENCE

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

ESS3: Earth and Human Activity

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock). ELA Connections – RST.6-8.1; WHST.6-8.2; WHST.6-8.9 Mathematics Connections – 6.EE.B.6; 7.EE.B.4	**HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.** Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised. Engineering, Technology, & Applications of Science Connections – HS-ETS1-1; HS-ETS1-5 (pp. 62 & 64) ELA Connections – RST.11-12.1; WHST.9-12.2 Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts). ELA Connections – RST.6-8.1; RST.6-8.7 Mathematics Connections – MP.2; 6.EE.B.6; 7.EE.B.4 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.4.2; CV8.4.3; CV8.4.4; CV8.5.2	**HS-ESS3-2. Evaluate competing design solutions for developing, managing, and using energy and mineral resources based on cost-benefit ratios.** Clarification Statement: Cost-benefit analysis should be based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g., economic, societal, environmental, and ethical considerations). Emphasis needs to include the conservation, recycling, and reuse of resources (e.g., minerals, metals, and water) where possible, and on minimizing impacts where it is not. Examples include developing best practices for wind, hydroelectric, and solar energy, agricultural soil use, mining (for coal and oil shales), and pumping (for petroleum and natural gas). Engineering, Technology, & Applications of Science Connections – HS-ETS1-1; HS-ETS1-3; HS-ETS1-5 (pp. 62-64) ELA Connections – RST.11-12.1; RST.11-12.8 Mathematics Connections – MP.2

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS3-3. Apply scientific principles to design a method for monitoring, evaluating, and managing a human impact on the environment. Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could manage that impact. Examples of human impacts can include conservation techniques, water usage (such as municipal withdrawals, industrial applications, and irrigation), land usage (such as urban development, recreation, agriculture, or reclamation), and pollution. Engineering, Technology & Application of Science Connections – MS-ETS1-1; MS-ETS1-2; MS-ETS1-3; MS-ETS1-4; MS-ETS2-2 (pp. 62-64) ELA Connections – 6.RP.A.1; 7.RP.A.2; 6.EE.B.6; 7.EE.B.4 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.5.1; CV8.5.2	**HS-ESS3-3. Use ~~a~~ computational tools to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.** Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning. Engineering, Technology, & Applications of Science Connections – HS-ETS1-1; HS-ETS1-2; HS-ETS1-3; HS-ETS1-4; HS-ETS1-5 (pp. 62-64) Mathematics Connections – MP.2; MP.4
MS-ESS3-4. Construct an argument supported by evidence for how changes in human population and per-capita consumption of natural resources impact Earth's systems. Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of changing human populations and the consumption of natural resources are described by science, but science does not make the decisions for the actions society takes. ELA Connections – RST.6-8.1; WHST.6-8.1; WHST.6-8.9 Mathematics Connections – 6.RP.A.1; 7.RP.A.2; 6.EE.B.6; 7.EE.B.4 Social Studies Connections – SS8.3.1; SS8.3.2; SS8.3.3 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.5.1; CV8.5.2	**HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.** Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Technological solutions to evaluate could include landscape reclamation, reducing, reusing, and recycling resources, emission control systems, or evaporation control. Examples for limiting future impacts could range from local efforts to large-scale design solutions. Engineering, Technology, & Applications of Science Connections – HS-ETS1-1; HS-ETS1-3; HS-ETS1-4; HS-ETS1-5 (pp. 62-64) ELA Connections – RST.11-12.1; RST.11-12.8 Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused changes in global temperatures over time. Clarification Statement: Examples of factors include natural processes and human activities. Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases, and the frequency and rates of natural processes and human activities. Engineering, Technology & Application of Science Connections –MS-ETS1-2 (pg. 62) ELA Connections – RST.6-8.1 Mathematics Connections – MP.2; 6.EE.B.6; 7.EE.B.4 Career & Vocational Education Connections – CV8.3.1; CV8.3.3; CV8.5.1; CV8.5.2	**HS-ESS3-5. Analyze data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional change in climate and associated future impacts to Earth systems.** Clarification Statement: Examples of evidence, for both data and climate model outputs, are for changes in climate (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmospheric and oceanic composition). State Assessment Boundary: Assessment is limited to one example of a change in climate and its associated impacts. ELA Connections – RST.11-12.1; RST.11-12.2; RST.11-12.7 Mathematics Connections – MP.2; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3
No Standard - Intentionally Left Blank	**HS-ESS3-6. Use the results of a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.** Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. Consideration should be given to both positive and negative modification results. State Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models. Mathematics Connections – MP.2; MP.4; HSN-Q.A.1; HSN-Q.A.2; HSN-Q.A.3

Engineering, Technology, & Applications of Science

SECONDARY GRADE PERFORMANCE EXPECTATIONS (BENCHMARKS)

