Table of Contents

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The Three Dimensions

Dimension 1: Science and Engineering Practices

What the students will do.

This dimension describes (a) the major practices that scientists employ as they investigate and build models and theories about the world and (b) a key set of engineering practices that engineers use as they design and build systems. We use the term "practices" instead of a term such as "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Similarly, because the term "inquiry," extensively referred to in previous standards documents, has been interpreted over time in many different ways throughout the science education community, part of our intent in articulating the practices in Dimension 1 is to better specify what is meant by inquiry in science and the range of cognitive, social and physical practices that it requires. As in all inquiry-based approaches to science teaching, our expectation is that students will themselves engage in the practices and not merely learn about them secondhand. Students cannot comprehend scientific practices, nor fully appreciate the nature of scientific knowledge itself, without directly experiencing those practices for themselves.

Dimension 2: Crosscutting Concepts

How the students will organize and connect their knowledge.

The crosscutting concepts have application across all domains of science. As such, they provide one way of linking across the domains in Dimension 3. There is a need to consider not only content but also the ideas and practices that cut across the science disciplines.

Dimension 3: Disciplinary Core Ideas

What the students will understand.

The continuing expansion of scientific knowledge makes it impossible to teach all the ideas related to a given discipline in exhaustive detail during the K-12 years. But given the cornucopia of information available today virtually at a touch– people live, after all, in an information age—an important role of science education is not to teach "all the facts" but rather to prepare students with sufficient core knowledge so that they can later acquire additional information on their own. An education focused on a limited set of ideas and practices in science and engineering should enable students to evaluate and select reliable sources of scientific information and allow them to continue their development well beyond their K-12 school years as science learners, users of scientific knowledge, and perhaps also as producers of such knowledge.

EIGHT SCIENCE AND ENGINEERING PRACTICES

PRACTICE	SCIENCE	ENGINEERING
Asking Questions and Defining Problems	Science begins with a question about a phenomenon, such as “Why is the sky blue?” or “What causes cancer?,” and seeks to develop theories that can provide explanatory answers to such questions. A basic practice of the scientist is formulating empirically answerable questions about phenomena, establishing what is already known, and determining what questions have yet to be satisfactorily answered.	Engineering begins with a problem, need, or desire that suggests an engineering problem that needs to be solved. A societal problem such as reducing the nation’s dependence on fossil fuels may engender a variety of engineering problems, such as designing more efficient transportation systems, or alternative power generation devices such as improved solar cells. Engineers ask questions to define the engineering problem, determine criteria for a successful solution, and identify constraints.
Developing and Using Models	Science often involves the construction and use of a wide variety of models and simulations to help develop explanations about natural phenomena. Models make it possible to go beyond observables and imagine a world not yet seen. Models enable predictions of the form “if . . .then . . . therefore” to be made in order to test hypothetical explanations.	Engineering makes use of models and simulations to analyze existing systems so as to see where flaws might occur or to test possible solutions to a new problem. Engineers also call on models of various sorts to test proposed systems and to recognize the strengths and limitations of their designs.
Planning and Carrying Out Investigations	Scientific **investigation** may be conducted in the field or the laboratory. A major practice of scientists is planning and carrying out a systematic investigation, which requires the identification of what is to be recorded and, if applicable, what are to be treated as the dependent and independent variables (control of variables). Observations and data collected from such work are used to test existing theories and explanations or to revise and develop new ones.	Engineers use investigation both to gain data essential for specifying design criteria or parameters and to test their designs. Like scientists, engineers must identify relevant variables; decide how they will be measured, and collect data for analysis. Their investigations help them to identify how effective, efficient, and durable their designs may be under a range of conditions.
Analyzing and Interpreting Data	Scientific **investigations** produce data that must be analyzed in order to derive meaning. Because data usually do not speak for themselves, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Sources of error are identified and the degree of certainty calculated. Modern technology makes the collection of large data sets much easier, thus providing many secondary sources for analysis.	Engineers analyze data collected in the tests of their designs and investigations; this allows them to compare different solutions and determine how well each one meets specific design criteria—that is, which design best solves the problem within the given constraints. Like scientists, engineers require a range of tools to identify the major patterns and interpret the results.

Using Mathematics and Computational Thinking	In **science,** mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks, such as constructing simulations, statistically analyzing data, and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable predictions of the behavior of physical systems, along with the testing of such predictions. Moreover, statistical techniques are invaluable for assessing the significance of patterns or correlations.	In **engineering,** mathematical and computational representations of established relationships and principles are an integral part of design. For example, structural engineers create mathematically based analyses of designs to calculate whether they can stand up to the expected stresses of use and if they can be completed within acceptable budgets. Moreover, simulations of designs provide an effective test bed for the development of designs and their improvement.
Constructing Explanations and Designing Solutions	The goal of **science** is the construction of theories that can provide explanatory accounts of features of the world. A theory becomes accepted when it has been shown to be superior to other explanations in the breadth of phenomena it accounts for and in its explanatory coherence and parsimony. Scientific explanations are explicit applications of theory to a specific situation or phenomenon, perhaps with the intermediary of a theory-based model for the system under study. The goal for students is to construct logically coherent explanations of phenomena that incorporate their current understanding of science, or a model that represents it, and are consistent with the available evidence.	**Engineering design,** a systematic process for solving engineering problems, is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technological feasibility, cost, safety, esthetics, and compliance with legal requirements. There is usually no single best solution but rather a range of solutions. Which one is the optimal choice depends on the criteria used for making evaluations.
Engaging in Argument from Evidence	In **science,** reasoning and argument are essential for identifying the strengths and weaknesses of a line of reasoning and for finding the best explanation for a natural phenomenon. Scientists must defend their explanations, formulate evidence based on a solid foundation of data, examine their own understanding in light of the evidence and comments offered by others, and collaborate with peers in searching for the best explanation for the phenomenon being investigated.	In **engineering,** reasoning and argument are essential for finding the best possible solution to a problem. Engineers collaborate with their peers throughout the design process, with a critical stage being the selection of the most promising solution among a field of competing ideas. Engineers use systematic methods to compare alternatives, formulate evidence based on test data, make arguments from evidence to defend their conclusions, evaluate critically the ideas of others, and revise their designs in order to achieve the best solution to the problem at hand.
Obtaining, Evaluating, and Communicating Information	**Science** cannot advance if scientists are unable to communicate their findings clearly and persuasively or to learn about the findings of others. A major practice of science is thus the communication of ideas and the results of inquiry—orally, in writing, with the use of tables, diagrams, graphs, and equations, and by engaging in extended discussions with scientific peers. Science requires the ability to derive meaning from scientific texts (such as papers, the Internet, symposia, and lectures), to evaluate the scientific validity of the information thus acquired, and to integrate that information.	**Engineers** cannot produce new or improved technologies if the advantages of their designs are not communicated clearly and persuasively. Engineers need to be able to express their ideas, orally and in writing, with the use of tables, graphs, drawings, or models and by engaging in extended discussions with peers. Moreover, as with scientists, they need to be able to derive meaning from colleagues' texts, evaluate the information, and apply it usefully. In engineering and science alike, new technologies are now routinely available that extend the possibilities for collaboration and communication.

