Table of Contents

Callie Weitzel
caweitzel@bluevalleyk12.org
239-4268
Christie Purdon
cpurdon@bluevalleyk12.org
239-4375

http://bluevalleyscience.weebly.com/
http://www.teachtci.com/
http://www.bozemanscience.com/next-generation-science-standards/

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.

THIRD GRADE OVERVIEW

The performance expectations in third grade help students formulate answers to questions such as: "What is typical weather in different parts of the world and during different times of the year? How can the impact of weather-related hazards be reduced? How do organisms vary in their traits? How are plants, animals, and environments of the past similar or different from current plants, animals, and environments? What happens to organisms when their environment changes? How do equal and unequal forces on an object affect the object? How can magnets be used?" Third grade performance expectations include **PS2, LS1, LS2, LS3, LS4, ESS2, and ESS3** Disciplinary Core Ideas from the NRC Framework. Students are able to organize and use data to describe typical weather conditions expected during a particular season. By applying their understanding of weather-related hazards, students are able to make a claim about the merit of a design solution that reduces the impacts of such hazards. Students are expected to develop an understanding of the similarities and differences of organisms' life cycles. An understanding that organisms have different inherited traits, and that the environment can also affect the traits that an organism develops, is acquired by students at this level. In addition, students are able to construct an explanation using evidence for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. Students are expected to develop an understanding of types of organisms that lived long ago and also about the nature of their environments. Third graders are expected to develop an understanding of the idea that when the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. Students are able to determine the effects of balanced and unbalanced forces on the motion of an object and the cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. They are then able to apply their understanding of magnetic interactions to define a simple design problem that can be solved with magnets. The crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; 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 third grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems; developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and 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.

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.B: GROWTH AND DEVELOPMENT OF ORGANISMS

Essential Question: How do organisms grow and develop?

The characteristic structures, functions, and behaviors of organisms change in predictable ways as they progress from birth to old age. For example, upon reaching adulthood, organisms can reproduce and transfer their genetic information to their offspring. Animals engage in behaviors that increase their chances for reproduction, and plants may develop specialized structures and/or depend on animal behavior to accomplish reproduction.

Understanding how a single cell can give rise to a complex, multicellular organism builds on the concepts of cell division and gene expression. In multi-cellular organisms, cell division is an essential component of growth, development, and repair. Cell division occurs via a process called mitosis: when a cell divides in two, it passes identical genetic material to two daughter cells. Successive divisions produce many cells. Although the genetic material in each of the cells is identical, small differences in the immediate environments activate or inactivate different genes, which can cause the cells to develop slightly differently. This process of differentiation allows the body to form specialized cells that perform diverse functions, even though they are all descended from a single cell, the fertilized egg. Cell growth and differentiation are the mechanisms by which a fertilized egg develops into a complex organism. In sexual reproduction, a specialized type of cell division called meiosis occurs and results in the production of sex cells, such as gametes (sperm and eggs) or spores, which contain only one member from each chromosome pair in the parent cell.

Grade Band Endpoints for LS1.B

By the end of grade 2. Plants and animals have predictable characteristics at different stages of development. Plants and animals grow and change. Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.

By the end of grade 5. Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles that include being born (sprouting in plants), growing, developing into adults, reproducing, and eventually dying.

Core Idea LS2

Ecosystems: Interactions, Energy, and Dynamics

Essential Question: How and why do organisms interact with their environment and what are the effects of these interactions?

Ecosystems are complex, interactive systems that include both biological communities (biotic) and physical (abiotic) components of the environment. As with individual organisms, a hierarchal structure exists; groups of the same organisms (species) form populations, different populations interact to form communities, communities live within an ecosystem, and all of the ecosystems on Earth make up the biosphere. Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. These same interactions can facilitate or restrain growth and enhance or limit the size of populations, maintaining the balance between available resources and those who consume them. These interactions can also change both biotic and abiotic characteristics of the environment. Like individual organisms, ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system. Ecosystems are dynamic, experiencing shifts in population composition and abundance and changes in the physical environment over time, which ultimately affects the stability and resilience of the entire system.

