6 – 8 Crosswalk

(Draft)

The intent of this crosswalk is to enhance understanding of the changes to the science expectations. The column on the left contains the newly adopted science expectations (2016). The column on the right contains the previous expectations (GLEs) which show some alignment. This document is intended to assist teachers with some of the issues associated with implementing new science standards: planning, pacing, professional development and curricular materials.

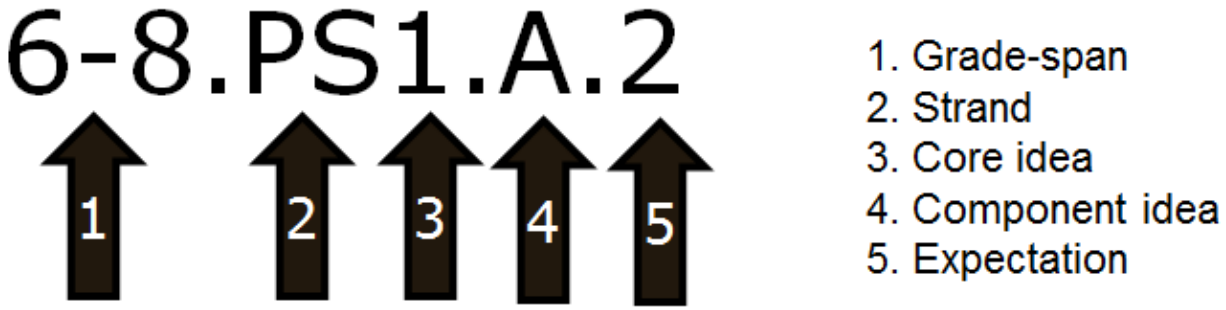
Expectations for middle school strands are based on 6 – 8 grade-spans: Physical Science (PS), Life Science (LS), Earth and Space Science (ESS) and Engineering, Technology and Application of Science (ETS). Within each strand there are Core Ideas: PS1 - Matter and Its Interactions or PS2 - Motion and Stability: Forces and Interactions. The Core Ideas are broken down to Component Ideas. Each Component Idea may have one or more performance expectations.

"A Framework for K-12 Science Education: Practices, Concepts and Core Ideas" explains a "3 dimensional" learning model in which the instruction of phenomena are accompanied by specific lists of practices and concepts. Review chapters 3 and 4 as these chapters illustrate the additional dimensions of science education. This book or individual chapters can be downloaded for free from the National Academies Press website (http://www.nap.edu/).

Strand 7 of the 6 – 8 GLEs primarily align with the "science and engineering practices" and "crosscutting concepts" from "A Framework for K-12 Science Educations: Practices, Concepts and Core Ideas". Review available resources to understand the alignment of the scientific inquiry skills from Strand 7with the practices and concepts from the 3 Dimensional Learning Model.

Assessments for the new expectations are currently scheduled for the 2018 – 2019 school year.

Note the changes to the coding of science expectations:



Missouri Learning Standards: Grade-Level Expectations (Adopted April 2016 for implementation in the 2016 – 2017 school year, assessed beginning in the 2018 – 2019 school year.)		**Missouri Learning Standards** (Revised edition 2008)	
	Physical Science		
	PS1 - Matter and Its Interactions		
	A. Structure and Properties of Matter		
6-8.PS1.A.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.]	ME. 1.A.8.a	Identify elements (unique atoms) and compounds (molecules or crystals) are pure substances that have characteristic properties
		ME.1.F.8.a	Identify more than 100 known elements (unique atoms) exist that may be combined in nature or by man to produce compounds that make up the living and nonliving substances in the environment (Do NOT assess memorization of the Periodic Table)
		ME. 1.C.6.a	Describe evidence (e.g., diffusion of food coloring in water, light reflecting off of dust particles in the air, condensation of water vapor by increased pressure or decreased temperature) that supports the theory that matter is composed of small particles (atoms, molecules) that are in constant, random motion
		ME.1.C.8.a	Describe evidence (e.g., diffusion of colored material into clear material such as water; light reflecting off of dust particles in air; changes in physical properties and reactivity such as gold hammered into foil, oil spreading on the surface of water, decay of organic matter, condensation of water vapor by increased pressure) that supports the theory that matter is composed of moving particles too small to be seen (atoms, molecules
6-8.PS1.A.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.]	**ME.1.C.8.b**	Describe the physical and chemical properties (e.g., magnetic attraction, conductivity, melting point and boiling point, reactivity) of pure substances (elements or compounds) (e.g., copper wire, aluminum wire, iron, charcoal, sulfur, water, salt, sugar, sodium bicarbonate, galena, quartz, magnetite, pyrite) using appropriate senses and tools
		ME.1.A.6	a. Identify matter is anything that has mass and volume b. Describe and compare the volumes (the amount of space an object occupies) of objects or substances directly, using a graduated cylinder, and/or indirectly, using displacement methods c. Describe and compare the masses (amounts of matter) of objects to the nearest gram using a balance d. Classify the types of matter in an object into pure substances