SEVEN CROSSCUTTING CONCEPTS OF THE FRAMEWORK

The organizational framework that connects knowledge into a coherent and scientifically based view of the world

Patterns: Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
Cause and Effect: Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
Scale, Proportion, and Quantity: In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
Systems and System Models: Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
Energy and Matter: Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
Structure and Function: The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
Stability and Change: For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

KINDERGARTEN OVERVIEW

The performance expectations in kindergarten help students formulate answers to questions such as: "What happens if you push or pull an object harder? Where do animals live and why do they live there? What is the weather like today and how is it different from yesterday?" Kindergarten performance expectations include **PS2, PS3, LS1, ESS2, ESS3, and ETS1** Disciplinary Core Ideas from the NRC Framework. Students are expected to develop understanding of patterns and variations in local weather and the purpose of weather forecasting to prepare for, and respond to, severe weather. Students are able to apply an understanding of the effects of different strengths or different directions of pushes and pulls on the motion of an object to analyze a design solution. Students are also expected to develop understanding of what plants and animals (including humans) need to survive and the relationship between their needs and where they live. The crosscutting concepts of patterns; cause and effect; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the kindergarten performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

PS = Physical Science

LS = Life Science

ESS = Earth Space Science

ETS = Engineering, Technology, and Application of Science

Physical Science K-5 Progression

Physical Science	K	1	2	3	4	5
PS1 Matter and Its Interactions						
PS1A Structure and Properties of matter			X			X
PS1B Chemical Reactions			X			X
PS1C Nuclear Processes						
PS2 Motion and Stability: Forces and Interactions						
PS2A Forces and Motion	X			X		
PS2B Types of Interactions	X			X		X
PS2C Stability and Instability in Physical Systems						
PS3 Energy						
PS3A Definitions of Energy					X	
PS3B Conservation of Energy and Energy Transfer	X				X	
PS3C Relationship Between Energy and Forces	X				X	
PS3D Energy and Chemical Processes in Everyday Life					X	X
PS4 Waves and Their Applications in Technologies for Information Transfer						
PS4A Wave Properties		X			X	
PS4B Electromagnetic Radiation		X			X	
PS4C Information Technologies and Instrumentation		X			X	

Core Idea PS2

Motion and Stability: Forces and Interactions

Essential Question: How can one explain and predict interactions between objects and within systems of objects?

Interactions between any two objects can cause changes in one or both of them. An understanding of the forces between objects is important for describing how their motions change, as well as for predicting stability or instability in systems at any scale. All forces between objects arise from a few types of interactions: gravity, electromagnetism, and the strong and weak nuclear interactions.

PS2.A: FORCES AND MOTION

Essential Question: How can one predict an object's continued motion, changes in motion, or stability?

Interactions of an object with another object can be explained and predicted using the concept of forces, which can cause a change in motion of one or both of the interacting objects. An individual force acts on one particular object and is described by its strength and direction. The strengths of forces can be measured and their values compared.

What happens when a force is applied to an object depends not only on that force but also on all the other forces acting on that object. A static object typically has multiple forces acting on it, but they sum to zero. If the total (vector sum) force on an object is not zero, however, its motion will change. Sometimes forces on an object can also change its shape or orientation. For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first but in the opposite direction (Newton's third law).

At the macroscale, the motion of an object subject to forces is governed by Newton's second law of motion. Under everyday circumstances, the mathematical expression of this law in the form $F = ma$ (total force = mass times acceleration) accurately predicts changes in the motion of a single macroscopic object of a given mass due to the total force on it. But at speeds close to the speed of light, the second law is not applicable without modification. Nor does it apply to objects at the molecular, atomic, and subatomic scales, or to an object whose mass is changing at the same time as its speed.

For speeds that are small compared with the speed of light, the momentum of an object is defined as its mass times its velocity. For any system of interacting objects, the total momentum within the system changes only due to transfer of momentum into or out of the system, either because of external forces acting on the system or because of matter flows. Within an isolated system of interacting objects, any change in momentum of one object is balanced by an equal and oppositely directed change in the total momentum of the other objects. Thus total momentum is a conserved quantity.

Grade Band Endpoints for PS2.A

By the end of grade 2. Objects pull or push each other when they collide or are connected. Pushes and pulls can have different strengths and directions. Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. An object sliding on a surface or sitting on a slope experiences a pull due to friction on the object due to the surface that opposes the object's motion.

By the end of grade 5. Each force acts on one particular object and has both a strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) The patterns of an object's motion in various situations can be observed and measured; when past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

PS2.B: TYPES OF INTERACTIONS

Essential Question: What underlying forces explain the variety of interactions observed?

All forces between objects arise from a few types of interactions: gravity, electromagnetism, and strong and weak nuclear interactions. Collisions between objects involve forces between them that can change their motion. Any two objects in contact also exert forces on each other that are electromagnetic in origin. These forces result from deformations of the objects' substructures and the electric charges of the particles that form those substructures (e.g., a table supporting a book, friction forces).

Gravitational, electric, and magnetic forces between a pair of objects do not require that they be in contact. These forces are explained by force fields that contain energy and can transfer energy through space. These fields can be mapped by their effect on a test object (mass, charge, or magnet, respectively).

