Archdiocese of Louisville Science Standards

2023

Table of Contents

Introduction

The purpose of this document is to define what students should know, understand, and be able to do by the end of each grade. The Archdiocese of Louisville Science Standards correspond to the Next Generation Science Standards and the Kentucky Academic Standards for Science.

Standards, Not Curriculum

The Archdiocese of Louisville Science Standards do not dictate curriculum or instructional methods. Learning opportunities and pathways will continue to vary across schools; educators should make every effort to meet the needs of individual students based on their pedagogical and professional impressions and assessments. The order in which the standards are presented is not the order in which the standards need to be taught. Standards from various domains are connected and educators will need to determine the best overall design and approach, as well as the instructional materials and strategies needed to support their learners to attain grade-level expectations and the knowledge articulated in these standards.

Science Framework

The Science standards outline the three dimensions that are needed to provide students with a high-quality science education. The integration of these three dimensions provides students with a context for the content of science, how science knowledge is acquired and understood, and how the individual sciences are connected through concepts that have universal meaning across disciplines. The three dimensions are: Dimension 1: Practices – Dimension 1 describes the major practices that scientists employ as they investigate and build models and theories about the world and a key set of engineering practices. Dimension 2: Crosscutting Concepts – The crosscutting concepts have application across all domains of science. They reflect the ideas and practices that cut across the science disciplines. Dimension 3: Disciplinary Core Ideas – An important role of science today is to prepare students with sufficient core knowledge so that they can later acquire additional information on their own.

Essential Standards

Writers identified Essential Standards among the Archdiocese of Louisville Science **Standards are denoted with one asterisk in this document.** Standards identified as essential were evaluated according to three criteria: 1. They have endurance. The knowledge and skills in this standard are valuable beyond a single unit of study. 2. They have leverage. The knowledge and skills in this standard are valuable in multiple disciplines. 3. They demand readiness. The knowledge and skills in this standard are essential for success at the next grade level. If a standard is noted as essential, the expectation is that every student at that particular grade level will achieve mastery of the standard by the end of the academic year. Each school is encouraged to modify and adapt the essential standard list to fit their specific student population. *Essential standards simply hold the priority skills for students to master; all other standards provide meaningful knowledge and grade-level skills.*

Supplementary Documents

Writers created a supplementary "Standards at a Glance" Document. This supplement intends to give a clear picture of the standards in an easily accessible format. Each grade level standards are listed without clarification statements and assessment boundaries, in order to provide a one page snapshot of the standards for each grade level. Essential standards are denoted with an asterisk. This document is intended for teachers who are well-versed in science content and familiar with their grade level standards.

Writers also created a Science Literature List which provides teachers with trade books that are aligned with grade level standards. Each grade level has at least one book aligned to every standard. Teachers can use this booklist to anchor science lessons, use in a book study, or include in the classroom library.

Lastly, writers created a list of Science and Religion Resources. The purpose of the literature list is to equip teachers with some resources to hold developmentally-appropriate conversations about faith and science with students. Teachers can use the resources to lead students to the understanding that faith and science do not contradict one another; they live in harmony.

Acknowledgements

Name	School	Name	School
Ned Berghausen	Assumption High School	Dana Jones	Saint Athanasius
Kate Bulinski	Bellarmine University	Sister Mary Joseph	Saint James E-Town
Elizabeth Deye	Saint Mary Academy	Kim Koestel	Saint Mary Academy
Lisa Dusterhoff	Sacred Heart Model School	Kathleen Nilsen	Saint Patrick
Rebecca Facktor	Saint Martha	Caitlin Ousley	Saint Agnes
Whitnie Hart	Sacred Heart Model School	Kelly Schleg	Saint Agnes
Haley Jenks	Saint Martha	Christina Sengelaub	Saint Edward
Kevin Hulsman	Holy Spirit	Salem Von Nostiz	Saint Agnes

An additional thank you to all science teachers who participated in listening visits and lesson observations and offered feedback to inform the work of our standards team.

Science and Engineering Practices (SEP) by Grade Band

Learning Priority	K-2	3-5	6-8
SEP1.A Asking Questions	**SCI.SEP1.A.K-2** Students ask simple descriptive questions that can be tested.	**SCI.SEP1.A.3-5** Students ask questions that specify qualitative relationships.	**SCI.SEP1.A.m** Students ask questions to specify relationships between variables and clarify arguments and models.
SEP1.B Defining Problems	**SCI.SEP1.B.K-2** Students define simple problems that can be solved throughout the development of a new or improved tool.	**SCI.SEP1.B.3-5** Students use prior knowledge to describe and define simple design problems that can be solved through the development of an object, tool, provess, or system.	**SCI.SEP1.B.m** Students formulate, refine, and evaluate design problems using models and simulations.
SEP2 Developing and Using Models	**SCI.SEP2.K-2** Students use and develop models (diagrams, drawings, replicas, dioramas, dramatizations, or storyboards) that represent concrete events or design solutions.	**SCI.SEP2.3-5** Students build and revise simple models and use models to represent events and design solutions.	**SCI.SEP2.m** Students use, synthesize, and develop models to predict and show relationships among variables and between systems and their components in the natural and designed world.
SEP3 Planning and Conducting Investigations	**SCI.SEP3.K-2** Students plan and carry out simple investigations, based on fair tests, which provide data to support explanations or design solutions.	**SCI.SEP3.3-5** Students plan and carry our investigations that control variables and provide evidence to support explanations or design solutions.	**SCI.SEP3.m** Students plan and carry out investigations that use multiple variables and provide evidence to support explanations or solutions.
SEP4 Analyzing and Interpreting Data	**SCI.SEP4.K-2** Students collect, record, and share observations.	**SCI.SEP4.3-5** Students begin to use quantitative approaches to collect data and conduct multiple trials of qualitative observations. Digital tools used when possible.	**SCI.SEP4.m** Students extend quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

SEP5 Using Mathematics and Computational Thinking	**SCI.SEP5.K-2** Students recognize that mathematics can be used to describe the natural and designed world.	**SCI.SEP5.3-5** Students extend quantitative measurements to a variety of physical properties, using computation and mathematics to analyze data and compare alternative design solutions	**SCI.SEP5.m** Students identify patterns in large data sets and use mathematical concepts to support explanations and arguments.
SEP6.A Constructing an Explanation	**SCI.SEP6.A.K-2** Students use evidence and ideas in constructing evidence-based accounts of natural phenomena.	**SCI.SEP6.A.3-5** Students use evidence to construct explanations that specify variables that describe and predict phenomena.	**SCI.SEP6.A.m** Students construct explanations supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
SEP6.B Designing Solutions	**SCI.SEP6.B.K-2** Students use evidence and ideas in designing solutions.	**SCI.SEP6.B.3-5** Students use evidence to create multiple solutions to design problems.	**SCI.SEP6.B.m** Students design solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
SEP7 Arguing from Evidence	**SCI.SEP7.K-2** Students compare ideas and representations about the natural and designed world.	**SCI.SEP7.3-5** Students critique the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world.	**SCI.SEP7.m** Students construct a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.
SEP8 Obtaining, Evaluating, and Communicating Information	**SCI.SEP8.K-2** Students use observations and texts to communicate new information.	**SCI.SEP8.3-5** Students evaluate the merit and accuracy of ideas and methods.	**SCI.SEP8.m** Students evaluate the merit and validity of ideas and methods.

