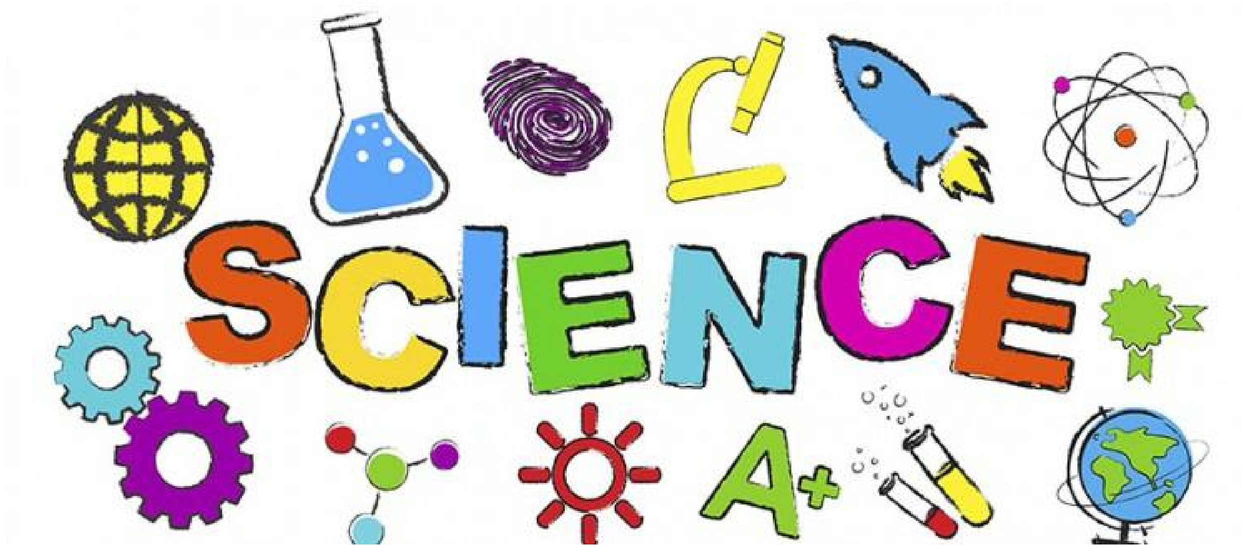

EHPS Science Curriculum
Revised - 2023

East Helena Public Schools
East Helena, Montana

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History

The EHPS science curriculum revision committee approached our work with this revision by relying heavily on the new Montana Science Standards (Adopted September 16, 2016 by the Board of Public Education) and the Next Generation Science Standards (2013). These are the most current standards available for our project. Once our curriculum document was aligned to the new standards, we researched new programs that most closely supported our curriculum goals and the implementation of STEM (Science, Technology, Engineering, and Math) concepts into classroom instruction.

The 2023 Science Curriculum

The science curriculum is based on the Next Generation Science Standards (NGSS). It includes columns for Topics, Disciplinary Core Ideas, Performance Expectations, Essential Vocabulary and Clarification Statements. The curriculum is organized by grade level. The K-5 component focuses on a spiraling curriculum emphasizing the beginnings of observation, critical thinking, and inquiry. These years are designed to provide a solid foundation of future scientific studies.

Within the 6-8 portion of the curriculum, there is still an emphasis on spiraling the disciplines of science--earth, physical, life, space science, and engineering--but now the focus is developing and extending those areas even more.

Definitions

DCI - Disciplinary Core Ideas are the key ideas in science that have broad importance within or across multiple science or engineering disciplines. These core ideas build on each other as students progress through grade levels and are grouped into the following four domains: Physical Science, Life Science, Earth and Space Science, and Engineering. They are statements of what students should be able to do after instruction.

Performance Expectation - These expectations state what students should be able to do in order to demonstrate that they have met the standard, thus providing the same clear and specific targets for curriculum, instruction, and assessment.

Clarification Statement - These statements expand upon the information provided in the performance expectations. They provide examples and information about assessment boundaries.

NGSS (Next Generation Science Standards) - The new standards were developed by the National Research Council, the staffing arm of the National Academy of Science. They are based on the *Framework for K-12 Science Education*. Their purpose is to stimulate and build interest in STEM given the many advances that have occurred in the fields of science and science education, as well as in our innovation-driven economy. The standards integrate rigorous content that reflects how science is practiced in the real world.