Objects with mass are sources of gravitational fields and are affected by the gravitational fields of all other objects with mass. Gravitational forces are always attractive. For two human-scale objects, these forces are too small to observe without sensitive instrumentation. Gravitational interactions are nonnegligible, however, when very massive objects are involved. Thus the gravitational force due to Earth, acting on an object near Earth's surface, pulls that object toward the planet's center. Newton's law of universal gravitation provides the mathematical model to describe and predict the effects of gravitational forces between distant objects. These long-range gravitational interactions govern the evolution and maintenance of large-scale structures in the universe (e.g., the solar system, galaxies) and the patterns of motion within them.

Electric forces and magnetic forces are different aspects of a single electromagnetic interaction. Such forces can be attractive or repulsive, depending on the relative sign of the electric charges involved, the direction of current flow, and the orientation of magnets. The forces' magnitudes depend on the magnitudes of the charges, currents, and magnetic strengths as well as on the distances between the interacting objects. All objects with electrical charge or magnetization are sources of electric or magnetic fields and can be affected by the electric or magnetic fields of other such objects. Attraction and repulsion of electric charges at the atomic scale explain the structure, properties, and transformations of matter and the contact forces between material objects (link to PS1.A and PS1.B). Coulomb's law provides the mathematical model to describe and predict the effects of electrostatic forces (relating to stationary electric charges or fields) between distant objects.

The strong and weak nuclear interactions are important inside atomic nuclei. These short-range interactions determine nuclear sizes, stability, and rates of radioactive decay (see PS1.C).

Grade Band Endpoints for PS2.B

By the end of grade 2. When objects touch or collide, they push on one another and can change motion or shape.

By the end of grade 5. Objects in contact exert forces on each other (friction, elastic pushes and pulls). Electric, magnetic, and gravitational forces between a pair of objects do not require that the objects be in contact—for example, magnets push or pull at a distance. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.

Core Idea PS3

Energy

Essential Question: How is energy transferred and conserved?

Interactions of objects can be explained and predicted using the concept of transfer of energy from one object or system of objects to another. The total energy within a defined system changes only by the transfer of energy into or out of the system.

PS3.B: CONSERVATION OF ENERGY AND ENERGY TRANSFER

Essential Questions: *What is meant by conservation of energy?*
How is energy transferred between objects or systems?

The total change of energy in any system is always equal to the total energy transferred into or out of the system. This is called conservation of energy. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. Many different types of phenomena can be explained in terms of energy transfers. Mathematical expressions, which quantify changes in the forms of energy within a system and transfers of energy into or out of the system, allow the concept of conservation of energy to be used to predict and describe the behavior of a system.

When objects collide or otherwise come in contact, the motion energy of one object can be transferred to change the motion or stored energy (e.g., change in shape or temperature) of the other objects. For macroscopic objects, any such process (e.g., collisions, sliding contact) also transfers some of the energy to the surrounding air by sound or heat. For molecules, collisions can also result in energy transfers through chemical processes, which increase or decrease the total amount of stored energy within a system of atoms; the change in stored energy is always balanced by a change in total kinetic energy—that of the molecules present after the process compared with the kinetic energy of the molecules present before it.

Energy can also be transferred from place to place by electric currents. Heating is another process for transferring energy. Heat transfer occurs when two objects or systems are at different temperatures. Energy moves out of higher temperature objects and into lower temperature ones, cooling the former and heating the latter. This transfer happens in three different ways—by conduction within solids, by the flow of liquid or gas (convection), and by radiation, which can travel across space. Even when a system is isolated (such as Earth in space), energy is continually being transferred into and out of it by radiation. The processes underlying convection and conduction can be understood in terms of models of the possible motions of particles in matter.

Radiation can be emitted or absorbed by matter. When matter absorbs light or infrared radiation, the energy of that radiation is transformed to thermal motion of particles in the matter, or, for shorter wavelengths (ultraviolet, X-ray), the radiation's energy is absorbed within the atoms or molecules and may possibly ionize them by knocking out an electron.

Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution within the system or between the system and its environment (e.g., water flows downhill, objects that are hotter than their surrounding environment cool down). Any object or system that can degrade with no added energy is unstable. Eventually it will change or fall apart, although in some cases it may remain in the unstable state for a long time before decaying (e.g., long-lived radioactive isotopes).

Grade-Level Endpoints for PS3.B

By the end of grade 2. Sunlight warms Earth's surface.

By the end of grade 5. Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.

Light also transfers energy from place to place. For example, energy radiated from the sun is transferred to Earth by light. When this light is absorbed, it warms Earth's land, air, and water and facilitates plant growth.

Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy (e.g., moving water driving a spinning turbine which generates electric currents).

PS3.C RELATIONSHIP BETWEEN ENERGY AND FORCES

Essential Question: How are forces related to energy?

When two objects interact, each one exerts a force on the other. These forces can transfer energy between the objects. Forces between two objects at a distance are explained by force fields (gravitational, electric, or magnetic) between them. Contact forces between colliding objects can be modeled at the microscopic level as due to electromagnetic force fields between the surface particles. When two objects interacting via a force field change their relative position, the energy in the force field between them changes. For any such pair of objects the force on each object acts in the direction such that motion of that object in that direction would reduce the energy in the force field between the two objects. However, prior motion and other forces also affect the actual direction of motion.

Patterns of motion, such as a weight bobbing on a spring or a swinging pendulum, can be understood in terms of forces at each instant or in terms of transformation of energy between the motion and one or more forms of stored energy. Elastic collisions between two objects can be modeled at the macroscopic scale using conservation of energy without having to examine the detailed microscopic forces.

Grade Band Endpoints for PS3.C

By the end of grade 2. A bigger push or pull makes things go faster. Faster speeds during a collision can cause a bigger change in shape of the colliding objects.

By the end of grade 5. When objects collide, the contact forces transfer energy so as to change the objects' motions. Magnets can exert forces on other magnets or on magnetizable materials, causing energy transfer between them (e.g., leading to changes in motion) even when the objects are not touching.