This page has been left intentionally blank.

Science Crosscutting Concepts (CC) by Grade Band

Learning Priority	K-2	3-5	6-8
CC1 Patterns	**SCI.CC1.K-2** Students recognize that patterns in the natural and human-designed world can be observed, used to describe phenomena, and used as evidence.	**SCI.CC1.3-5** Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change cycles, and use these patterns to make predictions.	**SCI.CC1.m** Students recognize macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human-designed systems. They use patterns to identify cause and effect relationships and use graphs and charts to identify patterns in data.
CC2 Cause and Effect	**SCI.CC2.K-2** Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.	**SCI.CC2.3-5** Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity may or may not signify a cause-and-effect relationship.	**SCI.CC2.m** Students classify relationships as causal or correlational, and recognize correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They understand that phenomena may have more than one cause, and some relationships in systems can only be explained using probability.
CC3 Scale, Proportion, and Quantity	**SCI.CC3.K-2** Students use relative scales (e.g., bigger and smaller, hotter and colder, faster and slower) to describe objects. They use standard units to measure length.	**SCI.CC3.3-5** Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as mass, time, temperature, and volume.	**SCI.CC3.m** Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.

CC4 **Systems and System Models**	**SCI.CC4.K-2** Students understand objects and organisms can be described in terms of their parts and that systems in the natural and designed world have parts that work together.	**SCI.CC4.3-5** Students understand a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They also describe a system in terms of its components and their interactions.	**SCI.CC4.m** Students understand systems may interact with other systems: They may have sub-systems and can be a part of larger complex systems. They use models to represent systems and their interactions; energy, matter, and information flow within systems. They also learn that models are limited in that they only represent certain aspects of the system under study.
CC5 **Energy and Matter**	**SCI.CC5.K-2** Students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.	**SCI.CC5.3-5** Students understand matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes, recognizing the total mass of substances does not change.	**SCI.CC5.m** Students understand matter is conserved because atoms are conserved in physical and chemical processes. They understand that within a natural or designed system the transfer of energy drives the motion and cycling of matter. Energy may take different forms. The transfer of energy can be tracked as energy flows through a designed or natural system.
CC6 **Structure and Function**	**SCI.CC6.K-2** Students observe the shape and stability of structures of natural and designed objects are related to their function(s).	**SCI.CC6.3-5** Students understand different materials have different substructures, which can sometimes be observed, and substructures have shapes and parts that serve functions.	**SCI.CC6.m** Students model complex and microscopic structures and visualize how their function depends on the shapes, composition, and relationships among their parts. They analyze complex natural and designed structures to determine how they function. They design structures to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.
CC7 **Stability and Change**	**SCI.CC7.K-2** Students observe some things stay the same while other things change, and things may change slowly or rapidly.	**SCI.CC7.3-5** Students measure change in terms of differences over time and observe that change may occur at different rates. They understand some systems appear stable, but over long periods of time they will eventually change.	**SCI.CC7.m** Students explain stability and change by examining changes and considering forces at different scales. They understand changes in part of a system might cause changes in another part; systems in dynamic equilibrium are stable due to a balance of feedback, and stability might be disturbed by sudden or gradual change over time.

This page has been left intentionally blank.

Science Standards Arranged by Disciplinary Core Idea (DCI)

Life Science	Physical Science
LS1 From Molecules to Organisms: Structures and Processes LS2 Ecosystems: Interactions, Energy and Dynamics LS3 Heredity: Inheritance and Variation of Traits LS4 Biological Evolution: Unity and Diversity	PS1 Matter and its Interactions PS2 Motion and Stability: Forces and Interactions PS3 Energy PS4 Waves and Their Applications in Technologies for Information Transfer
Earth and Space Science	**Engineering and Technology**
ESS1 Earth's Place in the Universe ESS2 Earth's Systems ESS3 Earth and Human Activity	ETS1 Engineering Design ETS2 Links Among Engineering, Technology, Science, and Society

Life Science Disciplinary Core Ideas (DCI) by Grade Band

Learning Priority	K-2	3-5	6-8
SCI.LA1.A Structure and Function	**SCI.LS1.A.1** All organisms have external parts that they use to perform daily functions.	**SCI.LS1.A.4** Plants and animals have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.	**SCI.LA1.A.m** All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.
SCI.LS1.B Growth and Development of Organisms	**SCI.LS1.B.1** Parents and offspring often engage in behaviors that help the offspring survive	**SCI.LS1.B.4** Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles..	**SCI.LA1.B.m** Animals engage in behaviors that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors..
SCI.LA1.C Organization for Matter and Energy Flow in Organisms	**SCI.LA1.C.K** Animals obtain food they need from plants or other animals. Plants need water and light.	**SCI.LS1.C.5** Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter, and obtain energy from sunlight, which is used to maintain conditions necessary for survival.	**SCI.LS1.C.m** Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy.
SCI.LA1.D Information Processing	**SCI.LS1.D.1** Animals sense and communicate information and respond to inputs with behaviors that help them grow and survive.	**SCI.LS1.D.4** Different sense receptors are specialized for particular kinds of information; animals use their perceptions and memories to guide their actions.	**SCI.LS1.D.m** Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain resulting in immediate behavior or memories.
SCI.LS2.A Interdependent Relationships in Ecosystems	**SCI.LS2.A.2** Plants depend on water and light to grow. Plants depend on animals for pollination or to move their seeds around.	**SCI.LS2.A.5** The food of almost any 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, while decomposers restore some materials back to the soil.	**SCI.LS2.A.m** Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. Competitive, predatory, and mutually beneficial interactions vary across ecosystems but the patterns are shared.