Science Curriculum				
Standard: See list for YOUR grade off of NGSS pages for your grade				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Essential Vocabulary**	**Clarification Statement**
Are outlined in the attached standards (google docs)	1. PAO Summary (process assessment outcome from OPI - this is very DETAILED)	These are the bulleted statements listed in the Montana Science Content Standards (You have been given a copy, or you can find it on OPI)	Have a list, but they are not separated by grade	
	2. NGSS Appendix E chart (short version)	They are also the bolded statements at the top of the original NGSS standards. (Given a copy for your grade)		
	3. Bottom of the actual NGSS standards (have been given your grade) It is under the column labeled DCI. There is additional info in written as clarification statement under each performance expectation.	Linked NGSS Standards		

Kindergarten

Standard: PS 1: Forces and Interactions: Pushes and Pulls				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statement**
PS2.A: Forces and Motion	Pushes and pulls can have different strengths and directions. (KPS2-1),(K-PS2-2) Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1),(K-PS2-2)	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. 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.*	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	K-PS2-1.Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other. Assessment 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. K-PS2-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.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]
PS2.B: Types of Interactions	When objects touch or collide, they push on one another and can change motion. (K-PS2-1)	K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.		
PS3.C: Relationship Between Energy and Forces	A bigger push or pull makes things speed up or slow down more quickly. (secondary to K-PS2-1)	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.		
ETS1.A: Defining Engineering Problems	A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (secondary to KPS2-2)	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.*		

Standard: LS 1: Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statement**
LS1.C: Organization for Matter and Energy Flow in Organisms	All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS1-1)	K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts	K-LS1-1.Examples of patterns could include that animals need to take in food but plants do not; 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.] K-ESS2-2 Examples of plants and animals changing their environment could include a
ESS2.E: Biogeology	Plants and animals can change their environment. (K-ESS2-2)	K-ESS2-2. Construct an argument supported by evidence for how plants and		

		animals (including humans) can change the environment to meet their needs.	[3D Learning] [3D Toolkit] [IEFA Resources] [STEM Teaching Tools]	squirrel digs in the ground to hide its food and tree roots can break concrete.] K-ESS3-1. Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas, and grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.] K-ESS3-3.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.]
ESS3.A: Natural Resources	Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. (K-ESS3-1)	K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live		
ESS3.C: Human Impacts on Earth Systems	Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (secondary to K-ESS2-2),(K-ESS3-3)	K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.* K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.		
ETS1.B: Developing Possible Solutions	Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (secondary to K-ESS3-3)			

Standard: PS 3: Weather and Climate

Topic	Disciplinary Core Idea	Performance Expectation	Resources	Clarification Statement
PS3.B: Conservation of Energy and Energy Transfer	Sunlight warms Earth's surface. (K-PS3-1),(K-PS3-2)	K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface. K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.*	[NGSS Glossary] [NGSS Search the Standard] [Science and Engineering Practices] [Crosscutting Concepts] [3D Learning] [3D Toolkit] [IEFA Resources]	K-PS3-1. Examples of Earth's surface could include sand, soil, rocks, and water [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.] K-PS3-2. Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.] K-ESS2-1. 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
ESS2.D: Weather and Climate	Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. (K-ESS2-1)	K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.		
ESS3.B:	Some kinds of severe weather are more	K-ESS3-2. Ask questions to obtain		

Natural Hazards	likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K-ESS3-2)	information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*	STEM Teaching Tools	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.] [Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler. K-ESS3-2. Emphasis is on local forms of severe weather.
ETS1.A: Defining and Delimiting an Engineering Problem	Asking questions, making observations, and gathering information are helpful in thinking about problems. (secondary to K-ESS3-2)	K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*		

Standard: ETS 1: Engineering Design				
Topic	**Disciplinary Core Ideas**	**Performance Expectations**	**Resources**	**Clarification Statement**
ETS1.A Defining and Delimiting Engineering Problems	A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)	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	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	
ETS1.B Developing Possible Solutions	Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)	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.		
ETS1.C Optimizing the Design Solution	Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)	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.		