Life Science K-5 Progression

Life Science	K	1	2	3	4	5
LS1 From Molecules to Organisms: Structures and Processes						
LS1A Structure and Function		X			X	
LS1B Growth and Development of Organisms		X		X		
LS1C Organization for Matter and Energy Flow in Organisms	X					X
LS1D Information Processing		X			X	
LS2 Ecosystems: Interactions, Energy, and Dynamics						
LS2A Interdependent Relationships in Ecosystems			X			X
LS2B Cycles of Matter and Energy Transfer in Ecosystems						X
LS2C Ecosystem Dynamics, Functioning, and Resilience				X		
LS2D Social Interactions and Group Behavior				X		
LS3 Heredity: Inheritance and Variation of Traits						
LS3A Inheritance of Traits		X		X		
LS3B Variation of Traits		X		X		
LS4 Biological Evolution: Unity and Diversity						
LS4A Evidence of Common Ancestry				X		
LS4B Natural Selection				X		
LS4C Adaptation				X		
LS4D Biodiversity and Humans			X	X		

Core Idea LS1

From Molecules to Organisms: Structures and Processes

Essential Question: How do organisms live, grow, respond to their environment, and reproduce?

All living organisms are made of cells. Life is the quality that distinguishes living things—composed of living cells—from nonliving objects or those that have died. While a simple definition of life can be difficult to capture, all living things—that is to say all organisms—can be characterized by common aspects of their structure and functioning. Organisms are complex, organized, and built on a hierarchical structure, with each level providing the foundation for the next, from the chemical foundation of elements and atoms, to the cells and systems of individual organisms, to species and populations living and interacting in complex ecosystems. Organisms can be made of a single cell or millions of cells working together and include animals, plants, algae, fungi, bacteria, and all other microorganisms.

Organisms respond to stimuli from their environment and actively maintain their internal environment through homeostasis. They grow and reproduce, transferring their genetic information to their offspring. While individual organisms carry the same genetic information over their lifetime, mutation and the transfer from parent to offspring produce new combinations of genes. Over generations natural selection can lead to changes in a species overall; hence, species evolve over time. To maintain all of these processes and functions, organisms require materials and energy from their environment; nearly all energy that sustains life ultimately comes from the sun.

LS1.C: ORGANIZATION FOR MATTER AND ENERGY FLOW IN ORGANISMS

Essential Question: How do organisms obtain and use the matter and energy they need to live and grow?

Sustaining life requires substantial energy and matter inputs. The complex structural organization of organisms accommodates the capture, transformation, transport, release, and elimination of the matter and energy needed to sustain them. As matter and energy flow through different organizational levels—cells, tissues, organs, organisms, populations, communities, and ecosystems—of living systems, chemical elements are recombined in different ways to form different products. The result of these chemical reactions is that energy is transferred from one system of interacting molecules to another.

In most cases, the energy needed for life is ultimately derived from the sun through photosynthesis (although in some ecologically important cases, energy is derived from reactions involving inorganic chemicals in the absence of sunlight—e.g., chemosynthesis). Plants, algae (including phytoplankton), and other energy-fixing microorganisms use sunlight, water, and carbon dioxide to facilitate photosynthesis, which stores energy, forms plant matter, releases oxygen, and maintains plants' activities. Plants and algae—being the resource base for animals, the animals that feed on animals, and the decomposers—are energy-fixing organisms that sustain the rest of the food web.

Grade Band Endpoints for LS1.C

By the end of grade 2. All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.

By the end of grade 5. Animals and plants alike generally need to take in air and water, animals must take in food, and plants need light and minerals; anaerobic life, such as bacteria in the gut, functions without air. Food provides animals with the materials they need for body repair and growth and is digested to release the energy they need to maintain body warmth and for motion. Plants acquire their material for growth chiefly from air and water and process matter they have formed to maintain their internal conditions (e.g., at night).

Earth Space K-5 Progression

Earth Space Science	K	1	2	3	4	5
ESS1 Earth's Place in the Universe						
ESS1A The Universe and Its Stars		X				X
ESS1B Earth and the Solar System		X				X
ESS1C The History of Planet Earth			X		X	
ESS2 Earth's Systems						
ESS2A Earth Materials and Systems			X		X	X
ESS2B Plate Tectonics and Large-Scale System Interactions			X		X	
ESS2C The Roles of Water in Earth's Surface Processes			X			X
ESS2D Weather and Climate	X			X		
ESS2E Biogeology	X				X	
ESS3 Earth and Human Activity						
ESS3A Natural Resources	X				X	
ESS3B Natural Hazards	X			X		
ESS3C Human Impacts on Earth Systems	X					X
ESS3D Global Climate Change						

Core Idea ESS2

Earth's Systems

Essential Question: How and why is Earth constantly changing?

Earth's surface is a complex and dynamic set of interconnected systems—principally the geosphere, hydrosphere, atmosphere, and biosphere—that interact over a wide range of temporal and spatial scales. All of Earth's processes are the result of energy flowing and matter cycling within and among these systems. For example, the motion of tectonic plates is part of the cycles of convection in Earth's mantle, driven by outflowing heat and the downward pull of gravity, which result in the formation and changes of many features of Earth's land and undersea surface. Weather and climate are shaped by complex interactions involving sunlight, the ocean, the atmosphere, clouds, ice, land, and life forms. Earth's biosphere has changed the makeup of the geosphere, hydrosphere, and atmosphere over geological time; conversely, geological events and conditions have influenced the evolution of life on the planet. Water is essential to the dynamics of most earth systems, and it plays a significant role in shaping Earth's landscape.

ESS2.D: WEATHER AND CLIMATE

Essential Question: What regulates weather and climate?

Weather, which varies from day to day and seasonally throughout the year, is the condition of the atmosphere at a given place and time. Climate is longer term and location sensitive; it is the range of a region's weather over 1 year or many years, and, because it depends on latitude and geography, it varies from place to place. Weather and climate are shaped by complex interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions can drive changes that occur over multiple time scales—from days, weeks, and months for weather to years, decades, centuries, and beyond—for climate.