SCI.LS2.B Cycles of Matter and energy Transfer in Ecosystems	*No Standards*	**SCI.LS2.B.5** Matter cycles between the air and soil and among organisms as they live and die.	**SCI.LS2.B.m** The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.
SCI.LS2.C Ecosystem Dynamics, Functioning, and Resilience	*No Standards*	**SCI.LS2.C.3** When the environment changes, some organisms survive and reproduce, some move to new locations, some move into transformed environments, and some die.	**SCI.LS2.C.m** Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.
SCI.LS2.D Social Interactions and Group Behavior	*No Standards*	**SCI.LS2.D.3** Being part of a group helps animals obtain food, defend themselves, and cope with changes.	**SCI.LS2.D.m** 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.
SCI.LS2.A Inheritance of Traits	**SCI.LS3.A.1** Young organisms are very much, but not exactly, like their parents, and also resemble other organisms of the same kind.	**SCI.LS3.A.3** Many characteristics of organisms are inherited from their parents. Other characteristics result from individuals' interactions with the environment. Many characteristics involve both inheritance and environment.	**SCI.LS3.A.m** Genes chiefly regulate a specific protein, which affects an individual's traits.
SCI.LS3.B Variation of Traits	**SCI.LS3.B.1** Individuals of the same kind of plant or animal are recognizable as similar, but can also vary in many ways.	**SCI.LS3.B.3** Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.	**SCI.LS3.B.m** In sexual reproduction, each parent contributes half of the genes acquired by the offspring resulting in variation between parent and offspring. Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism.

SCI.LS4.A Evidence of Common Ancestry and Diversity	*No Standards*	**SCI.LS4.A.3** Some living organisms resemble organisms that once lived on Earth. Fossils provide evidence about the types of organisms and environments that existed long ago.	**SCI.LS4.A.m** The fossil record documents the existence, diversity, extinction, and change of many life forms and their environments through Earth's history. The fossil record and comparisons of anatomical similarities between organisms enables the inference of lines of evolutionary descent.
SCI.LS4.B Natural Selection	*No Standards*	**SCI.LS4.B.3** Differences in characteristics between individuals of the same species provide advantages in surviving and reproducing.	**SCI.LS4.B.m** Both natural and artificial selection result from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain traits in a population.
SCI.LS4.C Adaptation	*No Standards*	**SCI.LS4.A.3** Particular organisms can only survive in particular environments.	**SCI.LS4.C.m** Species can change over time in response to changes in environmental conditions through adaptation by natural selection acting over generations. Traits that support successful survival and reproduction in the new environment become more common.
SCI.LS1.D Biodiversity and Humans	**SCI.LS1.D.2** There are many different kinds of living things in any area, and they exist in different places on land and in water.	**SCI.LS4.D.3** Populations of organisms live in a variety of habitats. Change in those habitats affects the organisms living there.	**SCI.LS4.D.m** Changes in biodiversity can influence humans' resources and ecosystem services they rely on.

This page has been left intentionally blank.

Physical Science Disciplinary Core Ideas (DCI) by Grade Band

Learning Priority	K-2	3-5	6-8
SCI.PS1.A Structure and Function	**SCI.S1.A.2** Matter exists as different substances that have different observable properties. Different properties are suited to different purposes. Objects can be built up from smaller parts.	**SCI.PS1.A.4** Matter exists as particles that are too small to see. Matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.	**SCI.PS1.A.m** The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.
SCI.PS1.B Chemical Reactions	**SCI.PS1.B.2** Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.	**SCI.PS1.B.5** Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties.	**SCI.PS1.B.m** Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.
SCI.PS1.C Nuclear Processes	*No Standards*	*No Standards*	*No Standards*
SCI.PS2.A Forces and Motion	**SCI.PS2.A.K** Pushes and pulls can have different strengths and directions, and can change the speed or direction of an object's motion, or start or stop it.A bigger push or pull makes things speed up or slow down more quickly.	**SCI.PS2.A.3** Qualities of motion and changes in motion require description of both size and direction. The effect of unbalanced forces on an object results in a change of motion. Patterns of motion can be used to predict future motion.	**SCI.PS2.A.3** Motion and changes in motion can be qualitatively described using concepts of speed, velocity, and acceleration (including speeding up, slowing down, and/or changing direction).(Newton's first, second, and third law).
SCI.PS2.B Types of Interactions	**SCI.PS2.B** When objects touch or collide, they push on one another and can result in a change of motion.	**SCI.PS2.B.3** Some forces act through contact, some forces (e.g. magnetic, electrostatic) act even when the objects are not in contact. **SCI.PS2.B.5** The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	**SCI.PS2.B.m** Forces that act at a distance involve fields that can be mapped by their relative strength and effect on an object.
SCI.PS3.A Definitions of Energy	*No Standards*	**SCI.PS3.A.4** Moving objects contain energy. The faster the object moves, the more energy it has.	**SCI.PS3.A.m** Kinetic energy can be distinguished from the various forms of potential energy.

SCI.PS3.B Conservation of Energy and Energy Transfer	*No Standards*	**SCI.PS3.B.4** Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form.	**SCI.PS3.B.m** Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.
SCI.PS3.C Relationships between Energy and Forces	**SCI.PS3.C.K** Bigger pushes and pulls cause bigger changes in an object's motion or shape.	**SCI.PS3.C.4** When objects collide, contact forces transfer energy so as to change objects' motions.	**SCI.PS3.C.m** When two objects interact, each one exerts a force on the other, and these forces can transfer energy between the interacting objects.
SCI.PS3.D Energy in Chemical Processes and Everyday Life	**SCI.PS3.D.K** Sunlight warms Earth's surface.	**SCI.PS3.D.4, 5** Plants capture energy from sunlight which can be used as fuel or food. Stored energy in food or fuel can be converted to usable energy.	**SCI.PS3.D.m** Sunlight is captured by plants and used in a chemical reaction to produce sugar molecules for storing this energy. This stored energy can be released by respiration or combustion, which can be reversed by burning those molecules to release energy.
SCI.PS4.A Wave Properties	**SCI.PS4.A.1** Sound can make matter vibrate, and vibrating matter can make sound.	**SCI.PS4.A.4** Waves are regular patterns of motion, which can be made in water by disturbing the surface. Waves of the same type can differ in amplitude and wavelength. Waves can make objects move.	**SCI.PS4.C.m** A simple wave model has a repeating pattern with a specific wavelength, frequency, and amplitude, and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena including sound and light. Waves can transmit energy
SCI.PS4.B Electro-magnetic Radiation	SCI.PS4.B.1 **Objects can be seen only when light is available to illuminate them.**	**SCI.PS4.B.4** Objects can be seen when light reflected from their surface enters our eyes.	**SCI.PS4.B.m** The construct of a wave is used to model how light interacts with objects
SCI.PS4.C Information Technologies and Instrumentation	**SCI.PS4.C.1** People use devices to send and receive information.	SCI.PS4.C.4 Patterns can encode, send, receive, and decode information.	**SCI.PS4.C.m** Waves can be used to transmit digital information. Digitized information consists of a pattern of 1s and 0s.