1st Grade

Standard: PS4 Waves: Light and Sound				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
PS4.A Wave Properties	Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)	1-PS4-1 Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	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.
PS4.B Electromagnetic Radiation	Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2) Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1- PS4-3)	1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated. 1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.		[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.] [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).] [Assessment Boundary: Assessment does not include the speed of light.]
PS4.C Information Technologies and Instrumentation	People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4)	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.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]

Standard: LS1 Structure, Function, and Information Processing				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
LS1.A Structure and Function	All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find,	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.*	NGSS Glossary NGSS Search the Standard	[Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing

	and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1-LS1-1)		[Science and Engineering Practices](#) [Crosscutting Concepts](#) [3D Learning](#) [3D Toolkit](#) [IEFA Resources](#) [STEM Teaching Tools](#)	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.]
LS1.B Growth and Development of Organisms	Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. (1-LS1-2)	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).]
LS1.D Information Processing	Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1-LS1-1)	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, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.]
LS3.A Inheritance of Traits	Young animals are very much, but not exactly, like their parents. Plants also are very much, but not exactly, like their parents. (1- LS3-1)	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.] [Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.]
LS3.B Variation of Traits	Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. (1-LS3-1)	1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.		
Standard: ESS1 Space Systems: Patterns and Cycles				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
ESS1.A The Universe and its Stars	Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1- ESS1-1)	1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.	[NGSS Glossary](#) [NGSS Search the Standard](#) [Science and](#)	[Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [Assessment Boundary: Assessment of star patterns is limited to stars being seen at night

			Engineering Practices	and not during the day.]
ESS1.B Earth and the Solar System	Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)	1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.	Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	[Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.]

Standard: K-2 Engineering Design

Topic	Disciplinary Core Idea	Performance Expectation	Resources	Clarification Statements
ETS1.A Defining and Delimiting Engineering Problems	A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2- ETS1-1) Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)	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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	
ETS1.B Developing Possible Solutions	Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)	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.		
ETS1.C Optimizing the Design Solution	Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)	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.		

2nd Grade

Standard: 2.Structure and Properties of Matter

Topic	Disciplinary Core Idea	Performance Expectation	Resources	Clarification Statements
PS1.A: Structure and Properties of Matter	Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1) Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3) A great variety of objects can be built up from a small set of pieces. (2-PS1-3)	2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* 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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share. Examples of properties could include, strength, flexibility, hardness, texture and absorbency. Examples of pieces could include blocks, building bricks, or other assorted small objects.
PS1.B: Chemical Reactions	Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)	2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.		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.

Standard: Interdependent Relationships in Ecosystems

Topic	Disciplinary Core Idea	Performance Expectations	Resources	Clarification Statements
LS2.A: Interdependent Relationships in Ecosystems	Plants depend on water and light to grow. (2-LS2-1)	2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit	
	Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)	2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*		
LS4.D: Biodiversity and Humans	There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)	LS4.D: There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)		Emphasis is on the diversity of living things in each of a variety of different habitats.
ETS1.B: Developing	Designs can be conveyed through sketches, drawings, or physical			

Possible Solutions	models. These representations are useful in communicating ideas for a problem's solutions to other people. (secondary to 2-LS2-2		IEFA Resources STEM Teaching Tools	

Standard: Earth's Systems: Processes that Shape the Earth

Topic	Disciplinary Core Idea	Performance Expectations	Resources	Clarification Statements
ESS1.C: The History of Planet Earth	Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)	2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slow	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.
ESS2.A: Earth Materials and Systems	Wind and water can change the shape of the land. (2- ESS2-1)	2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*		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.
ESS2.B: Plate Tectonics and Large-Scale System Interactions	Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2	2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.		
ESS2.C: The Roles of Water in Earth's Surface Processes	Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)	2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.		
ETS1.C: Optimizing the Design Solution	Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)	2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*		

Standard: K-2.Engineering Design

Topic	Disciplinary Core Ideas	Performance Expectations	Resources	Clarification Statements
ETS1.A: Defining and Delimiting Engineering Problems	A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2- ETS1-1) Asking questions, making	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	NGSS Glossary NGSS Search the Standard Science and	

	observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)		Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	
ETS1.B: Developing Possible Solutions	Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)	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.		
ETS1.C: Optimizing the Design Solutio	Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)	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.		

3rd Grade

Standard PS2 Forces and Interactions				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statement**
PS2.A: Forces and Motion	Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1) The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)	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. 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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	PS2-1 Examples 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. PS2-2 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. PS2-3 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 electromagnet and steel paper clips, and the force exerted by

PS2.B: Types of Interactions	Objects in contact exert forces on each other. (3-PS2-1) Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3),(3-PS2-4)	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. 3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.*		one magnet versus the force exerted by two magnets. PS2-4 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.