The ocean exerts a major influence on weather and climate. It absorbs and stores large amounts of energy from the sun and releases it very slowly; in that way, the ocean moderates and stabilizes global climates. Energy is redistributed globally through ocean currents (e.g., the Gulf Stream) and also through atmospheric circulation (winds). Sunlight heats Earth's surface, which in turn heats the atmosphere. The resulting temperature patterns, together with Earth's rotation and the configuration of continents and oceans, control the large-scale patterns of atmospheric circulation. Winds gain energy and water vapor content as they cross hot ocean regions, which can lead to tropical storms.

The "greenhouse effect" keeps Earth's surface warmer than it would be otherwise. To maintain any average temperature over time, energy inputs from the sun and from radioactive decay in Earth's interior must be balanced by energy loss due to radiation from the upper atmosphere. However, what determines the temperature at which this balance occurs is a complex set of absorption, reflection, transmission, and redistribution processes in the atmosphere and oceans that determine how long energy stays trapped in these systems before being radiated away. Certain gases in the atmosphere (water vapor, carbon dioxide, methane, and nitrous oxides), which absorb and retain energy that radiates from Earth's surface, essentially insulate the planet. Without this phenomenon, Earth's surface would be too cold to be habitable. However, changes in the atmosphere, such as increases in carbon dioxide, can make regions of Earth too hot to be habitable by many species.

Climate changes, which are defined as significant and persistent changes in an area's average or extreme weather conditions, can occur if any of Earth's systems change (e.g., composition of the atmosphere, reflectivity of Earth's surface). Positive feedback loops can amplify the impacts of these effects and trigger relatively abrupt changes in the climate system; negative feedback loops tend to maintain stable climate conditions.

Some climate changes in Earth's history were rapid shifts (caused by events, such as volcanic eruptions and meteoric impacts, that suddenly put a large amount of particulate matter into the atmosphere or by abrupt changes in ocean currents); other climate changes were gradual and longer term—due, for example, to solar output variations, shifts in the tilt of Earth's axis, or atmospheric change due to the rise of plants and other life forms that modified the atmosphere via photosynthesis. Scientists can infer these changes from geological evidence.

Climate changes, which are defined as significant and persistent changes in an area's average or extreme weather conditions, can occur if any of Earth's systems change (e.g., composition of the atmosphere, reflectivity of Earth's surface). Positive feedback loops can amplify the impacts of these effects and trigger relatively abrupt changes in the climate system; negative feedback loops tend to maintain stable climate conditions.

Some climate changes in Earth's history were rapid shifts (caused by events, such as volcanic eruptions and meteoric impacts, that suddenly put a large amount of particulate matter into the atmosphere or by abrupt changes in ocean currents); other climate changes were gradual and longer term—due, for example, to solar output variations, shifts in the tilt of Earth's axis, or atmospheric change due to the rise of plants and other life forms that modified the atmosphere via photosynthesis. Scientists can infer these changes from geological evidence.

Grade Band Endpoints for ESS2.D

By the end of grade 2. Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.

By the end of grade 5. Weather is the minute-by-minute to day-by-day variation of the atmosphere's condition on a local scale. Scientists record the patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. Climate describes the ranges of an area's typical weather conditions and the extent to which those conditions vary over years to centuries.

ESS2.E: BIOGEOLOGY

Essential Question: How do living organisms alter Earth's processes and structures?

Evolution, including the emergence and extinction of species, is a natural and ongoing process that is shaped by Earth's dynamic processes. The properties and conditions of Earth and its atmosphere affect the environments and conditions within which life emerged and evolved—for example, the range of frequencies of light that penetrate the atmosphere to Earth's surface. Organisms continually evolve to new and often more complex forms as they adapt to new environments. The evolution and proliferation of living things have changed the makeup of Earth's geosphere, hydrosphere, and atmosphere over geological time. Plants, algae, and microorganisms produced most of the oxygen (i.e., the O_2) in the atmosphere through photosynthesis, and they enabled the formation of fossil fuels and types of sedimentary rocks. Microbes also changed the chemistry of Earth's surface, and they continue to play a critical role in nutrient cycling (e.g., of nitrogen) in most ecosystems.

Organisms ranging from bacteria to human beings are a major driver of the global carbon cycle, and they influence global climate by modifying the chemical makeup of the atmosphere. Greenhouse gases in particular are continually movedthrough the reservoirs represented by the ocean, land, life, and atmosphere. The abundance of carbon in the atmosphere is reduced through the ocean floor accumulation of marine sediments and the accumulation of plant biomass; atmospheric carbon is increased through such processes as deforestation and the burning of fossil fuels.

As Earth changes, life on Earth adapts and evolves to those changes, so just as life influences other Earth systems, other Earth systems influence life. Life and the planet's nonliving systems can be said to co-evolve.

Grade Band Endpoints for ESS2.E

By the end of grade 2. Plants and animals (including humans) depend on the land, water, and air to live and grow. They in turn can change their environment (e.g., the shape of land, the flow of water).

By the end of grade 5. Living things affect the physical characteristics of their regions (e.g., plants' roots hold soil in place, beaver shelters and human-built dams alter the flow of water, plants' respiration affects the air). Many types of rocks and minerals are formed from the remains of organisms or are altered by their activities.

Core Idea ESS3

Earth and Human Activity

Essential Question: How do Earth's surface processes and human activities affect each other?

Earth's surface processes affect and are affected by human activities. Humans depend on all of the planet's systems for a variety of resources, some of which are renewable or replaceable and some of which are not. Natural hazards and other geological events can significantly alter human populations and activities. Human activities, in turn, can contribute to the frequency and intensity of some natural hazards. Indeed, humans have become one of the most significant agents of change in Earth's surface systems. In particular, it has been shown that climate change—which could have large consequences for all of Earth's surface systems, including the biosphere—is driven not only by natural effects but also by human activities. Sustaining the biosphere will require detailed knowledge and modeling of the factors that affect climate, coupled with the responsible management of natural resources.

ESS3.A: NATURAL RESOURCES

Essential Question: How do humans depend on Earth's resources?

Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources, including air, water, soil, minerals, metals, energy, plants, and animals. Some of these resources are renewable over human lifetimes, and some are nonrenewable (mineral resources and fossil fuels) or irreplaceable if lost (extinct species).