LS2.C: ECOSYSTEM DYNAMICS, FUNCTIONING, AND RESILIENCE

Essential Question: What happens to ecosystems when the environment changes?

Ecosystems are dynamic in nature; their characteristics fluctuate over time, depending on changes in the environment and in the populations of various species. Disruptions in the physical and biological components of an ecosystem—which can lead to shifts in the types and numbers of the ecosystem's organisms, to the maintenance or the extinction of species, to the migration of species into or out of the region, or to the formation of new species (speciation)—occur for a variety of natural reasons. Changes may derive from the fall of canopy trees in a forest, for example, or from cataclysmic events, such as volcanic eruptions. But many changes are induced by human activity, such as resource extraction, adverse land use patterns, pollution, introduction of nonnative species, and global climate change. Extinction of species or evolution of new species may occur in response to significant ecosystem disruptions.

Species in an environment develop behavioral and physiological patterns that facilitate their survival under the prevailing conditions, but these patterns may be maladapted when conditions change or new species are introduced. Ecosystems with a wide variety of species—that is, greater biodiversity—tend to be more resilient to change than those with few species.

Grade Band Endpoints for LS2.C

By the end of grade 2. The places where plants and animals live often change, sometimes slowly and sometimes rapidly. When animals and plants get too hot or too cold, they may die. If they cannot find enough food, water, or air, they may die.

By the end of grade 5. When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.

LS2.D: SOCIAL INTERACTIONS AND GROUP BEHAVIOR

Essential Question: How do organisms interact in groups so as to benefit individuals?

Group behaviors are found in organisms ranging from unicellular slime molds to ants to primates, including humans. Many species, with a strong drive for social affiliation, live in groups formed on the basis of genetic relatedness, physical proximity, or other recognition mechanisms (which may be species specific). Group behavior evolved because group membership can increase the chances of survival for individuals and their relatives. While some groups are stable over long periods of time, others are fluid, with members moving in and out. Groups often dissolve if their size or operation becomes counterproductive, if dominant members lose their place, or if other key members are removed from the group. Group inter-dependence is so strong that animals that usually live in groups suffer, behaviorally as well as physiologically, when reared in isolation, even if all of their physical needs are met.

Grade Band Endpoints for LS2.D

By the end of grade 2. Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.

By the end of grade 5. Groups can be collections of equal individuals, hierarchies with dominant members, small families, groups of single or mixed gender, or groups composed of individuals similar in age. Some groups are stable over long periods of time; others are fluid, with members moving in and out. Some groups assign specialized tasks to each member; in others, all members perform the same or a similar range of functions.

Core Idea LS3

Heredity: Inheritance and Variation of Traits

Essential Questions: *How are characteristics of one generation passed to the next?*
How can individuals of the same species and even siblings have different characteristics?

Heredity explains why offspring resemble, but are not identical to, their parents and is a unifying biological principle. Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes. Genes encode the information for making specific proteins, which are responsible for the specific traits of an individual. Each gene can have several variants, called alleles, which code for different variants of the trait in question. Genes reside in a cell's chromosomes, each of which contains many genes. Every cell of any individual organism contains the identical set of chromosomes. When organisms reproduce, genetic information is transferred to their offspring. In species that reproduce sexually, each cell contains two variants of each chromosome, one inherited from each parent. Thus sexual reproduction gives rise to a new combination of chromosome pairs with variations between parent and offspring. Very rarely, mutations also cause variations, which may be harmful, neutral, or occasionally advantageous for an individual. Environmental as well as genetic variation and the relative dominance of each of the genes in a pair play an important role in how traits develop within an individual. Complex relationships between genes and interactions of genes with the environment determine how an organism will develop and function.

LS3.A: INHERITANCE OF TRAITS

Essential Question: How are the characteristics of one generation related to the previous generation?