			or mixtures using their specific physical properties	
		ME.1.G.6	a. Identify and classify changes in matter as chemical and/or physical b. Identify chemical changes (i.e., rusting, oxidation, burning, decomposition by acids, decaying, baking) in common objects (i.e., rocks such as limestone, minerals, wood, steel wool, plants) as a result of interactions with sources of energy or other matter that form new substances with different characteristic properties c. Identify physical changes in common objects (e.g., rocks, minerals, wood, water, steel wool, plants) and describe the processes which caused the change (e.g., weathering, erosion, cutting, dissolving)	
		ME.1.B.6	a. Describe the properties of each component in a mixture/solution and their distinguishing properties (e.g., salt water, oil and vinegar, pond water, Kool-Aid) b. Describe appropriate ways to separate the components of different types of mixtures (sorting, evaporation, filtration, magnets, boiling, chromatography, screening) c. Predict how various solids (soluble/insoluble) behave (e.g., dissolve, settle, float) when mixed with water	
6-8.PS1.A.3	Gather, analyze, and present information to describe that synthetic materials come from natural resources and how they 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.]			
6-8.PS1.A.4	Develop a model that 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.]	**ME.1.D.6.a**	Describe the relationship between the change in the volume of water and changes in temperature as it relates to the properties of water (i.e., water expands and becomes less dense when frozen)	
		ME.1.D.7.a	Describe the relationship between temperature and the movement of atmospheric gases (i.e., warm air rises due to expansion of the volume of gas, cool air sinks due to contraction of the volume of gas)	
		ME.1.D.8	a. Using the Kinetic Theory model, illustrate and account for the physical properties (i.e., shape, volume, malleability, viscosity)	

			of a solid, liquid, or gas in terms of the arrangement and motion of molecules in a substance b. Use the Kinetic Theory model to explain changes in the volume, shape, and viscosity of materials in response to temperature changes during a phase change c. Predict the effect of energy transfer on the physical properties of a substance as it changes to or from a solid, liquid, or gas (i.e., phase changes that occur during freezing, melting, evaporation, boiling, condensation)
	PS1 - Matter and Its Interactions		
	B. Chemical Reactions		
6-8.PS1.B.1	Develop and use a model to describe how the total number of atoms remains the same during 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.]	**ME.1.G.8.b**	Identify chemical changes (i.e., rusting, oxidation, burning, decomposition by acids, decaying, baking) in common objects (i.e., rocks such as limestone, minerals, wood, steel wool, plants) as a result of interactions with sources of energy or other matter that form new substances with different characteristic properties
		ME.1.I.6.a	Demonstrate and provide evidence that mass is conserved during a physical change
		ME.1.I.8.a	Provide evidence that mass is conserved during a chemical change in a closed system (e.g., vinegar + baking soda, mold growing in a closed container, steel wool rusting)
6-8.PS1.B.2	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.]	**ME.F.2.8.a**	Identify the evidence of different energy transformations (e.g., explosion of light, heat, and sound, temperature change, electrical charge) that may occur as chemical energy is released during a chemical reaction
		ME.2.A.8.a	Recognize and describe how chemical energy is stored in chemical compounds (e.g., energy stored in and released from food molecules, batteries, nitrogen explosives, fireworks, organic fuels)
	C. **Nuclear Process**		

	PS2 - Motion and Stability: Forces and Interactions		
	A. Forces and Motion		
6-8.PS2.A.1	Apply physics principles to design a solution that minimizes the force of an object during a collision and develop an evaluation of the solution.	**FM.2.A.7**	a. Identify and describe the types of forces acting on an object in motion, at rest, floating/sinking (i.e., type of force, direction, amount of force in Newton's) b. Compare the forces acting on an object by using a spring scale to measure them to the nearest Newton
6-8.PS2.A.2	Plan and conduct 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.]	**FM.2.D.7**	a. Compare the effects of balanced and unbalanced forces (including magnetic, gravity, friction, push or pull) on an object's motion b. Explain that when forces (including magnetic, gravity, friction, push or pull) are balanced, objects are at rest or their motion remains constant c. Explain that a change in motion is the result of an unbalanced force acting upon an object d. Explain how the acceleration of a moving object is affected by the amount of net
	B. Types of Interaction		