LS4: Interdependent Relationships in Ecosystems

Topic	Disciplinary Core Idea	Performance Expectation	Resources	Clarification Statement
LS2.C: Ecosystem Dynamics, Functioning, and Resilience	When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (secondary to 3-LS4-4)	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.*	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	LS4-1 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. LS4-3 Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other. LS4-4 Environment changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.
LS2.D: Social Interactions and Group Behavior	Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. (Note: Moved from K–2) (3-LS2-1)	3-LS2-1.Construct an argument that some animals form groups that help members survive.		
LS4.A: Evidence of Common Ancestry and Diversity	Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (Note: Moved from K–2) (3-LS4-1) Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)	3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.		
LS4.C: Adaptation	For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)	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.		
LS4.D: Biodiversity and Humans	Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)	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.*		

Standard: LS1 Inheritance and Variation of Traits: Life Cycles and Traits				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statement**
LS1.B: Growth and Development of Organisms	Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)	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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	LS1- 1 Changes organisms go through during their life form a pattern LS3-1 Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organism other than human LS3-2 Examples of the environment affecting a trait could include normally tall plants grown with sufficient eaters are stunted; and a pet dog that is given too much food and little exercise. LS4-2 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.
LS3.A: Inheritance of Traits	Many characteristics of organisms are inherited from their parents. (3-LS3-1) Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3- LS3-2)	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. 3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.		
LS3.B: Variation of Traits	Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1) The environment also affects the traits that an organism develops. (3-LS3-2)	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. 3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.		
LS4.B: Natural Selection	Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (3-LS4-2)	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.		

Standard ESS2 Weather and Climate				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statement**
ESS2.D: Weather and Climate	Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1)	3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.	NGSS Glossary NGSS Search the Standard	ESS2-1 Examples of data could include average temperature, precipitation, and wind direction. ESS3-1 Design solutions to

	Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2)	3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.	Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods
ESS3.B: Natural Hazards	A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3-ESS3-1) (Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)	3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*		
Standard 3-5. Engineering Design				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statement**
ETS1.A: Defining and Delimiting Engineering Problems	Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)	3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	
ETS1.B: Developing Possible Solutions	Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2) At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)	3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		

ETS1.C: Optimizing the Design Solution	Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)	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.		

4th Grade

Standard: 4. Energy				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
PS3.A: Definitions of Energy	The faster a given object is moving, the more energy it possesses. (4-PS3-1) Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3)	4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. 4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	4-PS3-1 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. 4-PS3-2 Assessment Boundary: Assessment does not include quantitative measurements of energy. 4-PS3-3 Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. Assessment Boundary: Assessment does not include quantitative measurements of energy.
PS3.B: Conservation of Energy and Energy Transfer	Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2),(4-PS3-3) Light also transfers energy from place to place. (4-PS3-2) Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced	4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. 4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide. 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*		4-PS3-2 Assessment Boundary: Assessment does not include quantitative measurements of energy. 4-PS3-3 Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. Assessment Boundary: Assessment does not include quantitative measurements of energy. 4-PS3-4 Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device. Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored

	to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4)			energy to cause motion or produce light or sound. 4-PS3-3 Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact. Assessment Boundary: Assessment does not include quantitative measurements of energy. 4-PS3-4 Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device. Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound. 4-ESS3-1 Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels. 4-PS3-4 Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device. Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.
PS3.C: Relationship Between Energy and Forces	When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)	4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.		
PS3.D: Energy in Chemical Processes and Everyday Life	The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)	4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*		
ESS3.A: Natural Resources	Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)	4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.		
ETS1.A: Defining Engineering Problems	Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (secondary to 4-PS3-4)	4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*		
Standard: 4. Waves: Waves and Information				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
PS4.A:	Waves, which are regular patterns of	4-PS4-1. Develop a model of waves to	[NGSS Glossary]	4-PS4-1 Clarification Statement: Examples of

Wave Properties	motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (Note:This grade band endpoint was moved from K–2). (4-PS4-1) Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)	describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.	NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves. Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength. 4-PS4-3 Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves. Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength. 4-PS4-3 Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves. Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.
PS4.C: Information Technologies and Instrumentation	Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)	4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.*		
ETS1.C: Optimizing The Design Solution	Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary to 4-PS4-3)	4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.*		
		Standard: 4. Structure, Function, and Information Processing		
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
PS4.B: Electromagnetic Radiation	An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)	4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning	4-PS4-2 Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works. 4-LS1-1 Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin. Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.
LS1.A: Structure and Function	Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.		
LS1.D:	Different sense receptors are	4-LS1-2. Use a model to describe that		