In all organisms, the genetic instructions for forming species' characteristics are carried in the chromosomes. Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. DNA molecules contain four different kinds of building blocks, called nucleotides, linked together in a sequential chain. The sequence of nucleotides spells out the information in a gene. Before a cell divides, the DNA sequence of its chromosomes is replicated and each daughter cell receives a copy. DNA controls the expression of proteins by being transcribed into a "messenger" RNA, which is translated in turn by the cellular machinery into a protein. In effect, proteins build an organism's identifiable traits. When organisms reproduce, genetic information is transferred to their offspring, with half coming from each parent in sexual reproduction. Inheritance is the key factor causing the similarity among individuals in a species population.

Grade Band Endpoints for LS3.A

By the end of grade 2. Organisms have characteristics that can be similar or different. Young animals are very much, but not exactly, like their parents and also resemble other animals of the same kind. Plants also are very much, but not exactly, like their parents and resemble other plants of the same kind.

By the end of grade 5. Many characteristics of organisms are inherited from their parents. Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.

LS3.B: VARIATION OF TRAITS

Essential Question: Why do individuals of the same species vary in how they look, function, and behave?

Variation among individuals of the same species can be explained by both genetic and environmental factors. Individuals within a species have similar but not identical genes. In sexual reproduction, variations in traits between parent and offspring arise from the particular set of chromosomes (and their respective multiple genes) inherited, with each parent contributing half of each chromosome pair. More rarely, such variations result from mutations, which are changes in the information that genes carry. Although genes control the general traits of any given organism, other parts of the DNA and external environmental factors can modify an individual's specific development, appearance, behavior, and likelihood of producing offspring. The set of variations of genes present, together with the interactions of genes with their environment, determines the distribution of variation of traits in a population.

Grade Band Endpoints for LS3.B

By the end of grade 2. Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.

By the end of grade 5. Offspring acquire a mix of traits from their biological parents. Different organisms vary in how they look and function because they have different inherited information. In each kind of organism there is variation in the traits themselves, and different kinds of organisms may have different versions of the trait. The environment also affects the traits that an organism develops—differences in where they grow or in the food they consume may cause organisms that are related to end up looking or behaving differently.

Core Idea LS4

Biological Evolution: Unity and Diversity

Essential Questions: *How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms?*
How does biodiversity affect humans?

Biological evolution explains both the unity and the diversity of species and provides a unifying principle for the history and diversity of life on Earth. Biological evolution is supported by extensive scientific evidence ranging from the fossil record to genetic relationships among species. Researchers continue to use new and different techniques, including DNA and protein sequence analyses, to test and further their understanding of evolutionary relationships. Evolution, which is continuous and ongoing, occurs when natural selection acts on the genetic variation in a population and changes the distribution of traits in that population gradually over multiple generations. Natural selection can act more rapidly after sudden changes in conditions, which can lead to the extinction of species. Through natural selection, traits that provide an individual with an advantage to best meet environmental challenges and reproduce are the ones most likely to be passed on to the next generation. Over multiple generations, this process can lead to the emergence of new species. Evolution thus explains both the similarities of genetic material across all species and the multitude of species existing in diverse conditions on Earth—its biodiversity—which humans depend on for natural resources and other benefits to sustain themselves.

LS4.A: EVIDENCE OF COMMON ANCESTRY AND DIVERSITY

Essential Question: What evidence shows that different species are related?

Biological evolution, the process by which all living things have evolved over many generations from shared ancestors, explains both the unity and the diversity of species. The unity is illustrated by the similarities found betwen species; which can be explained by the inheritance of similar characteristics from related ancestors. The diversity of species is also consistent with common ancestry; it is explained by the branching and diversification of lineages as populations adapted, primarily through natural selection, to local circumstances.

Evidence for common ancestry can be found in the fossil record, from comparative anatomy and embryology, from the similarities of cellular processes and structures, and from comparisons of DNA sequences between species. The understanding of evolutionary relationships has recently been greatly accelerated by using new molecular tools to study developmental biology, with researchers dissecting the genetic basis for some of the changes seen in the fossil record, as well as those that can be inferred to link living species (e.g., the armadillo) to their ancestors (e.g., glyptodonts, a kind of extinct gigantic armadillo).

Grade Band Endpoints for LS4.A

By the end of grade 2. Some kinds of plants and animals that once lived on Earth (e.g., dinosaurs) are no longer found anywhere, although others now living (e.g., lizards) resemble them in some ways.