This page has been left intentionally blank.

Earth and Space Science Disciplinary Core Ideas (DCI) by Grade Band

Learning Priority	K-2	3-5	6-8
SCI.ESS1.A The Universe and Its Stars	**SCI.ESS1.A.1** Patterns of movement of the sun, moon, and stars, as seen from Earth, can be observed, described, and predicted.	**SCI.ESS1.A.5** Stars range greatly in size and distance from Earth, and this can explain their relative brightness.	**SCI.ESS1.A.m** The solar system is part of the Milky Way, which is one of many billions of galaxies.
SCI.ESS1.B Earth and the Solar System	**SCI.ESS1.B.1** Seasonal patterns of sunrise and sunset can be observed, described, and predicted.	**SCI.ESS1.B.5** The Earth's orbit and rotation, and the orbit of the moon around the Earth cause observable patterns.	**SCI.ESS1.B.m** The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons.
SCI.ESS1.C The History of Planet Earth	**SCI.ESS1.C.2** Some events on Earth occur very quickly; others can occur very slowly.	**SCI.ESS1.C.4** Certain features on Earth can be used to order events that have occurred in a landscape.	**SCI.ESS1.C.m** Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history.
SCI.ESS2.A Earth Materials and Systems	**SCI.ESS2.A.2** Wind and water change the shape of the land.	**SCI.ESS2.A.4,5** Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around.	**SCI.ESS2.A.m** Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.
SCI.ESS2.B Plate Tectonics and Large-Scale System Interactions	**SCI.ESS2.B.2** Maps show where things are located. One can map the shapes and kinds of land and water in any area.	**SCI.ESS2.B.4** Earth's physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events.	**SCI.ESS2.B.m** Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. Maps are used to display evidence of plate movement.
SCI.ESS2.C The Roles of Water in Earth's Surface Processes	**SCI.ESS2.C.2** Water is found in many types of places and in different forms on Earth.	**SCI.ESS2.C.5** Most of Earth's water is in the ocean, and much of the Earth's freshwater is in glaciers or underground.	**SCI.ESS2.C.m** Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.

SCI.ESS2.D Weather and Climate	**SCI.ESS2.D.K** Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time.	**SCI.ESS2.D.3** Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.	**SCI.ESS2.D.m** Complex interactions determine local weather patterns and influence climate, including the role of the ocean.
SCI.ESS2.E Biogeology	**SCI.ESS2.E.K** Plants and animals can change their local environment.	**SCI.ESS2.E.4** Living things can affect the physical characteristics of their environment.	**SCI.ESS2.E.m** The fossil record documents the existence, diversity, extinction, and change of many life forms throughout history (linked to content in LS4.A).
SCI.ESS3.A Natural Resources	**SCI.ESS3.A.K** 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.	**SCI.ESS3.A.4** Energy and fuels humans use are derived from natural sources, and their use affects the environment. Some resources are renewable over time, others are not.	**SCI.ESS3.A.m** Humans depend on Earth's land, oceans, fresh water, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.
SCI.ESS3.B Natural Hazards	**SCI.ESS3.B.K** In a region, some kinds of severe weather are more likely than others. Forecasts allow communities to prepare for severe weather.	**SCI.ESS3.B.3,4** A variety of hazards result from natural processes; humans cannot eliminate hazards but can reduce their impacts.	**SCI.ESS3.B.m** Patterns can be seen through mapping the history of natural hazards in a region and understanding related geological forces.
SCI.ESS3.C Human Impacts on Earth Systems	**SCI.ESS3.C.K** Things people do can affect the environment but they can make choices to reduce their impacts**.**	**SCI.ESS3.C.5** Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments.	**SCI.ESS3.C.m** Human activities have altered the hydrosphere, atmosphere, and lithosphere which in turn has altered the biosphere. Changes to the biosphere can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.
SCI.ESS3.D Global Climate Change	*No Standard*	*No Standard*	**SCI.ESS3.D.m** Evidence suggests human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.

This page has been left intentionally blank.

Engineering Design Disciplinary Core Ideas (DCI) by Grade Band

Learning Priority	K-2	3-5	6-8
SCI.ETS1.A Defining and Delimiting Engineering Problems	**SCI.ETS1.A.K-2** A situation that people want to change or create can be approached as a problem to be solved through engineering. Asking questions, making observations, and gathering information are helpful in thinking about problems. Before beginning to design a solution, it is important to clearly understand the problem.	**SCI.ETS1.A.3-5** 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.	**SCI.ETS1.A.m** 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.
SCI.ETS1.B Developing Possible Solutions	**SCI.ETS1.B.K-2** 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.	**SCI.ETS1.B.3-5** 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.	**SCI.ETS1.B.m** A solution needs to be tested and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
SCI.ETS1.C Optimizing the Design Solution	**SCI.ETS1.C.2** Because there is more than one possible solution to a problem, it is useful to compare and test designs.	**SCI.ETS1.C.4** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	**SCI.ETS1.C.m** 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.
SCI.ETS2.A Interdependence of Science, Engineering, and Technology	**SCI.ETS2.A.K-2** 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.	**SCI.ETS2.A.3-5** 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.	**SCI.ETS2.A.m** A solution needs to be tested and then modified on the basis of the test results in order to improve it.