6-8.PS2.B.1	Analyze diagrams and collect 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.]	**ME.2.A.7**	h. Describe the interactions (i.e., repel, attract) of like and unlike charges (i.e., magnetic, static electric, electrical) i. Diagram and identify a complete electric circuit by using a source (battery), means of transfer (wires), and receiver (resistance bulbs, motors, fans) j. Observe and describe the evidence of energy transfer in a closed series circuit k. Describe the effects of resistance (number of receivers), amount of voltage (number of energy sources), and kind of transfer materials on the current being transferred through a circuit (e.g., brightness of light, speed of motor) l. Classify materials as conductors or insulators of electricity when placed within a circuit (e.g., wood, pencil lead, plastic, glass, aluminum foil, lemon juice, air, water) m. Diagram and distinguish between complete series and parallel circuits n. Identify advantages and disadvantages of series and parallel circuits
6-8.PS2.B.2	Create and analyze a graph to use as evidence to support the claim that gravitational interactions depend on the mass 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.]	**FM.2.B.7**	a. Explain every object exerts a gravitational force of attraction on every other object b. Recognize an object's weight is a measure of the gravitational force of a planet/moon acting on that object c. Compare the amount of gravitational force acting between objects (which is dependent upon their masses and the distance between them)
	PS3 - Energy		
	A. Definitions of Energy		
6-8.PS3.A.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	**FM.1.A.7**	a. Describe the circular motion of a moving object as the result of a force acting toward the center b. Classify different types of motion (e.g., straight line, projectile, circular, vibrational) c. Given an object in motion, calculate its speed (distance/time) d. Interpret a line graph representing an object's motion in terms of distance over time (speed) using metric units

	ball.]	**ME. 2.A.7.a**	Identify thermal energy as the random motion (kinetic energy) of molecules or atoms within a substance
6-8.PS3.A.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.]	**ME.2.A.7.h**	Describe the interactions (i.e., repel, attract) of like and unlike charges (i.e., magnetic, static electric, electrical)
		ME.2.D.7	a. Compare the effects of balanced and unbalanced forces (including magnetic, gravity, friction, push or pull) on an object's motion b. Explain that when forces (including magnetic, gravity, friction, push or pull) are balanced, objects are at rest or their motion remains constant c. Explain that a change in motion is the result of an unbalanced force acting upon an object d. Explain how the acceleration of a moving object is affected by the amount of net force applied and the mass of the object
6-8.PS3.A.3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.]	**ME.2.F.7**	a. Identify the different energy transformations that occur between different systems (e.g., chemical energy in battery converted to electricity in circuit converted to light and heat from a bulb) b. Identify that, during an energy transformation, heat is often transferred from one object (system) to another because of a difference in temperature c. Recognize and describe how energy is not lost but conserved as it is transferred and transformed
		ME.2.A.7	b. Use the kinetic molecular model to explain changes in the temperature of a material c. Identify thermal energy is transferred as heat from warmer objects to cooler objects until both reach the same temperature (equilibrium)
6-8.PS3.A.4	Plan and conduct an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in 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	**ME.2.A.7.g**	Predict the differences in temperature over time on different colored (black and white) objects placed under the same heat source