By the end of grade 5. Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and also about the nature of their environments. Fossils can be compared with one another and to living organisms according to their similarities and differences.

LS4.B: NATURAL SELECTION

Essential Question: How does genetic variation among organisms affect survival and reproduction?

Genetic variation in a species results in individuals with a range of traits. In any particular environment individuals with particular traits may be more likely than others to survive and produce offspring. This process is called natural selection and may lead to the predominance of certain inherited traits in a population and the suppression of others. Natural selection occurs only if there is variation in the genetic information within a population that is expressed in traits that lead to differences in survival and reproductive ability among individuals under specific environmental conditions. If the trait differences do not affect reproductive success, then natural selection will not favor one trait over others.

Grade Band Endpoints for LS4.B

By the end of grade 2. [Intentionally left blank.]

By the end of grade 5. Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.

LS4.C: ADAPTATION

Essential Question: How does the environment influence populations of organisms over multiple generations?

When an environment changes, there can be subsequent shifts in its supply of resources or in the physical and biological challenges it imposes. Some individuals in a population may have morphological, physiological, or behavioral traits that provide a reproductive advantage in the face of the shifts in the environment. Natural selection provides a mechanism for species to adapt to changes in their environment. The resulting selective pressures influence the survival and reproduction of organisms over many generations and can change the distribution of traits in the population. This process is called adaptation. Adaptation can lead to organisms that are better suited for their environment because individuals with the traits adaptive to the environmental change pass those traits on to their offspring, whereas individuals with traits that are less adaptive produce fewer or no offspring. Over time, adaptation can lead to the formation of new species. In some cases, however, traits that are adaptive to the changed environment do not exist in the population and the species becomes extinct. Adaptive changes due to natural selection, as well as the net result of speciation minus extinction, have strongly contributed to the planet's biodiversity.

Adaption by natural selection is ongoing. For example it is seen in the emergence of antibiotic-resistant bacteria. Organisms like bacteria, in which multiple generations occur over shorter time spans, evolve more rapidly than those for which each generation takes multiple years.

Grade Band Endpoints for LS4.C

By the end of grade 2. Living things can survive only where their needs are met. If some places are too hot or too cold or have too little water or food, plants and animals may not be able to live there.

By the end of grade 5. Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

LS4.D: BIODIVERSITY AND HUMANS

Essential Question: What is biodiversity, how do humans affect it, and how does it affect humans?

Human beings are part of and depend on the natural world. Biodiversity—the multiplicity of genes, species, and ecosystems—provides humans with renewable resources, such as food, medicines, and clean water. Humans also benefit from "ecosystem services," such as climate stabilization, decomposition of wastes, and pollination that are provided by healthy (i.e., diverse and resilient) ecosystems. The resources of biological communities can be used within sustainable limits, but in many cases humans affect these ecosystems in ways—including habitat destruction, pollution of air and water, overexploitation of resources, introduction of invasive species, and climate change—that prevent the sustainable use of resources and lead to ecosystem degradation, species extinction, and the loss of valuable ecosystem services.

Grade Band Endpoints for LS4.D

By the end of grade 2. There are many different kinds of living things in any area, and they exist in different places on land and in water.

By the end of grade 5. Scientists have identified and classified many plants and animals. Populations of organisms live in a variety of habitats, and change in those habitats affects the organisms living there. Humans, like all other organisms, obtain living and nonliving resources from their environments.

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.

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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.

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.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.

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						

A Closer Look at the Scope and Sequence
Third Grade 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.