SCI.ETS2.B Influence of Engineering Technology, and Science on Society and the Natural World	**SCI.ETS2.B.K-2** Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials.	**SCI.ETS2.B.3-5** People's needs and wants change over time, as do their demands for new and improved technologies.	**SCI.ETS2.B.m** All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment.
SCI.ETS3.A Science and Engineering are Human Endeavors	**SCI.ETS3.A.K-2** People of diverse backgrounds can become scientists and engineers. People have practiced science and engineering for a long time. Creativity and imagination are important to science and engineering.	**SCI.ETS3.A.3-5** Science and engineering knowledge have been created by many cultures. People use the tools and practices of science and engineering in many different situations.	**SCI.ETS3.A.m** Individuals and teams from many nations, cultures, and backgrounds have contributed to advances in science and engineering. Scientists and engineers are persistent, use creativity, reasoning, and skepticism, and remain open to new ideas. Science and engineering are influenced by what is valued in society.
SCI.ETS3.B Science and Engineering are Unique Ways of Thinking with Different Purposes	**SCI.ETS3.B.K-2** Scientists use evidence to explain the natural world. Science assumes natural events happen today as they happened in the past. Engineers solve problems to meet the needs of people and communities.	**SCI.ETS3.B.3-5** Science and engineering are both bodies of knowledge and processes that add new knowledge to our understanding. Scientific findings are limited to what can be supported with evidence from the natural world. Basic laws of nature are the same everywhere in the universe.Engineering solutions often have drawbacks as well as benefits.	**SCI.ETS3.B.m** Science asks questions to understand the natural world and assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. Science carefully considers and evaluates anomalies in data and evidence.Engineering seeks solutions to human problems, including issues that arise due to human interaction with the environment. Scientists and engineers need to pursue their work in an ethical manner that requires honesty, fairness, and dedication
SCI.ETS3.C Science and Engineering use Multiple Approaches to Create new Knowledge and Solve Problems	**SCI.ETS3.C.K-2** Science and engineers use many approaches to answer questions about the natural world and solve problems. Scientific explanations are strengthened by being supported with evidence. An engineering problem can have many solutions. The strength of a solution depends on how well it solves the problem.	**SCI.ETS3.C.3-5** The products of science and engineering are not developed through one set process. Instead, they use a variety of approaches described in the Science and Engineering Practices. Science explanations are based on a body of evidence and multiple tests, and describe the mechanisms for natural events. Explanations can change based on new evidence. There is no perfect design in engineering.	**SCI.ETS3.C.m** Scientists develop theories of some aspect of the natural world by using multiple approaches. Validity of these theories is increased through a review process that tests and evaluates the evidence supporting scientific claims. A hypothesis is a statement that can be tested to evaluate a theory. Scientific laws describe cause and effect relationships among observable phenomena.

This page has been left intentionally blank.

Kindergarten Standards

K-PS2 Motion and Stability: Forces and Interactions

K-PS2-1 Plan and conduct an investigation to compare the effects of different strengths on different directions of pushes and pulls on the motion of an object. *

- [Clarification Statement: Examples include a string attached to an object being pulled, pushing an object, stopping a rolling ball, and two objects colliding and pushing on each other.] [*Assessment Boundary: limited to different relative strengths or different directions, but not both at the same time. Does not include non-contact pushes or pulls such as those produced by magnets.*]

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 pull.

- [Clarification Statement: Example of a problem is making a marble move a certain distance, follow a particular path, and knock down other objects. Solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object to turn.] [*Assessment Boundary: does not include friction as a mechanism for change in speed.]*

K-PS3 Energy

K-PS3-1 Make observations to determine the effect of sunlight on Earth's surface. *

- [Clarification Statement: Examples include sand, soil, rocks, and water.] [*Assessment Boundary: limited to relative measures such as warmer/cooler.*]

K-PS3-2 Use tools and materials to design and build a structure that will reduce the warming effects of sunlight on an area.

- [Clarification Statement: Examples include umbrellas, canopies, and tents that create shade.]

K-LS1 From Molecules to Organisms: Structures and Processes

K-LS1-1 Use observations to describe patterns of what plants and animals (including humans) need to survive. *

- [Clarification Statement: Examples 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 Earth's Systems

K-ESS2-1 Use and share observations of local weather conditions to describe patterns over time.

- [Clarification Statement: Observations include descriptions of the weather; quantitative observations could include numbers of sunny, windy, and rainy days in a month. Patterns could include that it is usually cooler in the morning than in the afternoon.] [*Assessment Boundary: limited to whole numbers and relative measures such as warmer/cooler.*]

K-ESS2-2 Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.

- [Clarification Statement: Focus should be on observable ways that plants and animals change the environment (ex. tree roots can break concrete).]

K-ESS3 Earth and Human Activity

K-ESS3-1 Use a model to represent the relationship between the needs of different plants/animals (including humans) and the places they live.

- [Clarification Statement: Examples 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-ESS3-2 Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather. *

- [Clarification Statement: Emphasis is on local forms of severe weather.]

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. *

- [Clarification Statement: Examples include cutting trees to produce paper and using resources to produce bottles. Solutions could include reusing paper and recycling cans and bottles.]

K-2-ETS1 Engineering Design

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. *

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.

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.

This page has been left intentionally blank.

First Grade Standards

1-PS4 Waves and Their Applications in Technologies for Information Transfer

1-PS4-1 Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. *

- [Clarification Statement: Examples include tuning forks and plucking a stretched string, holding a piece of paper near a speaker making sound, and holding an object near a vibrating tuning fork.]

1-PS4-2 Make observations to construct an evidence-based account that objects in darkness can only be seen when illuminated.

- [Clarification Statement: Examples include explaining day vs. night, a fully dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination comes from an external light source.]

1-PS4-3 Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. *

- [Clarification Statement: Examples include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).]

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 include a light source to send signals, a paper cup, and string "telephones," and create instruments to produce sound.]

1-LS1 From Molecules to Organisms: Structures and Processes

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 include creating and explaining how animals' unique features keep them safe (large eyes, ears, shells, quills, etc.)]

1-LS1-2 Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.

- [Clarification Statement: Examples include the signals that offspring make (crying, smiling, and other noises) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]

1-LS3 Heredity: Inheritance and Variation of Traits

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 include shared traits (same hair color, shape, etc.) but young plants and animals are not the same as their parents.]

1-ESS1 Earth's Place in the Universe

1-ESS1-1 Use observations of the sun, moon, and stars to describe patterns that can be predicted. *

- [Clarification Statement: Examples include the moon cycle, 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.]

1-ESS1-2 Make observations at different times of year to relate the amount of daylight to the time of year.

- [Clarification Statement: Examples include seasonal daylight changes and daylight savings]

K-2-ETS1 Engineering Design

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.

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. *

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.

This page has been left intentionally blank.

Second Grade Standards

2-PS1 Matter and its Interactions

2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

- [Clarification Statement: Observations include color, texture, hardness, and flexibility.]

2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

- [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [*Assessment Boundary: limited to length.*]

2-PS1-3 Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. *

- [Clarification Statement: Examples include blocks, building bricks, and other parts.]

2-PS1-4 Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

2-LS2 Ecosystems: Interactions, Energy, and Dynamics

2-LS2-1 Plan and conduct an investigation to determine if plants need sunlight and water to grow.