Materials important to modern technological societies are not uniformly distributed across the planet (e.g., oil in the Middle East, gold in California). Most elements exist in Earth's crust at concentrations too low to be extracted, but in some locations—where geological processes have concentrated them—extraction is economically viable. Historically, humans have populated regions that are climatically, hydrologically, and geologically advantageous for fresh water availability, food production via agriculture, commerce, and other aspects of civilization. Resource availability affects geopolitical relationships and can limit development. As the global human population increases and people's demands for better living conditions increase, resources considered readily available in the past, such as land for agriculture or drinkable water, are becoming scarcer and more valued.

All forms of resource extraction and land use have associated economic, social, environmental, and geopolitical costs and risks, as well as benefits. New technologies and regulations can change the balance of these factors—for example, scientific modeling of the long-term environmental impacts of resource use can help identify potential problems and suggest desirable changes in the patterns of use. Much energy production today comes from nonrenewable sources, such as coal and oil. However, advances in related science and technology are reducing the cost of energy from renewable resources, such as sunlight, and some regulations are favoring their use. As a result, future energy supplies are likely to come from a much wider range of sources.

Grade Band Endpoints for ESS3.A

By the end of grade 2. Living things need water, air, and resources from the land, and they try to live in places that have the things they need. Humans use natural resources for everything they do: for example, they use soil and water to grow food, wood to burn to provide heat or to build shelters, and materials such as iron or copper extracted from Earth to make cooking pans.

By the end of grade 5. All materials, energy, and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.

ESS3.B: NATURAL HAZARDS

Essential Question: How do natural hazards affect individuals and societies?

Natural processes can cause sudden or gradual changes to Earth's systems, some of which may adversely affect humans. Through observations and knowledge of historical events, people know where certain of these hazards—such as earthquakes, tsunamis, volcanic eruptions, severe weather, floods, and coastal erosion—are likely to occur. Understanding these kinds of hazards helps us prepare for and respond to them.

While humans cannot eliminate natural hazards, they can take steps to reduce their impacts. For example, loss of life and economic costs have been greatly reduced by improving construction, developing warning systems, identifying and avoiding high-risk locations, and increasing community preparedness and response capability.

Some natural hazards are preceded by geological activities that allow for reliable predictions; others occur suddenly, with no notice, and are not yet predictable. By tracking the upward movement of magma, for example, volcanic eruptions can often be predicted with enough advance warning to allow neighboring regions to be evacuated. Earthquakes, in contrast, occur suddenly; the specific time, day, or year cannot be predicted. However, the history of earthquakes in a region and the mapping of fault lines can help forecast the likelihood of future events. Finally, satellite monitoring of weather patterns, along with measurements from land, sea, and air, usually can identify developing severe weather and lead to its reliable forecast.

Natural hazards and other geological events have shaped the course of human history, sometimes significantly altering the size of human populations or driving human migrations. Natural hazards can be local, regional, or global in origin, and even local events can have distant impacts because of the interconnectedness of human societies and Earth's systems. Human activities can contribute to the frequency and intensity of some natural hazards (e.g., flooding, forest fires), and risks from natural hazards increase as populations—and population densities—increase in vulnerable locations.

Grade Band Endpoints for ESS3.B

By the end of grade 2. Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that communities can prepare for and respond to these events.

By the end of grade 5. A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions, severe weather, floods, coastal erosion). Humans cannot eliminate natural hazards but can take steps to reduce their impacts.

ESS3.C: HUMAN IMPACTS ON EARTH SYSTEMS

Essential Question: How do humans change the planet?

Recorded history, as well as chemical and geological evidence, indicates that human activities in agriculture, industry, and everyday life have had major impacts on the land, rivers, ocean, and air. Humans affect the quality, availability, and distribution of Earth's water through the modification of streams, lakes, and groundwater. Large areas of land, including such delicate ecosystems as wetlands, forests, and grasslands, are being transformed by human agriculture, mining, and the expansion of settlements and roads. Human activities now cause land erosion and soil movement annually that exceed all natural processes. Air and water pollution caused by human activities affect the condition of the atmosphere and of rivers and lakes, with damaging effects on other species and on human health. The activities of humans have significantly altered the biosphere, changing or destroying natural habitats and causing the extinction of many living species. These changes also affect the viability of agriculture or fisheries to support human populations. Land use patterns for agriculture and ocean use patterns for fishing are affected not only by changes in population and needs but also by changes in climate or local conditions (such as desertification due to overuse or depletion of fish populations by over extraction).

Thus humans have become one of the most significant agents of change in the near-surface Earth system. And because all of Earth's subsystems are interconnected, changes in one system can produce unforeseen changes in others.

The activities and advanced technologies that have built and maintained human civilizations clearly have large consequences for the sustainability of these civilizations and the ecosystems with which they interact. As the human population grows and per-capita consumption of natural resources increases to provide a greater percentage of people with more developed lifestyles and greater longevity, so do the human impacts on the planet.

Some negative effects of human activities are reversible with informed and responsible management. For example, communities are doing many things to help protect Earth's resources and environments. They are treating sewage, reducing the amount of materials they use, and reusing and recycling materials. Regulations regarding water and air pollution have greatly reduced acid rain and stream pollution, and international treaties on the use of certain refrigerant gases have halted the growth of the annual ozone hole over Antarctica. Regulation of fishing and the development of marine preserves can help restore and maintain fish populations. In addition, the development of alternative energy sources can reduce the environmental impacts otherwise caused by the use of fossil fuels.

The sustainability of human societies and of the biodiversity that supports them requires responsible management of natural resources not only to reduce existing adverse impacts but also to prevent such impacts to the extent possible. Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

Grade Band Endpoints for ESS3.C

By the end of grade 2. Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things—for example, by reducing trash through reuse and recycling.

By the end of grade 5. Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. For example, they are treating sewage, reducing the amounts of materials they use, and regulating sources of pollution such as emissions from factories and power plants or the runoff from agricultural activities.