	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.]		
	B. Conservation of Energy and Energy Transfer		
6-8.PS3.B	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.]	**ME.2.A.7**	d. Identify the type of materials that transfer energy by conduction, convection, and/or radiation e. Describe how heat is transferred by conduction, convection, and radiation, and classify examples of each f. Classify common materials (e.g., wood, foam, plastic, glass, aluminum foil, soil, air, water) as conductors or insulators of thermal energy
	C. Relationship Between Energy and Forces		
	PS4 - Waves and Their Applications in Technologies for Information Transfer		
	A. Wave Properties		
6-8.PS4.A.2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.]	**ME.2.A.6**	a. Identify sources of visible light (e.g., the Sun and other stars, flint, bulb, flames, lightning) b. Describe evidence (i.e., cannot bend around walls) that visible light travels in a straight line, using the appropriate tools (i.e., pinhole viewer, ray box, laser pointer) c. Compare the reflection of visible light by various surfaces (i.e., mirror, smooth and rough surfaces, shiny and dull surfaces, Moon) d. Compare the refraction of visible light passing through different transparent and translucent materials (e.g., prisms, water, a lens) e. Predict how different surfaces (transparent, translucent, opaque) and lenses (convex, concave) affect the behavior of visible light rays and the resulting image of an object f. Identify receivers of visible light energy (e.g., eye, photocell) g. Recognize and explain that an object is "seen" only when the object emits or reflects light to the eye h. Recognize differences in wavelength and energy levels within that range of visible light that can be seen by the human eye are perceived as differences in color i. Describe how sound energy is transferred by wave-like disturbances that spread away from the source through a medium k. Predict how the properties of the medium (e.g., air, water, empty space, rock) affect the speed of different types of mechanical waves (i.e., earthquake, sound) i. Describe how sound energy is transferred by wave-like

			disturbances that spread away from the source through a medium j. Describe how changes in energy cause changes in loudness and pitch of a sound k. Predict how the properties of the medium (e.g., air, water, empty space, rock) affect the speed of different types of mechanical waves (i.e., earthquake, sound)
		ME.2.C.6.	a. Recognize and describe how energy from the Sun is transferred to Earth in a range of wavelengths and energy levels, including visible light, infrared radiation, and ultraviolet radiation
	B. Electromagnetic Radiation		
	LS1 - From Molecules to Organisms: Structure and Processes		
	A. Structure and Function		
6-8.LS1.A.1	Provide evidence that organisms (unicellular and multicellular) are made of cells and that a single cell must carry out all of the basic functions of life. [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.]	**LO.1.A.6.a**	Describe the common life processes necessary to the survival of organisms (i.e., growth, reproduction, life span, response to stimuli, energy use, exchange of gases, use of water, elimination of waste)
		LO.1.C.6.a	Recognize all organisms are composed of cells, the fundamental units of life, which carry on all life processes
		LO.1.E.6	a. Recognize most of the organisms on Earth are unicellular (e.g., bacteria, protists) and other organisms, including humans, are multicellular b. Identify examples of unicellular (e.g., bacteria, some protists, fungi) and multicellular organisms (e.g., some fungi, plants, animals)
6-8.LS1.A.2	Develop and use a model to describe the function of a cell as a whole and ways parts of the cells contribute to that function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.]	**LO.2.A.6**	a. Compare and contrast the following plant and animal cell structures: cell membrane, nucleus, cell wall, chloroplast, and cytoplasm b. Recognize the chloroplast as the cell structure where food is produced in plants and some unicellular organisms (e.g., algae, some protists)
		LO.2.A.8	a. Describe how the cell membrane helps regulate the transfer of materials in and out of the cell b. Identify the function of the chloroplast during photosynthesis

6-8.LS1.A.3	Develop an argument supported by evidence for how multicellular organisms are organized by varying levels of complexity; cells, tissue, organs, organ systems.	**LO.2.C.8.a**	Identify and give examples of each level of organization (cell, tissue, organ, organ system) in multicellular organisms (plants, animals)
6-8.LS1.A.4	Present evidence that body systems interact to carry out key body functions, including providing nutrients and oxygen to cells, removing carbon dioxide and waste from cells and the body, controlling body motion/activity and coordination, and protecting the body.	**ME.2.A.6.f**	Identify receivers of visible light energy (e.g., eye, photocell)
		LO.2.A.8	a. Describe photosynthesis is a chemical change with reactants (water and carbon dioxide) and products (energy-rich sugar molecules and oxygen) that takes place in the presence of light and chlorophyll b. Describe how oxygen is needed by all cells of most organisms for the release of energy from nutrient (sugar) molecules (Do NOT assess the term cellular respiration) c. Describe the importance of the transport and exchange of oxygen and carbon dioxide to the survival of the organism
		LO.2.A.6.a	Describe how plants use energy from the Sun to produce food and oxygen through the process of photosynthesis
		LO.2.C.8	b. Illustrate and explain the path water and nutrients take as they move through the transport system of a plant c. Explain the interactions between the circulatory and digestive systems as nutrients are processed by the digestive system, passed into the blood stream, and transported in and out of the cell d. Compare and contrast the processes of mechanical and chemical digestion, and their role in providing materials necessary for survival of the cell and organism e. Identify the importance of the transport and exchange of nutrient and waste molecules to the survival of the cell and organism f. Explain the interactions between the circulatory and respiratory systems in exchanging oxygen and carbon dioxide between cells and the atmosphere (when oxygen enters the body, passes into the blood stream, and is transported into the cell; carbon dioxide is transported out of the cell, passes into the blood stream, and exits the body) g. Explain the interactions between the nervous and muscular systems when an organism responds to a stimulus
	B. Growth and Development of Organisms		
6-8.LS1.B.1	Construct an explanation for how characteristic animal behaviors as well as specialized plant structures affect the probability of successful reproduction of animals and plants respectively. [Clarification Statement: Examples of animal 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.	**LO.1.D.8.a**	Identify and contrast the structures of plants and animals that serve similar functions (e.g., taking in water and oxygen, support, response to stimuli, obtaining energy, circulation, digestion, excretion, reproduction)
		LO.3.A.8	a. Compare and contrast the processes of asexual and sexual reproduction, including the type and number of cells involved (one body cell in asexual, two sex cells in sexual), and the number of gene sets (body cell has two sets, sex cells have one set each) passed from