- [*Assessment Boundary: limited to testing one variable at a time.*]

2-LS2-2 Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.

2-LS4 Biological Evolution: Unity and Diversity

2-LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats. *

- [Clarification Statement: Emphasis on the diversity of living things in a variety of habitats.]

2-ESS1 Earth's Place in the Universe

2-ESS1-1 Use information from several sources to provide evidence that Earth events can occur quickly or slowly. *

- [Clarification Statement: Examples could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.]

2-ESS2 Earth's Systems

2-ESS2-1 Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

2-ESS2-2 Develop a model to represent the shapes and kinds of land and bodies of water in an area.

- [*Assessment Boundary: Assessment does not include quantitative scaling in models.*]

2-ESS2-3 Obtain information to identify where water is found on Earth and that it can be solid or liquid.

K-2-ETS1 Engineering Design

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.

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.

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. *

This page has been left intentionally blank.

Third Grade Standards

3-PS2 Motion and Stability: Forces and Interactions

3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. *

- [Clarification Statement: Examples include an unbalanced force on an object that makes it move; Balanced forces from both sides of an object will not produce motion.] [*Assessment Boundary: limited to one variable at a time and limited to gravity as a force that pulls objects down]*

3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

- [Clarification Statement: Examples include a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [*Assessment Boundary: does not include technical terms such as period and frequency.*]

3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. *

- [Clarification Statement: Examples of electric force include an electrically charged balloon on hair; examples of a magnetic force include the force between a magnet and steel paperclips.] [*Assessment Boundary: limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.*]

3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets.

- [Clarification Statement: Examples include constructing a latch to keep a door shut.]

3-LS1 From Molecules to Organisms: Structures and Processes

3-LS1-1 Develop models to describe that organisms have unique and diverse life cycles but they all have birth, growth, reproduction, and death.*

- [Clarification Statement: Changes organisms go through during their life form a pattern.]

3-LS2 Ecosystems: Interactions, Energy, and Dynamics

3-LS2-1 Construct an argument that some animals form groups that help members survive

3-LS3 Heredity: Inheritance and Variation of Traits

3-LS3-1 Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. *

- [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.]

3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment. *

- [Clarification Statement: Examples include a plant's growth stunted with insufficient water; a pet dog that is given too much food and little exercise may become overweight.]

3-LS4 Biological Evolution: Unity and Diversity

3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. *

- [Clarification Statement: Data examples include type, size, and distributions of fossil organisms. Examples of environments include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [*Assessment Boundary: limited to major fossil types and relative ages.*]

3-LS4-2 Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

- [Clarification Statement: Examples include plants that have larger thorns may be less likely to be eaten by predators; Animals that have better camouflage coloration may be more likely to survive therefore more likely to leave offspring.]

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.

3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

- [Clarification Statement: Examples include changes in land characteristics, water distribution, temperature, food, and other organisms.] [*Assessment Boundary: limited to a single environmental change and does not include the greenhouse effect or climate change.*]

3-ESS2 Earth's Systems

3-ESS2-1 Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

- [Clarification Statement: Examples include average temperature, precipitation, and wind direction.] [*Assessment Boundary: graphical displays are limited to pictographs and bar graphs.*]

3-ESS2-2 Obtain and combine information to describe climates in different regions of the world.

3-ESS3 Earth and Human Activity

3-ESS3-1 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard. *

- [Clarification Statement: Examples include barriers to prevent flooding, wind resistant roofs, and lightning rods.]

3-5-ETS1 Engineering Design

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. *

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.

This page has been left intentionally blank.

Fourth Grade Standards

4-PS3 Energy

4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.

- [*Assessment Boundary: Doesn't include quantitative definition of energy or changes in speed of an 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. *

- [*Assessment Boundary: does not include quantitative measurements of energy.*]

4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide. *

- [Clarification Statement: Emphasis on the change in energy due to change in speed as objects interact.] [*Assessment Boundary: does not include quantitative measurements of energy.*]

4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

- [Clarification Statement: Examples of devices are electric currents (electric energy → motion, light, or sound); solar heater (light → heat)] [*Assessment Boundary: limited to converting motion energy to electric energy or stored energy to cause motion, light, or sound*.]

4-PS4 Waves and their Applications in Technologies for Information Transfer

4-PS4-1 Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. *

- [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [*Assessment Boundary: does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.*]

4-PS4-2 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

- [*Assessment Boundary: does not include specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.*]

4-PS4-3 Generate and compare multiple solutions that use patterns to transfer information.

- [Clarification Statement: Examples of could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

4-LS1 From Molecules to Organisms: Structures and Processes

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. *

4-LS1-2 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

- [Clarification Statement: Emphasis on systems of information transfer.] [*Assessment Boundary: Doesn't include how the brain stores/recalls information, or how sensory receptors function.*]

4-ESS1 Earth's Place in the Universe

4-ESS1-1 Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

- [Clarification Statement: Examples of evidence 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.] [*Assessment Boundary: does not include the process of rock formation or memorization of specific rock formations and layers.*]

4-ESS2 Earth's Systems

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. *

- [Clarification Statement: Examples of variables include the 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: limited to a single form of weathering or erosion.*]

4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.

- [Clarification Statement: Examples 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-ESS3 Earth and Human Activity

4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

- [Clarification Statement: Examples of renewable energy include wind energy, water behind dams, and sunlight; non-renewable energy includes fossil fuels and fissile materials. 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-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

- [Clarification Statement: Examples include designing an earthquake resistant building and improving monitoring of volcanic activity.] [*Assessment Boundary: limited to earthquakes, floods, tsunamis, and volcanic eruptions.*]

3-5-ETS1 Engineering Design

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.

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.

This page has been left intentionally blank.

Fifth Grade Standards

5-PS1 Matter and its Interactions

5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen. *

- [Clarification Statement: Examples of a model include filling a ball with air, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [*Assessment Boundary: does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.*]

5-PS1-2 Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. *

- [Clarification Statement: Changes can include phase changes by heating. cooling, dissolving, or mixing substances.] [Assessment Boundary: does not include distinguishing between mass and weight)

5-PS1-3 Make observations and measurements to identify materials based on their properties.

- [Clarification Statement: Examples of materials include baking soda and other powders, metals, minerals, and liquids. Examples of properties include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility.] [*Assessment Boundary: does not include density or distinguishing mass and weight.*]

5-PS1-4 Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

5-PS2 Motion and Stability: Forces and Interactions

5-PS2-1 Support an argument that the gravitational force exerted by Earth on objects is directed down.