Information Processing	specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)	animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.	3D Toolkit IEFA Resources STEM Teaching Tools	4-LS1-2 Clarification Statement: Emphasis is on systems of information transfer. Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.
Standard: 4. Earth's Systems: Processes that Shape the Earth				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
ESS1.C: The History of Planet Earth	Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)	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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	4-ESS1-1 Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock. Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time. 4-ESS2-1. Make observations and/or measurements to provide evidence of the effect 4-ESS2-2 Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes. 4-ESS2-1 Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow. Assessment Boundary: Assessment is limited to a single form of weathering or erosion.
ESS2.A: Earth Materials and Systems	Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1)	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.		
ESS2.B: Plate Tectonics and Large-Scale System Interactions	The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)	4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.		
ESS2.E: Biogeology	Living things affect the physical characteristics of their regions. (4-ESS2-1)	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.		

ESS3.B: Natural Hazards	A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.)	4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*		4-ESS3-2 Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity. Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.
ETS1.B: Designing Solutions to Engineering Problems	Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)	4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*		4-ESS3-2 Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity. Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.

Standard: 4. 3-5.Engineering Design

Topic	Disciplinary Core Idea	Performance Expectation	Resources	Clarification Statements
ETS1.A: Defining and Delimiting Engineering Problems	Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)	3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	
ETS1.B: Developing Possible Solutions	Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2) At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) Tests are often designed to identify	3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		

	failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)			
ETS1.C: Optimizing the Design Solution	Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)	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.		

5th Grade

Standard: Structure and Properties of Matter				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
PS1A Structure and Properties of Matter	Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1) The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2) Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3)	5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. 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. 5-PS1-3. Make observations and measurements to identify materials based on their properties.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	5-PS1-1. Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water. 5-PS1-1. Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles. 5-PS1-2. Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances. 5-PS1-2. Assessment Boundary: Assessment does not include distinguishing mass and weight. 5-PS1-3. Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property. 5-PS1-3.Assessment Boundary: Assessment does
PS1.B: Chemical	- When two or more different substances are mixed, a new substance with	5-PS1-4. Conduct an investigation to determine whether the mixing of		

Reactions	different properties may be formed. (5-PS1-4) - No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (5-PS1-2)	two or more substances results in new substances. 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.		not include density or distinguishing mass and weight.

Standard 5. Matter and Energy in Organisms and Ecosystems				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Vocab/Resources**	**Clarification Statements**
PS3.D: Energy in Chemical Processes and Everyday Life	The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1)	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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	5-PS3-1. Clarification Statement: Examples of models could include diagrams, and flow charts. 5-PS3-1. Clarification Statement: Examples of models could include diagrams, and flow charts. 5-LS1-1. Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil. 5-LS2-1. 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. 5-LS2-1. Assessment Boundary: Assessment does not include molecular explanations. 5-LS2-1. 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. 5-LS2-1. Assessment Boundary: Assessment does not include molecular explanations.
LS1.C: Organization for Matter and Energy Flow in Organisms	Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary to 5-PS3-1) Plants acquire their material for growth chiefly from air and water. (5-LS1-1)	5-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. 5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.		
LS2.A: Interdependent Relationships in Ecosystems	The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some	5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment		

	materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1)			
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gasses, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)	5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment		

Standard 5. Earth's Systems

Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
ESS2.A: Earth Materials and Systems	Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)	5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	5-ESS2-1. 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. 5-ESS2-1. Assessment Boundary: Assessment is limited to the interactions of two systems at a time. 5-ESS2-2. Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.
ESS2.C: The Roles of Water in Earth's Surface Processes	Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)	5-ESS2-2. Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.		

Standard 5. Space Systems: Stars and the Solar System

Topic	Disciplinary Core Idea	Performance Expectation	Resources	Clarification Statements
PS2.B: Types of Interactions	The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5-PS2-1)	5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	5-PS2-1. Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth. 5-PS2-1. Assessment Boundary: Assessment does not include mathematical representation of gravitational force. 5-ESS1-1. Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage). 5-ESS1-2. 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. 5-ESS1-2. Assessment Boundary: Assessment does not include causes of seasons.
ESS1.A: The Universe and its Stars	The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)	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.		
ESS1.B: Earth and the Solar System	The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)	5-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.		