	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 that affect the probability of plant reproduction 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.]		parent(s) to offspring b. Identify examples of asexual reproduction (i.e., plants budding, binary fission of single cell organisms) c. Compare and contrast the reproductive mechanisms of classes of vertebrates (i.e., internal vs. external fertilization) d. Describe how flowering plants reproduce sexually
		LO.2.B.8.a	Predict the response the body may take to maintain internal balance during an environmental change (e.g., shivering when cold, slowing metabolism when food supply decreases or when dehydrated, adrenaline rush when frightened)
6-8.LS1.B.2	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.]		
	C. Organization for Matter and Energy Flow in Organisms		
6-8.LS1.C	Construct a scientific explanation based on evidence for the role of photosynthesis and cellular respiration in the cycling of matter and flow of energy into and out of organisms.	**LO.1.A.8.a**	Recognize that most plants and animals require food and oxygen (needed to release the energy from that food)
		EC.2.B.8	a. Illustrate the oxygen/carbon dioxide cycles (including the processes of photosynthesis and cellular respiration) b. Describe the processes involved in the recycling of matter in the oxygen/carbon dioxide cycles
	LS2 - Ecosystems: Interactions, Energy, and Dynamics		
	A. Interdependent Relationships in Ecosystems		
6-8.LS2.A.1	Analyze and interpret data to provide evidence for the effects of resource availability on individual 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.].	**EC.1.D.6**	a. Describe beneficial and harmful activities of organisms, including humans (e.g., deforestation, overpopulation, water and air pollution, global warming, restoration of natural environments, river bank/coastal stabilization, recycling, channelization, reintroduction of species, depletion of resources), and explain how these activities affect organisms within an ecosystem

6-8.LS2.A.2	Construct an explanation that predicts the patterns of interactions among and between the biotic and abiotic factors in a given ecosystem. [Clarification Statement: Relationships may include competition, predation, and symbiosis.]	**LO.2.G.8**	a. Explain the cause and effect of diseases (e.g., AIDS, cancer, diabetes, hypertension) on the human body (locally assessed) b. Relate some common diseases (i.e., cold, influenza, strep throat, dysentery, fungal infections) to the organisms that cause them (bacteria, viruses, protests, fungi) c. Differentiate between infectious and noninfectious diseases d. Explain the role of antibiotics and vaccines in the treatment and prevention of diseases
	B. Cycles of matter and Energy Transfer in Ecosystems		
6-8.LS2.B	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, including food chains and food webs.]	**ME.1.I.8.c**	Explain that the amount of matter remains constant while being recycled through food chains and food webs
		EC.1.A.6.a	Identify the biotic factors (populations of organisms) and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition) that make up an ecosystem
		EC.2.A.6	a. Diagram and describe the transfer of energy in an aquatic food web and a land food web with reference to producers, consumers, decomposers, scavengers, and predator/prey relationships b. Classify populations of unicellular and multicellular organisms as producers, consumers, and decomposers by the role they serve in the ecosystem
	C. Ecosystems Dynamics, Functioning and Resilience		
6-8.LS2.C.1	Construct an argument supported by empirical evidence that explains how changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making inferences about changes in populations, defining the boundaries of the system, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]	**EC.1.A.6**	a. Identify populations within a community that are in competition with one another for resources b. Identify the factors that affect the number and types of organisms an ecosystem can support (e.g., food availability, abiotic factors such as quantity of light and water, temperature and temperature range, soil composition, disease, competitions from other organisms, predation) c. Predict the possible effects of changes in the number and types of organisms in an ecosystem on the populations of other organisms within that ecosystem
6-8.LS2.C.2	Evaluate benefits and limitations of differing design solutions for maintaining an ecosystem. [Clarification Statement: Examples of design solutions could include water, land, and species protection, and the prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]	**EC.1.D.6**	b. Predict the impact (beneficial or harmful) of a natural environmental change (e.g., forest fire, flood, volcanic eruption, avalanche) on the organisms in an ecosystem c. Describe possible solutions to potentially harmful environmental changes within an ecosystem
	LS3 - Heredity: Inheritance and Variation of Traits		
	A. **Inheritance of Traits**		