- [Clarification Statement: “Down” describes the direction that points toward the center of l Earth.] [*Assessment Boundary: does not include a mathematical representation of gravitational force.*]

5-PS3 Energy

5-PS3-1 Use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

- [Clarification Statement: Examples of models could include diagrams, and flow charts.]

5-LS1 From Molecules to Organisms: Structures and Processes

5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.

- [Clarification Statement: It is a common misconception that plants get their matter from the soil. This misconception can be debunked by learning the process of photosynthesis]

5-LS2 Ecosystems: Interactions, Energy, Dynamics

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

- [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food.] [Assessment Boundary: does not include molecular explanations.]

5-ESS1 Earth's Place in the Universe

5-ESS1-1 Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth. *

- [*Assessment Boundary: 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 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

- [Clarification Statement: Patterns include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [*Assessment Boundary: does not include causes of seasons.*]

5-ESS2 Earth's Systems

5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

- [Clarification Statement: Examples include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [*Assessment Boundary: limited to the interactions of two systems at a time.*]

5-ESS2-2 Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

- [*Assessment Boundary: limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.*]

5-ESS3 Earth and Human Activity

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. *

3-5-ETS1 Engineering Design

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.

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. *

This page has been left intentionally blank.

Sixth Grade Standards

6-ESS1 Earth's Place in the Universe

6-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases.

- [Clarification Statement: Models can be physical, graphical, or conceptual.]

6-ESS1-2 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

- [Clarification Statement: Emphasis on gravity as the force that holds together the solar system and the Milky Way galaxy and controls orbital motions within them. Models can be physical or conceptual.] [*Assessment Boundary: does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets.*]

6-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system. *

- [Clarification Statement: Emphasis on data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Scale properties include the sizes of an object's layers, surface features, and orbital radius. Data includes statistical information, drawings, photographs, and models.] [*Assessment Boundary: does not include recalling facts about properties of the planets and other solar system bodies.*]

6-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. *

- [Clarification Statement: Emphasis on using rock formations and the fossils they contain to establish relative ages of major events in Earth's history. Examples of major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life).] [*Assessment Boundary: does not include recalling the names of specific periods or epochs and events within them.*]

6-ESS2 Earth's Systems

6-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

- [Clarification Statement: Emphasis on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [*Assessment Boundary: does not include identification and naming of minerals.*]

6-ESS2-2 Provide an evidence-based explanation for how geoscience processes have changed Earth's surface at varying time and spatial scales.

- [Clarification Statement: Processes can change Earth's surface at large and small time and spatial scales (such as slow plate motions or rapid landslides), and how many geoscience processes (earthquakes, volcanoes, and meteors) usually behave gradually but are punctuated by catastrophic events.]

6-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. *

- [Clarification Statement: Examples include similarities of rock and fossil types in various locations, the shapes of the continents, and the locations of ocean structures (ridges, fracture zones, and trenches).] [*Assessment Boundary: does not include paleomagnetic anomalies in oceanic and continental crust.*]

6-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

- [Clarification Statement: Emphasize the way water changes state as it moves through the hydrologic cycle. Models can be conceptual or physical.] [*Assessment Boundary: does not include a quantitative understanding of the latent heats of vaporization and fusion.*]

6-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.

- [Clarification Statement: Air masses flow from high pressure to low pressure, causing weather to change over time. Sudden changes in weather can result when different air masses collide. Weather can be predicted within probabilistic ranges.] [*Assessment Boundary: does not include the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.*]

6-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. *

- [Clarification Statement: Patterns vary by latitude, altitude, and geographic distribution.Emphasize ocean circulation on the transfer of heat by the global convection cycle, which is constrained by the Coriolis effect and continental outlines. Models include diagrams, maps/globes, or digital models.] [*Assessment Boundary: does not include dynamics of the Coriolis effect.*]

6-ESS3 Earth and Human Activity

6-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. *

- [Clarification Statement: Emphasize that resources are limited and typically non-renewable, and their distributions are significantly changing as a result of removal by humans. Uneven distributions of resources include petroleum, metal ore, and soil.]

6-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

- [Clarification Statement: 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 (earthquakes or volcanic eruptions), surface processes (mass wasting or tsunamis), or severe weather events (hurricanes, tornadoes, and floods).]

6-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

- [Clarification Statement: Examples include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Human impacts can include water usage, land usage, and pollution.]

6-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.

- [Clarification Statement: Evidence can include grade-appropriate databases on human populations and the rates of consumption of food and natural resources. Impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change.]

6-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

- [Clarification Statement: Factors can include human activities (fossil fuel combustion, cement production, and agricultural activity) and natural processes (changes in incoming solar radiation or volcanic activity). Evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gasses, and the rates of human activities. Emphasize the major role that human activities play in the rise in global temperatures.]

MS-ETS1 Engineering Design

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. *

MS-ETS1-2 Evaluate 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.

This page has been left intentionally blank.

Seventh Grade Standards

7-LS1 From Molecules to Organisms: Structures and Processes

7-LS1-1 Conduct an investigation to provide evidence that living things are made of cells (one cell or many different numbers and types of cells). *

- [Clarification Statement: Emphasis 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.]

7-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. *

- [Clarification Statement: Calles are made up of organelles which have specific functions within the cell.] [*Assessment Boundary: limited to the function of organelles is limited to their relationship to the whole cell. Does not include the biochemical function of cells or cell parts.*]

7-LS1-3 Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

- [Clarification Statement: Cells form tissues and tissues form organs specialized for particular body functions.] [*Assessment Boundary: does not include the mechanism of one body system independent of others. Limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.*]

7-LS1-4 Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

- [Clarification Statement: Behaviors that affect the probability of animal reproduction 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. Animals affect plant reproduction by transferring pollen or seeds, and creating conditions for seed germination and growth. Plants attract animals with 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.]

7-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

- [Clarification Statement: Environmental conditions include availability of food, light, space, and water. Genetic factors include large breed cattle and species of grass affecting growth of organisms. Evidence could include 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: does not include genetic mechanisms, gene regulation, or biochemical processes.*]

7-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. *

- [Clarification Statement: Emphasis on tracing movement of matter and energy.] [*Assessment Boundary: does not include the mechanisms of photosynthesis.*]

7-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as their matter moves through an organism. *

- [Clarification Statement: Molecules are broken apart and put back together in this process, and energy is released.] [*Assessment Boundary: does not include details of chemical reactions for photosynthesis or respiration.*]

7-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

- [*Assessment Boundary: does not include mechanisms for the transmission of information.*]

7-LS2 Ecosystems: Interactions, Energy, and Dynamics

7-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

- [Clarification Statement: Emphasize that the availability of Earth's resources determines a species' survival.]