Standard 3-5. Engineering Design

Topic	Disciplinary Core Idea	Performance Expectation	Resources	Clarification Statements
ETS1.A: Defining and Delimiting Engineering Problems	Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)	3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	
ETS1.B: Developing Possible Solutions	Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.	3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the		

	(3-5-ETS1-2) At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)	problem. 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		
ETS1.C: Optimizing the Design Solution	Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)	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.		

6th Grade

Topic	Disciplinary Core Idea	Performance Expectation	Resources	Clarification Statements
ESS3A Natural Resources	Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)	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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	
ESS3B Natural Hazards	Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)	MS-ESS1- 4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6 -billion- year-old history. MS-ESS2- 2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.		

		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.		
Standard: ESS3C Human Impacts on Earth Systems				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
	Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MSESS3-3),(MS-ESS3-4)	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. MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	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).]
Standard: ESS3D Global Climate Change				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
	Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge	MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning	

	wisely in decisions and activities. (MS-ESS3-5)		3D Toolkit IEFA Resources STEM Teaching Tools	
Standard: MS.Engineering Design				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	
Defining and Delimiting Engineering Problems	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1- 1)	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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	
Developing Possible Solutions	A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) Models of all kinds are important for testing	MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. 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. MS-ETS1-4. Develop a model to generate data for iterativ	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit	

	solutions. (MSETS1-4)		IEFA Resources STEM Teaching Tools	
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	
Optimizing the Design Solution	Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	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. MS-ETS1-4. 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	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	

7th Grade

Standard: LS1 From Molecules to Organisms: Structures and Processes				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
LS1A Structure and Function	All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1) Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2) In multicellular organisms, the body is a system of multiple interacting	MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources	MS-LS1-1 . [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.] MS-LS1-2 [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.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the

	subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)	groups of cells.	STEM Teaching Tools	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 or cell parts.] MS-LS1-3 [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.] [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.] MS-LS3-2 [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.] MS-LS1-4 [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.] MS-LS1-5 [Clarification Statement: Examples of local environmental conditions could include
LS1D Information Processing	Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1- 8)	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.		

				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.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.] MS-LS1-6 [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.] MS-LS1-7 [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.] MS-LS1-6 [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.] MS-LS1-7 [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.] MS-LS1-8 [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

LS1D Information Processing	Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1- 8)	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.		
Standard: LS2 Ecosystems: Interactions, Energy, and Dynamics				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
LS2A Interdependent Relationships in Ecosystems	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2- 1) Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.	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. MS-LS2-2. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	MS-LS2-1 [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.] MS-LS2-2 [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.] MS-LS2-3 [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.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.] MS-LS2-4 [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.] MS-LS2-5 [Clarification Statement: Examples of

	(MS-LS2-2)			ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.] MS-LS2-5 [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 social considerations.] none identified
LS2B Cycles of Matter and Energy Transfer in Ecosystems	Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. (MS-LS2-3)		
LS2C Ecosystem Dynamics, Functioning and Resilience	Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4) Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)	MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.		
ETS1B Developing Possible Solutions	There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)	MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.		

LS2D Social Interactions and Group Behavior	Groups may form because of genetic relatedness, physical proximity, or other recognition mechanisms (which may be species specific). They engage in a variety of signaling behaviors to maintain the group's integrity or to warn of threats. Groups often dissolve if they no longer function to meet an individual's needs, if dominant members lose their place, or if other key members are removed from the group through death, predation, or exclusion by other members.	none identified		
Standard: LS3 Heredity: Inheritance and Variation of Traits				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
LS3A Inheritance of Traits	Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)	MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. MS-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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	MS-LS3-1 [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.] MS-LS3-2 [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.]

LS3B Variation of Traits	In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)	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. MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.		MS-LS3-2 [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.] MS-LS3-1 [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]
Standard: LS4 Biological Evolution: Unity and Diversity				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
LS4A Biological Evolution: Unity and Diversity	The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1) Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2) Comparison of the embryological development of different species also reveals similarities that show	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. 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. MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	MS-LS4-1 . [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.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.] MS-LS4-2 [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.] MS-LS4-3 [Clarification Statement:Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross

	relationships not evident in the fully-formed anatomy. (MS-LS4-3)	relationships not evident in the fully formed anatomy.		appearance of anatomical structures in embryological development.]
LS4B Natural Selection	Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)	MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.		MS-LS4-4 [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations
LS4C Adaptation	Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	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.		MS-LS4-6 [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]
LS4D Biodiversity and Humans	Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5)	MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.		MS-LS2-5 [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 social considerations.]
ETS1B Developing Possible Solutions	There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)	MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.		MS-LS2-5 [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 social considerations.]