Engineering, Technology and Application of Science K-5 Progression

Engineering, Technology, and Applications of Science	K	1	2	3	4	5
ETS1: Engineering Design						
ETS1A Defining and Delimiting Engineering Problems	X				X	
ETS1B Developing Possible Solutions	X		X		X	
ETS1C Optimizing the Design Solution			X		X	
ETS2: Links Among Engineering, Technology, Science and						
ETS2.A Interdependence of Science, Engineering and Technology						
ETS2.B Influence of Engineering, Technology, and Science on Society and the Natural World						

Core Idea ETS1

Engineering Design

Essential Question: How do engineers solve problems?

The design process—engineers' basic approach to problem solving—involves many different practices. They include problem definition, model development and use, investigation, analysis and interpretation of data, application of mathematics and computational thinking, and determination of solutions. These engineering practices incorporate specialized knowledge about criteria and constraints, modeling and analysis, and optimization and trade-offs.

ETS1.A: DEFINING AND DELIMITING AN ENGINEERING PROBLEM

Essential Questions: *What is a design for?*
What are the criteria and constraints of a successful solution?

The engineering design process begins with the identification of a problem to solve and the specification of clear goals, or criteria, that the final product or system must meet. Criteria, which typically reflect the needs of the expected end-user of a technology or process, address such things as how the product or system will function (what job it will perform and how), its durability, and its cost. Criteria should be quantifiable whenever possible and stated so that one can tell if a given design meets them.

Engineers must contend with a variety of limitations, or constraints, when they engage in design. Constraints, which frame the salient conditions under which the problem must be solved, may be physical, economic, legal, political, social, ethical, aesthetic, or related to time and place. In terms of quantitative measurements, constraints may include limits on cost, size, weight, or performance, for example. And although constraints place restrictions on a design, not all of them are permanent or absolute.

Grade Band End Points for ETS1.A

By the end of grade 2. A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. 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.

By the end of grade 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.

ETS1.B: DEVELOPING POSSIBLE SOLUTIONS

Essential Question: What is the process for developing potential design solutions?

The creative process of developing a new design to solve a problem is a central element of engineering. This process may begin with a relatively open-ended phase during which new ideas are generated both by individuals and by group processes such as brainstorming. Before long, the process must move to the specification of solutions that meet the criteria and constraints at hand. Initial ideas may be communicated through informal sketches or diagrams, although they typically become more formalized through models. The ability to build and use physical, graphical, and mathematical models is an essential part of translating a design idea into a finished product, such as a machine, building, or any other working system. Because each area of engineering focuses on particular types of systems (e.g., mechanical, electrical, biotechnological), engineers become expert in the elements that such systems need. But whatever their fields, all engineers use models to help develop and communicate solutions to design problems.

Models allow the designer to better understand the features of a design problem, visualize elements of a possible solution, predict a design's performance, and guide the development of feasible solutions (or, if possible, the optimal solution). A physical model can be manipulated and tested for parameters of interest, such as strength, flexibility, heat conduction, fit with other components, and durability. Scale models and prototypes are particular types of physical models. Graphical models, such as sketches and drawings, permit engineers to easily share and discuss design ideas and to rapidly revise their thinking based on input from others.

Mathematical models allow engineers to estimate the effects of a change in one feature of the design (e.g., material composition, ambient temperature) on other features, or on performance as a whole, before the designed product is actually built. Mathematical models are often embedded in computer-based simulations. Computer-aided design (CAD) and computer-aided manufacturing (CAM) are modeling tools commonly used in engineering.

Data from models and experiments can be analyzed to make decisions about modifying a design. The analysis may reveal performance information, such as which criteria a design meets, or predict how well the overall designed system or system component will behave under certain conditions. If analysis reveals that the predicted performance does not align with desired criteria, the design can be adjusted.

Grade Band Endpoints for ETS1.B

By the end of grade 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. To design something complicated, one may need to break the problem into parts and attend to each part separately but must then bring the parts together to test the overall plan.

By the end of grade 5. Research on a problem should be carried out—for example, through Internet searches, market research, or field observations—before beginning to design a solution. An often productive way to generate ideas is for people to work together to brainstorm, test, and refine possible solutions. Testing a solution involves investigating how well it performs under a range of likely conditions. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.

There are many types of models, ranging from simple physical models to computer models. They can be used to investigate how a design might work, communicate the design to others, and compare different designs.

A Closer Look at the Scope and Sequence
Kindergarten Unit 1

This is a **performance expectation**. Performance expectations describe what students should be able to do at the end of instruction and incorporates a science and engineering practice, a disciplinary core idea (DCI) and a crosscutting concept. Performance expectations are not instructional strategies or objectives for a lesson. Instead, they are intended to guide the development of assessments. Clarification statements and assessment boundary statements are provided in the original documents to render additional support and clarification of the performance expectation.

K-ESS2-1 K = grade level
ESS2 = Core Idea
1 = the number within the core idea (so this is the first performance expectation in the core idea ESS2)

K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.	
Science and Engineering Practice • **Analyzing and Interpreting Data** – Use observation to describe patterns in the natural world in order to answer scientific questions.	what they will do
Disciplinary Core Idea • **ESS2.D: Weather and Climate -** Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.	what they will understand
Crosscutting Concept • **Patterns** - Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.	how they will organize and connect their knowledge

BLUE VALLEY DISTRICT CURRICULUM

Science | Grade K

ORGANIZING THEME/TOPIC	FOCUS STANDARDS AND SKILLS
Weather and Climate **Bring Science Alive!** Unit 3: Weather Lessons 1 - 2 Suggested Time Frame: 25 days	**K-ESS2-1.** Use and share observations of local weather conditions to describe patterns over time. Science and Engineering Practice • **Analyzing and Interpreting Data** – Use observation to describe patterns in the natural world in order to answer scientific questions. Disciplinary Core Idea • **ESS2.D: Weather and Climate -** Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. Crosscutting Concept • **Patterns** - Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.
Sunlight **Bring Science Alive!** Unit 3: Weather Lessons 3 - 4 Suggested Time Frame: 17 days	**K-PS3-1.** Make observations to determine the effect of sunlight on Earth's surface. **K-PS3-2.** Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area. Science and Engineering Practices • **Planning and Carrying Out Investigations** – Make observations to collect data that can be used to make comparisons. • **Constructing Explanations and Designing Solutions –** Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. Disciplinary Core Idea • **PS3.B: Conservation of Energy and Energy Transfer -** Sunlight warms Earth's surface. Crosscutting Concept • **Cause and Effect** – Events have causes that generate observable patterns.