7-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. *

- [Clarification Statement:Emphasize the prediction of consistent patterns of interactions in different ecosystems in terms of the relationships among organisms and abiotic components of ecosystems. Examples of interactions could include competitive, predatory, and mutually beneficial.]

7-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

- [Clarification Statement: Describing the conservation of matter and flow of energy into and out of various ecosystems; define the boundaries of the system.] [*Assessment Boundary: does not include the use of chemical reactions to describe the processes.*]

7-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. *

- [Clarification Statement: Recognize patterns in data and make inferences about changes in populations, and evaluate empirical evidence supporting arguments about changes to ecosystems.]

7-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

- [Clarification Statement: Examples include water purification, nutrient recycling, and prevention of soil erosion. Design solution constraints could include scientific, economic, and social considerations.]

7-LS3 Heredity: Inheritance and Variation of Traits

7-LS3-1 Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

- [Clarification Statement: Emphasis on understanding that changes in genetic material may result in making different proteins.] [*Assessment Boundary: does not include changes at the molecular level, mechanisms for protein synthesis, or types of mutations.*]

7-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. *

- [Clarification Statement: Use models (Punnett squares, diagrams, and simulations) to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

7-LS4 Biological Evolution: Unity and Diversity

7-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

- Clarification Statement: Find changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: does not include the names of species or geological eras in the fossil record.]

7-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. *

- [Clarification Statement: Evolutionary relationships of anatomical structures over time shows relationships among species.]

7-LS4-3 Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species (not including humans) to identify relationships not evident in fully-formed anatomy. *

- [Clarification Statement: Infer general patterns of relatedness among different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: limited to gross appearance of anatomical structures in embryological development.]

7-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.

- [Clarification Statement: Construct explanations using probability and proportional reasoning.]

7-LS4-5 Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

- [Clarification Statement: Synthesize information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy). Evaluate the impact these technologies have on society.]

7-LS4-6 Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. *

- [Clarification Statement: Use mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [*Assessment Boundary: does not include Hardy Weinberg calculations.*]

MS-ETS1 Engineering Design

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.

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.

This page has been left intentionally blank.

Eighth Grade Standards

8-PS1 Matter and its Interactions

8-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures (i.e., elements and organization of the Periodic Table). *

- [Clarification Statement: Emphasis on developing models of molecules that vary in complexity. Simple molecules could include ammonia and methanol. Extended structures could include sodium chloride or diamonds.] [*Assessment Boundary: does not include bonding energy or a complete description of all individual atoms in a complex molecule or extended structure.*]

8-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

- [Clarification Statement: Reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [*Assessment boundary: limited to analysis of density, melting point, boiling point, solubility, flammability, and odor.*]

8-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

- [Clarification Statement: Emphasis on natural resources that undergo a chemical process to form the synthetic material. Examples could include new medicine, foods, and alternative fuels.] [*Assessment Boundary: limited to qualitative information.*]

8-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

- [Clarification Statement: Use qualitative molecular-level models of solids, liquids, and gasses to show that adding or removing thermal energy increases/decreases kinetic energy of the particles until a change of state occurs.]

8-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. *

- [Clarification Statement: Emphasis on the law of conservation of matter and on models that represent atoms.] [*Assessment Boundary: does not include the use of atomic masses or intermolecular forces.*]

8-PS1-6 Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

- [Clarification Statement: Emphasize the design, controlling the transfer of energy to the environment, and modifying a device using factors such as type and concentration of a substance. Designs could involve chemical reactions like dissolving ammonium chloride or calcium chloride.] [*Assessment Boundary: limited to the criteria of amount, time, and temperature of substance in testing the device.*]

8-PS2 Motion and Stability: Forces and Interactions

8-PS2-1 Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. *

- [*Assessment Boundary: limited to vertical or horizontal interactions in one dimension.*]

8-PS2-2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. *

- [Clarification Statement:Use Newton's First and Third Laws to see balanced and unbalanced forces, qualitative comparisons of forces, mass and changes in motion, frame of reference, and specification of units.] [*Assessment Boundary: limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Does not include the use of trigonometry.*]

8-PS2-3 Ask questions about the data to determine the factors that affect the strength of electric and magnetic forces.

- [Clarification Statement: Examples of devices: electromagnets, electric motors, or generators.[*Assessment Boundary: quantitative answers are limited to proportional reasoning and algebraic thinking.*]

8-PS2-4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the mass of interacting objects.

- [Clarification Statement: Evidence for arguments include data generated from simulations or digital tools, charts displaying mass, strength of interaction, and distance from the Sun.] [*Assessment Boundary: does not include Kepler's Laws.*]

8-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

- [Clarification Statement: Examples include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Investigations may include first-hand experiences or simulations.] [*Assessment Boundary: limited to electric and magnetic fields.*]

8-PS3 Energy

8-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to mass and speed of an object. *

- [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed.]

8-PS3-2 Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. *

- [Clarification Statement:. Examples of objects interacting at varying distances include: a roller coaster cart at multiple positions on a hill or objects at varying heights on shelves, changing the direction of a magnet, and a balloon with static electrical charge approaching hair. *Assessment Boundary: limited to two objects and electric, magnetic, and gravitational interactions.*]

8-PS3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

- [Clarification Statement: Devices may include an insulated box, a solar cooker, and a Styrofoam cup.] [*Assessment Boundary: does not include calculating the total amount of thermal energy transferred.*]

8-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.

- [*Assessment Boundary: does not include calculating the total amount of thermal energy transferred.*]

8-PS3-5 Construct, use, and present arguments to illustrate that when the kinetic energy of an object changes, energy is transferred to or from the object. *

8-PS4 Waves and Their Applications in Technologies for Information Transfer

8-PS4-1 Use mathematical representations to describe a model for waves that includes how the amplitude of a wave is related to the energy in a wave. *

- [Clarification Statement: Describe waves with both qualitative and quantitative thinking.] [*Assessment Boundary: limited to standard repeating waves.*]

8-PS4-2 Develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials. *

- [Clarification Statement: Use both light and mechanical waves.] [*Assessment Boundary: limited to qualitative applications pertaining to light and mechanical waves.*]

8-PS4-3 Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

- [Clarification Statement: Understand waves can be used for communication purposes.] [*Assessment Boundary: does not include the specific mechanism of a device.*]

MS-ETS1 Engineering Design

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.

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. *