	B. **Variation of Traits**		
	LS4 - Biological Evolution; Unity and Diversity		
	A. Evidence of Common Ancestry and Diversity		
6-8.LS4.A	Analyze and interpret evidence from the fossil record to infer patterns of environmental change resulting in extinction and changes to life forms throughout the history of the Earth. [Clarification Statement: Examples of evidence include sets of fossils that indicate an environment, anatomical structures that indicate the function of an organism in the environment, and fossilized tracks that indicate behavior of organisms.]		a. Identify fossils as evidence some types of organisms (e.g., dinosaurs, trilobites, mammoths, giant tree ferns) that once lived in the past, and have since become extinct, have similarities with and differences from organisms living today
	B. Natural Selection		
6-8.LS4.B.1	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]	**EC.3.C.6**	a. Relate examples of adaptations (specialized structures or behaviors) within a species to its ability to survive in a specific environment (e.g., hollow bones/flight, hollow hair/insulation, dense root structure/compact soil, seeds/food, protection for plant embryo vs. spores, fins/movement in water) b. Predict how certain adaptations, such as behavior, body structure, or coloration, may offer a survival advantage to an organism in a particular environment
6-8.LS4.B.2	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, and farming practices).]		

	C. **Adaptation**		
6-8.LS4.C	Interpret graphical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.		
	ESS1 - Earth's Place in the Universe		
	A. **The Universe and its Stars**		
6-8.ESS1.A.1	Develop and use a model of the Earth-sun-moon system to explain the cyclic patterns of lunar phases and eclipses of the sun and moon. [Clarification Statement: Examples of models can be physical, graphical, or conceptual and should emphasize relative positions and distances.]	**UN.2.C.7.e**	Recognize and explain the phases of the moon are due to the relative positions of the Moon with respect to the Earth and Sun
6-8.ESS1.A.2	Develop and use a model of the Earth-sun system to explain the cyclical pattern of seasons, which includes the Earth's tilt and directional angle of sunlight on different areas of Earth across the year. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]	**ME.2.C.6.b**	Recognize and apply the fact that energy from the Sun is the source of almost all energy used to produce the food for living organisms
		ME.2.C.7.a	Identify solar radiation as the primary source of energy for weather phenomena
		UN.2.C.7	a. Illustrate and explain a day as the time it takes a planet to make a full rotation about its axis b. Diagram the path (orbital ellipse) the Earth travels as it revolves around the Sun c. Illustrate and explain a year as the time it takes a planet to revolve around the Sun d. Explain the relationships between a planet's length of year (period of revolution) and its position in the solar system f. Relate the axial tilt and orbital position of the Earth as it revolves around the Sun to the intensity of sunlight falling on different parts of the Earth during different seasons
6-8.ESS1.A.3	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 or conceptual.]	**UN.2.D.7**	a. Describe how the Earth's gravity pulls any object on or near the Earth toward it (including natural and artificial satellites) b. Describe how the planets' gravitational pull keeps satellites and moons in orbit around them c. Describe how the Sun's gravitational pull holds the Earth and other planets in their orbits
	B. **Earth and the Solar System**		
6-8.ESS1.B	Analyze and interpret data to determine scale properties of objects in the solar system. [Clarification Statement: Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and	**UN.1.A.7**	a. Classify celestial bodies in the solar system into categories: Sun, Moon, planets, and other small bodies (i.e., asteroids, comets, meteors), based on physical properties b. Compare and contrast the size, composition, atmosphere, and