Severe Weather **Bring Science Alive!** Unit 3: Weather Lessons 5 - 6 Suggested Time Frame: 19 days	**K-ESS3-2.** **Ask questions to obtain information** about the purpose of **weather forecasting** to prepare for, and respond to, severe weather. **Science and Engineering Practices** • **Asking Questions and Defining Problems** – Ask questions based on observations to find more information about the designed world. • **Obtaining, Evaluating, and Communicating Information** - Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world. **Disciplinary Core Ideas** • **ESS3.B: Natural Hazards -** Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. • **ETS1.A: Defining and Delimiting an Engineering Problem –** Asking questions, making observations, and gathering information are helpful in thinking about problems. **Crosscutting Concepts** • **Cause and Effect –** Events have causes that generate observable patterns.
Plant and Animal Needs **Bring Science Alive!** Unit 1: Plants and Animals Lessons 1-3 Suggested Time Frame: 29 days	**K-LS1-1.** **Use observations to describe patterns of** what plants and animals (including humans) need to survive. **Science and Engineering Practice** • **Analyzing and Interpreting Data** - Use observations to describe patterns in the natural world in order to answer scientific questions. **Disciplinary Core Idea** • **LS1.C: Organization for Matter and Energy Flow in Organisms -** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. **Crosscutting Concepts** • **Patterns** – Patterns in the natural and human designed world can be observed and used as evidence.
Relationships: Plants, Animals and Places **Bring Science Alive!** Unit 1: Plants and Animals Lesson 4 Suggested Time Frame: 9 days	**K-ESS3-1.** **Use a model to represent the relationship between the needs** of different plants and animals (including humans) **and the places** they live. **Science and Engineering Practice** • **Developing and Using Models** – Use a model to represent relationships in the natural world. **Disciplinary Core Idea** • **ESS3.A: Natural Resources -** Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. **Crosscutting Concept** • **System and System Models** – Systems in the natural and designed world have parts that work together.

Changing the Environment **Bring Science Alive!** Unit 1: Plants and Animals Lessons 5 – 7 Suggested Time Frame: 34 days	**K-ESS2-2.** **Construct an argument supported by evidence for how plants and animals (including humans) can change the environment** to meet their needs. **Science and Engineering Practice** • **Engaging in Argument from Evidence** – Construct an argument with evidence to support a claim. **Disciplinary Core Idea** • **ESS2.E: Biogeology** - Plants and Animals can change their environment. **Crosscutting Concept** • **Systems and System Models** – Systems in the natural and designed world have parts that work together. **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. **Science and Engineering Practice** • **Obtaining, Evaluating, and Communicating Information** – Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. **Disciplinary Core Idea** • **ESS3.C: Human Impacts on Earth Systems** - Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. • **ETS1.B: Developing Possible Solutions –** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. **Crosscutting Concept** • **Cause and Effect** – Events have causes that generate observable patterns.

Push and Pull **Bring Science Alive!** Unit 2: Pushes and Pulls Lessons 1 - 5 Suggested Time Frame: 45 days	**K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.** **K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.** Science and Engineering Practice • **Planning and Carrying Out Investigations** - With guidance, plan and conduct an investigation in collaboration with peers. • **Analyzing and Interpreting Data** – Analyze data from tests on an object or tool to determine if it works as intended. Disciplinary Core Ideas • **PS2.A: Forces and Motion -** Pushes and pulls can have different strengths and directions. • **PS2.A: Forces and Motion** Pushing and pulling on an object can change the speed or direction of its motion and can start or stop it. • **PS2.B: Types of Interactions -** When objects touch or collide, they push on one another and can change motion. • **PS3.C: Relationship Between Energy and Forces -** A bigger push or pull makes things speed up or slow down more quickly. • **ETS1.A: Defining Engineering Problems –** A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. Crosscutting Concept • **Cause and Effect –** Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Materials for Investigations: It is recommended that you keep track of the materials you use throughout the year so that you can replenish the necessary materials for the following year. All expenses for materials will be paid for by the building. A unit by unit materials checklist is provided on our website.

TCI Kit Materials				Teacher/Student Provided Materials	
Consumables Materials		Non-Consumables Materials			
Aluminum foi, roll		Bowl, plastic, 6 quart		Scissors	
Balloons, round pkg/35		Box, cardboard		Stapler	
Cardboard, corrugated, 30 cmX 30 cm		Chips, counting , set/200		Washable Markers	
Clay, modeling, pkg. 4		Cloth, cotton		Yarn	
Cornstarch		Gravel		Glue Sticks	
Craft Sticks, pkg/30		Petri Dishes, pkg/6		Crayons/Markers	
cups, plastic, 9 ounce, pkg/50		Sand, medium grain		Poster paper	
Flour		Soil, potting		Large Lawn Bag	
Pipe Cleaners, pkg/100		Spoon, plastic mxing		Newspaper	
Plates, paper, pkg/50		Strainer		Pencils	
Stir Sticks, pkg/50				Water	
String, cotton				Paper Towels	
Tube, cardboard				Balls	
				Index Cards	
				Counting Chips	
				Construction Paper	
				Hole Punch	
				Tape	
				Construction Paper	
				Copy Paper	

Consumables are the materials that will need to be replenished yearly or bi-yearly. The cost of these materials will be covered through your building (Instructional expenses). Most of these items can be purchased at Wal-Mart or the Dollar Store. The highlighted item(s) will need to be purchased through Ward's Science at https://wardsci.com/.

Non-consumables are the materials that will be used over and over. However, sometimes things break or get lost so you may have to purchase something from this list at some point. Again, most things can be purchased at Wal-mart or the Dollar Store but some may need to be purchased through Ward's Science at https://wardsci.com/ .

Teacher/student provided materials are (for the most part) things that you have in your classroom already. Highlighted items will most likely need to be purchased for the investigations. They can be purchased at Wal-Mart or a hardware store.