8th Grade

Standard: PS1 Matter and Its Interactions				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
PS1A Structure and Properties of matter	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)	MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. MS-PS1-2. Analyze and interpret data on the properties of substances before and after the	NGSS Glossary NGSS Search the Standard Science and	MS-PS1-1 [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

	Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) (Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.) Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4) Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) (Note: This Disciplinary	substances interact to determine if a chemical reaction has occurred. MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. 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. 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. MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*	Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.] MS-PS1-3 [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.] [Assessment Boundary: Assessment is limited to qualitative information.] MS-PS1-4 [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.] MS-PS1-2 [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.] MS-PS1-5 [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic

	Core Idea is also addressed by MS-PS1-3.)			masses, balancing symbolic equations, or intermolecular forces.]
PS1B Chemical Reactions	Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-3) (Note: This Disciplinary Core Idea is also addressed by MS-PS1-2 and MS-PS1-5.) The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) Some chemical reactions release energy, others store energy. (MS-PS1-6)	MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. 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. MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. 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. 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. MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*		MS-PS1-6[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.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

Standard: PS2 Motion and Stability: Forces and Interactions				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statement**
PS2A Forces and Motion	For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1)	MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.* 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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices	MS-PS2-1 [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.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]

	The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2) All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information withother people, these choices must also be shared. (MS-PS2-2)	MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. 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. 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.	Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	MS-PS2-2 [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.] [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.] MS-PS2-3 [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.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.] MS-PS2-4 [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.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.] MS-PS2-5 [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.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and is limited to qualitative
PS2B Types of Interactions	Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) ▪ Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4) ▪ Forces that act at a distance (electric, magnetic, and gravitational) can be explained by	MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.* 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. MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. 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. MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide		

	fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)	evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.		evidence for the existence of fields.]
Standard: PS3 Energy				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statement**
PS3A Definitions of Energy	The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MSPS1-4) The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary to MS-PS1-4) Motion energy is properly called	MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. 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. 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. 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. MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* 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	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	MS-PS3-1 [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 wiffle ball versus a tennis ball.] MS-PS3-2 [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.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.] MS-PS3-3 [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] MS-PS3-4 [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted

	kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1) A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4)	temperature of the sample. 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.		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.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] MS-PS3-5 [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.] [Assessment Boundary: Assessment does not include calculations of energy.]
PS3B Conservation of Energy and Energy Transfer	When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3- Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3)	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. 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. MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* 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. 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.		
PS3C Relationship Between Energy and Forces	When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)	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. 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. MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* 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. 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.		
Standard: PS4 Waves and Their Applications in Technologies for Information Transfer				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statement**
PS4A Wave Properties	A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) A sound wave needs a medium through which it is transmitted. (MS-PS4-2)	MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. MS-PS4-3. Integrate qualitative scientific and	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts	MS-PS4-1 [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.] MS-PS4-2 [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and

		technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.	[3D Learning](#) [3D Toolkit](#) [IEFA Resources](#) [STEM Teaching Tools](#)	written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.] MS-PS4-3 [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 wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]
PS4B Electromagnetic Radiation	When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2) The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2) A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)	MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. 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.		
PS4C Information Technologies and Instrumentation	Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)	MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. 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.		

Standard: MS.Engineering Design

Topic	Disciplinary Core Idea	Performance Expectation	Resources	Clarification Statement
ETS1.A: Defining and Delimiting Engineering Problems	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)	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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	
ETS1.B: Developing Possible Solutions	A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) Models of all kinds are important for testing solutions. (MSETS1-4)	MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. 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. MS-ETS1-4. 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.		
ETS1.C: Optimizing the Design Solution	Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated	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.		

	into the new design. (MS-ETS1-3) The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	MS-ETS1-4. 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.		