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. Clarification Statement: Example problems could include citing and designing a retirement home, a hospice building, or a new Junior High School within the city. Science Standards Connections MS-PS1-6; MS-PS2-1; MS-PS3-3; MS-ESS3-3 Career & Vocational Educational Connections CV8.3.1; CV8.5.4	**HS-ETS1-1. Analyze a local, regional, or global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.** Clarification Statement: Examples of challenges could include rural cell phone coverage, geothermal energy use, and sage grouse population. Science Standards Connections HS-LS2-7; HS-LS4-6; HS-PS2-6; HS-PS4-2; HS-PS4-5; HS-ESS3-1; HS-ESS3-2; HS-ESS3-3; HS-ESS3-4 ELA/Literacy Connections RST.11-12.7, RST.11-12.8; RST.11-12.9 Mathematics Connections MP.2; MP.4
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. Clarification Statement: Preliminary building designs could involve overall dimensions, number of rooms, entries & exits, orientation to permit solar energy collection. Criteria and constraints could include these design elements or those of another project. Science Standards Connections MS-PS1-6; MS-PS2-1; MS-PS3-3; MS-LS2-5; MS-ESS3-3; MS-ESS3-5 Career & Vocational Educational Connections CV8.5.2	**HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.** Clarification Statement: Emphasis is on creativity, innovation, and inquiry. Science Standards Connections HS-PS2-3; HS-PS3-3; HS-PS4-1; HS-LS2-7; HS-LS4-6; HS-ESS3-3 Mathematics Connections MP.4

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. Clarification Statement: Tests could include building capacity, heating efficiency, use of hazardous materials, meeting ADA requirements, or earthquake survival. Science Standards Connections MS-PS1-6; MS-PS2-1; MS-PS3-3; MS-LS2-5; MS-ESS3-3 Career & Vocational Educational Connections CV8.3.3; CV8.4.3	**HS-ETS1-3. Evaluate a solution to a real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.** Clarification Statement: Examples could include evaluation of historical, present day, and potential future challenges which take into account shifts in cultural norms and values, societal priorities, and/or technology. Science Standards Connections HS-PS2-3; HS-PS4-2; HS-PS4-5; HS-LS2-7; HS-LS4-6; HS-ESS3-2; HS-ESS3-3; HS-ESS3-4 ELA/Literacy Connections RST.11-12.7; RST.11-12.8; RST.11-12.9 Mathematics Connections MP.2; MP.4
MS-ETS1-4. Develop a model for a proposed object, tool, or process and then use an iterative process to test the model, collect data, and generate modification ideas trending toward an optimal design. Clarification Statement: The object, tool or process could include a bicycle, a bridge, a smart furnace, or an auto airbag system. Test data could be collected from tests of a model object, or from test data for a similar object, tools, or process found on the internet. Science Standards Connections MS-PS1-6; MS-PS2-1; MS-LS2-5; MS-ESS3-3 Social Studies Connections SS8.4.2	**HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.** Clarification Statement: Examples can include using spreadsheets to modify and evaluate data, PhET simulations, GIS spatial modeling, etc. Science Standards Connections HS-PS2-3; HS-PS2-6; HS-PS3-1; HS-PS3-3; HS-PS4-1; HS-LS2-1; HS-LS2-2; HS-LS2-7; HS-LS4-6; HS-ESS2-4; HS-ESS2-6; HS-ESS3-3; HS-ESS3-4 Mathematics Connections MP.2; MP.4

MIDDLE SCHOOL 6-8	HIGH SCHOOL 9-12
No Standard - Intentionally Left Blank	**HS-ETS1-5 - Evaluate the validity and reliability of claims in a variety of materials.** Clarification Statement: Examples of materials could include trade books, scientific publications, magazines, web resources, videos, and other passages that may reflect bias. Science Standards Connections HS-PS2-6; HS-PS4-1; HS-PS4-2; HS-LS2-6; HS-LS2-7; HS-LS3-2; HS-LS4-5; HS-ESS2-2; HS-ESS3-1; HS-ESS3-2; HS-ESS2-7; HS-ESS3-3; HS-ESS3-4; HS-ESS2-4 ELA/Literacy Connections RST.9-10.8; RST.11-12.1; RST.11-12.7; RST.11-12.8; WHST.9-12.2; WHST.11-12.8 Mathematics Connections MP.2
MS-ETS2-1. Ask questions about a common household appliance, collect data to reverse-engineer the appliance and learn how it's design has evolved, describe how scientific discoveries, technological advances, and engineering design played significant roles in its development, and explore how science, engineering and technology might be used together or individually in producing improved versions of the appliance. Clarification Statement: Examples of household appliances could include radios, heaters, food processors, refrigerators, and washing machines. Science Standards Connections MS-PS1-3; MS-LS4-5; MS-ESS1-3	
MS-ETS2-2. Develop a model defining and prioritizing the impacts of human activity on a particular aspect of the environment, identifying positive and negative consequences of the activity, both short and long-term, and investigate and explain how the ethics and integrity of scientists and engineers and respect for individual property rights might constrain future development. Clarification Statement: The model could be mathematical, tabular, or graphic. Examples of impacted activities could include agriculture, medicine, energy production and water resources. Constraints on human impacts could include balancing costs, benefits, and risks to society. Science Standards Connections MS-PS1-3; MS-PS2-1; MS-LS2-5; MS-LS4-5; MS-ESS3-3	