	orbital radius. Examples of data include statistical information, drawings and photographs, and models.]		surface of the planets (inner vs. outer) in our solar system and Earth's moon c. Describe the relative proximity of common celestial bodies (i.e., Sun, Moon, planets, smaller celestial bodies such as comets and meteors, other stars) in the sky to the Earth
	C. **The History of Planet Earth**		
6-8.ESS1.C	Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 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.]	**ES.2.D.8**	a. Describe the methods used to estimate geologic time and the age of the Earth (e.g., techniques used to date rocks and rock layers, presence of fossils) b. Use rock and fossil evidence to make inferences about the age, history, and changing life forms and environment of the Earth (i.e., changes in successive layers of sedimentary rock and the fossils contained within them, similarities between fossils in different geographic locations, similarities between fossils and organisms present today, fossils of organisms indicating changes in climate, fossils of extinct organisms)
	ESS2 - Earth's Systems		
	A. **Earth Materials and Systems**		
6-8.ESS2.A.1	Develop and use a model to illustrate that energy from the Earth's interior drives convection which cycles Earth's crust leading to melting, crystallization, weathering and deformation of large rock formations, including generation of ocean sea floor at ridges, submergence of ocean sea floor at trenches, mountain building and active volcanic chains. [Clarification Statement: The emphasis is on large-scale cycling resulting from plate tectonics that includes changes in rock types through erosion, heat and pressure.]	**ME.1.I.8.b**	Explain that the amount of matter remains constant while being recycled through the rock cycle
		ES.2.A.6	a. Make inferences about the formation of sedimentary rocks from their physical properties (e.g., layering and the presence of fossils indicate sedimentation) b. Explain how the formation of sedimentary rocks depends on weathering and erosion
6-8.ESS2.A.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.]	**ES.2.A.6**	c. Describe how weathering agents and erosional processes (i.e., force of water as it freezes or flows, expansion/contraction due to temperature, force of wind, force of plant roots, action of gravity, chemical decomposition) slowly cause surface changes that create and/or change landforms d. Describe how the Earth's surface and surface materials can change abruptly through the activity of floods, rock/mudslides, or volcanoes
		ES.2.B.6.a	Identify events (earthquakes, volcanic eruptions) and the landforms created by them on the Earth's surface that occur at different plate boundaries
		ES.2.B.8.c	a. Explain convection currents are the result of uneven heating inside the mantle resulting in the melting of rock materials,

			convection of magma, eruption/flow of magma, and movement of crustal plates b. Explain how rock layers are affected by the folding, breaking, and uplifting of rock layers due to plate motion c. Describe how the movement of crustal plates can cause earthquakes and volcanic eruptions that can result in mountain building and trench formation
	B. Plate Tectonics and Large-Scale Systems		
6-8.ESS2.B	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).]	**ES.2.D.6.b**	Use fossil evidence to make inferences about changes on Earth and in its environment (i.e., superposition of rock layers, similarities between fossils in different geographical locations, fossils of seashells indicate the area was once underwater)
	C. **The Role of Water in Earth's Surface Processes**		
6-8.ESS2.C.1	Design and 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.]	**ME.1.I.7.a**	Explain that the amount of matter remains constant while being recycled through the water cycle
		ES.1.B.6.a	Identify and describe the properties of water that make it an essential component of the Earth system (e.g., its ability to act as a solvent, its ability to remain as a liquid at most Earth temperatures)
		ES.2.E.7	a. Explain and trace the possible paths of water through the hydrosphere, geosphere, and atmosphere (i.e., the water cycle: evaporation, condensation, precipitation, surface run-off/ groundwater flow) b. Relate the different forms water can take (i.e., snow, rain, sleet, fog, clouds, dew, humidity) as it moves through the water cycle to atmospheric conditions (i.e., temperature, pressure, wind direction and speed, humidity) at a given geographic location c. Explain how thermal energy is transferred throughout the water cycle by the processes of convection, conduction, and radiation
6-8.ESS2.C.2	Research, collect, and analyze 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 possible ranges. Examples of data can be provided to students (such as weather	**ES.2.F.7**	a. Explain how the differences in surface temperature, due to the different heating and cooling rates of water and soil, affect the temperature and movement of the air above b. Describe the characteristics of air masses (i.e., high/low barometric pressure, temperature) and predict their effect on the weather in a given location c. Identify weather conditions associated with cold fronts and warm fronts d. Identify factors that affect weather patterns in a particular region (e.g., proximity to large bodies of water, latitude, altitude, prevailing

	maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).]		wind currents, amount of solar radiation, location with respect to mountain ranges) e. Collect and interpret weather data (e.g., cloud cover, precipitation, wind speed and direction) from weather instruments and maps to explain present day weather and to predict the next day's weather f. Describe the significant changes in temperature and barometric pressure may cause dramatic weather phenomena (i.e., severe thunderstorms, tornadoes, hurricanes)
6-8.ESS2.C.3	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.]		g. Differentiate between weather and climate. h. Identify factors that affect climate (e.g., latitude, altitude, prevailing wind currents, amount of solar radiation)
	D. **Weather and Climate**		
	E. **Biogeology**		
	ESS3 - Earth and Human Activity		
	A. **Natural Resources**		
6-8.ESS3.A	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 and human activity. [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).]		
	B. Natural Hazards		
6-8.ESS3.B	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).]		
	C. **Human Impacts on Earth's Systems**		
6-8.ESS3.C.1	Analyze data to define the relationship for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of data 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.]		
6-8.ESS3.C.2	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]	**ES.3.A. 6**	b. Describe the affect of human activities (e.g., landfills, use of fertilizers and herbicides, farming, septic systems) on the quality of water c. Analyze the ways humans affect the erosion and deposition of soil and rock materials (e.g., clearing of land, planting vegetation, paving land, construction of new buildings, building or removal of dams) and propose possible solutions
		ES.3.A.7.b	Provide examples of how the availability of fresh water for humans and other living organisms is dependent upon the water cycle
	D. **Global Climate Change**		

6-8.ESS3.D	Analyze evidence of the factors that have caused the change in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities.]		
	ETS1 - Engineering Design		
	A. **Defining and Delimiting Engineering Problems**		
6-8.ETS1.A	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.	**ST.1.C.6-8**	a. Describe how technological solutions to problems (e.g., storm water runoff, fiber optics, windmills, efficient car design, electronic trains without conductors, sonar, robotics, Hubble telescope) can have both benefits and drawbacks (e.g., design constraints, unintended consequences, risks) (Assess Locally)
		ST.3.B.6-8	a. Describe ways in which science and society influence one another (e.g., scientific knowledge and the procedures used by scientists influence the way many individuals in society think about themselves, others, and the environment; societal challenges often inspire questions for scientific research; social priorities often influence research priorities through the availability of funding for research) b. Identify and evaluate the physical, social, economic, and/or environmental problems that may be overcome using science and technology (e.g., the need for alternative fuels, human travel in space, AIDS)
	B. **Developing Possible Solutions**		
6-8-ETS1.B.1	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	**ST.1.A.6-8**	a. Explain how technological improvements, such as those developed for use in space exploration, the military, or medicine, have led to the invention of new products that may improve lives here on Earth (e.g., new materials, freeze-dried foods, infrared goggles, Velcro, satellite imagery, robotics, lasers)
6-8-ETS1.B.2	Analyze data from tests to determine similarities and differences among several design solutions to identify the best	**ST.2.B.6-8**	a. Describe the difficulty science innovators experience as they attempt to break through accepted ideas (hypotheses, laws,

	characteristics of each that can be combined into a new solution to better meet the criteria for success.		theories) of their time to reach conclusions that may lead to changes in those ideas and serve to advance scientific understanding (e.g., Darwin, Copernicus, Newton) b. Describe explanations have changed over time as a result of new evidence
6-8-ETS1.B.3	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	**ST.1.B.6-8**	a. Identify the link between technological developments and the scientific discoveries made possible through their development (e.g., Hubble telescope and stellar evolution, composition and structure of the universe; the electron microscope and cell organelles; sonar and the composition of the Earth; manned and unmanned space missions and space exploration; Doppler radar and weather conditions; MRI and CAT-scans and brain activity)
		ST.2.A.6-8	a. Describe how the contributions of scientists and inventors, representing different cultures, races, and gender, have contributed to science, technology and human activity (e.g., George Washington Carver, Thomas Edison, Thomas Jefferson, Isaac Newton, Marie Curie, Galileo, Albert Einstein, Mae Jemison, Edwin Hubble, Charles Darwin, Jonas Salk, Louis Pasteur, Jane Goodall, Tom Akers, John Wesley Powell, Rachel Carson) (Assess Locally)