High School- Earth and Space

Standard: HS.Space Systems				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
ESS1.A: The Universe and Its Stars	The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HSESS1-1) The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3) The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2) Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2),(HS-ESS1-3)	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. 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. HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	HS-ESS1-1 [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.] [Assessment Boundary: Assessment does not include details of the atomic and subatomic processes involved with the sun's nuclear fusion.] HS-ESS1-2 [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 gasses (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).] HS-ESS1-3 [Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of
ESS1.B: Earth	Kepler's laws describe common features of	HS-ESS1-4. Use mathematical		

and the Solar System	the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)	or computational representations to predict the motion of orbiting objects in the solar system.		the mass of a star and the stage of its lifetime.] [Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of different masses are not assessed.] HS-ESS1-4 [Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [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.] HS-ESS1-1 [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.] [Assessment Boundary: Assessment does not include details of the atomic and subatomic processes involved with the sun's nuclear fusion.] HS-ESS1-2 [Clarification Statement: Emphasis is on the astronomical evidence of the redshift 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 gasses (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).]
PS3.D: Energy in Chemical Processes and Everyday Life	Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary to HS-ESS1-1)	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.		
PS4.B Electromagnetic Radiation	Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2)	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.		

High School Life Science

Standard: HS.Structure and Function				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
LS1A Structure and Function	Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2). Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)	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. HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	HS-LS1-1 . [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.] HS-LS1-2 [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.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.] MS-LS1-3 [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomata response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]

High School Chemistry

Standard: HS.Structure and Property of Matter				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Clarification Statements**	**Resources**
PS1.A: Structure and Properties of Matter	Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)	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.	HS-PS1-1 [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.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond	NGSS Glossary NGSS Search the Standard Science and

	The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1) The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6)	HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*	relative trends.] HS-PS1-3 [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 bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.] HS-PS2-6 [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.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]	Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools
PS1.C: Nuclear Processes	Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. (HSPS1-8)	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.	HS-PS1-8 [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.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.]	
PS2.B: Types of Interactions	Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (secondary to HS-PS1-1),(secondary to HS-PS1-3),(HS-PS2-6)	HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. HS-PS2-6. Communicate scientific and technical information about why the	HS-PS1-3 [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 bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.]	

		molecular-level structure is important in the functioning of designed materials.*	HS-PS2-6 [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.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]	
Standard: HS.Chemical Reactions				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Clarification Statements**	**Resources**
PS1.A: Structure and Properties of Matter	The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-2) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.) A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)	HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. 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.	HS-PS1-2 [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.] HS-PS1-4 [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that 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.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools
PS1.B: Chemical Reactions	Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules	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. HS-PS1-5. Apply scientific principles and evidence to	HS-PS1-4 [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that 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.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of	

	that are matched by changes in kinetic energy. (HS-PS1-4),(HS-PS1-5) In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6) The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2),(HS-PS1-7)	provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.* HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	reactants and products.] HS-PS1-5 [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [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.] HS-PS1-6 [Clarification Statement: Emphasis is on the application of Le Chatelier's Principle and on 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.] [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.] HS-PS1-2 [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.] HS-PS1-7 [Clarification Statement: Emphasis is on using mathematical ideas 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. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]	
ETS1.C:	Criteria may need to be broken	HS-PS1-6. Refine the design of	HS-PS1-6 [Clarification Statement: Emphasis is on the	

Optimizing the Design Solution	down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (secondary to HS-PS1-6)	a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*	application of Le Chatelier's Principle and on 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.] [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.]	

High School Physics

Standard: HS.Forces and Interactions				
Topic	**Disciplinary Core Idea**	**Performance Expectation**	**Resources**	**Clarification Statements**
PS2.A: Forces and Motion	Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1) Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2) If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3)	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. 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. 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.	NGSS Glossary NGSS Search the Standard Science and Engineering Practices Crosscutting Concepts 3D Learning 3D Toolkit IEFA Resources STEM Teaching Tools	HS-PS2-1 [Clarification Statement: Examples of data could 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 sliding down a ramp, or a moving object being pulled by a constant force.] [Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.] HS-PS2-2 [Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.] [Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.] MS-PS2-3 [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.] [Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic
PS2.B: Types of Interactions	Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces	HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the		

	between distant objects. (HS-PS2-4) Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2- 4),(HS-PS2-5)	gravitational and electrostatic forces between objects. 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.		manipulations.] HS-PS2-4 [Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [Assessment Boundary: Assessment is limited to systems with two objects.] HS-PS2-5 [Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools. HS-PS2-5 [Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.] HS-PS2-3 [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.] [Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.] HS-PS2-3 [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.] [Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.]
PS3.A: Definitions of Energy	"Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5)	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.		
ETS1.A: Defining and Delimiting Engineering Problems	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS2- 3)	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.*		
ETS1.C: Optimizing the Design Solution	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade offs) may be needed. (secondary to HS-PS2-3)	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.*		