3-ESS2-1 3 = grade level
ESS2 = Core Idea
1 = the number within the core idea (so this is the first performance expectation in the core idea ESS2)

3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.	
Science and Engineering Practice • **Analyzing and Interpreting Data** – Represent data in tables and various graphical displays to reveal patterns that indicate relationships.	what they will do
Disciplinary Core Idea • **ESS2.D: Weather and Climate –** Scientists record patterns of the weather across different times and areas.	what they will understand
Crosscutting Concept • **Patterns** - Patterns of change can be used to make predictions.	how they will organize and connect their knowledge

BLUE VALLEY DISTRICT CURRICULUM

Science | Grade 3

ORGANIZING THEME/TOPIC	FOCUS STANDARDS & SKILLS
Weather Patterns and Predictions **Bring Science Alive!** Unit 3: Weather and Climate Lessons 1 - 5 Suggested Time Frame: 39 days	**3-ESS2-1. Represent data in tables and graphical displays to describe** typical weather conditions **expected during a particular season**. **Science and Engineering Practice** • **Analyzing and Interpreting Data -** Represent data in tables and various graphical displays to reveal patterns that indicate relationships. **Disciplinary Core Idea** • **ESS2.D: Weather and Climate -** Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. **Crosscutting Concept** • **Patterns -** Patterns of change can be used to make predictions.
Climates of the World **Bring Science Alive!** Unit 3: Weather and Climate Lessons 6 Suggested Time Frame: 6 days	**3-ESS2-2**. **Obtain and combine information to describe climates in different regions** of the world. **Science and Engineering Practice** • **Obtaining, Evaluating, and Communicating Information -** Obtain and combine information from books and other reliable media to explain phenomena. **Disciplinary Core Idea** • **ESS2.D: Weather and Climate -** Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. **Crosscutting Concept** • **Patterns -** Patterns of change can be used to make predictions.

Weather Related Hazards **Bring Science Alive**! Unit 3: Weather and Climate Lessons 7-8 Suggested Time Frame: 13 days	**3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of** a weather-related hazard. **Science and Engineering Practice** • **Engaging in Argument from Evidence** - Make a claim about the merit of a solution to a problem by citing relevant evidence about hot it meets the criteria and constraints of the problem. **Disciplinary Core Idea** • **ESS3.B: Natural Hazards -** A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. **Crosscutting Concept** • **Cause and Effect -** Cause and effect relationships are routinely identified, tested, and used to explain change.
Balanced and Unbalanced Forces **Bring Science Alive!** Unit 2: Forces and Motion Lessons 1 - 2 Suggested Time Frame: 13 days	**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. **Science and Engineering Practice** • **Planning and Carrying Out Investigations -** Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. **Disciplinary Core Idea** • **PS2.A: Forces and Motion -** Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion**.** • **PS2.B: Types of Interactions -** Objects in contact exert forces on each other. **Crosscutting Concept** • **Cause and Effect -** Cause and effect relationships are routinely identified.
Predicting Motions **Bring Science Alive!** Unit 2: Forces and Motion Lesson 3 Suggested Time Frame: 7 days	**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. **Science and Engineering Practice** • **Planning and Carrying Out Investigations -** Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of phenomenon or test a design solution. **Disciplinary Core Idea** • **PS2.A: Forces and Motion -** The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. **Crosscutting Concept** • **Patterns -** Patterns of change can be used to make predictions.

Magnetism and Electricity **Bring Science Alive!** Unit 2: Forces and Motion Lessons 4- 5 Suggested Time Frame: 14 days	**3-PS2-3.** **Ask questions to determine cause and effect relationships** of electric or magnetic interactions between two objects not in contact with each other. **3-PS2-4.** **Define a simple design problem that can be solved by applying scientific ideas** about magnets. **Science and Engineering Practice** • **Asking Questions and Defining Problems -** Ask questions that can be investigated based on patterns such as cause and effect relationships. • **Asking Questions and Defining Problems -** Define a simple problem that can be solved through the development of a new or improved object or tool. **Disciplinary Core Idea** • **PS2.B: Types of Interactions -** Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. **Crosscutting Concept** • **Cause and Effect -** Cause and effect relationships are routinely identified, tested and used to explain change. • **Interdependence of Science, Engineering and Technology -** Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.

Survival of Organisms **Bring Science Alive!** Unit 1: Environments and Living Things Lessons 1 - 4 Suggested Time Frame: 28 days	**3-LS2-1.** **Construct an argument that** some animals **form groups that help** members survive. **Science and Engineering Practice** • **Engaging in Argument from Evidence -** Construct an argument with evidence, data, and/or a model **Disciplinary Core Idea** • **LS2.D: Social Interactions and Group Behavior -** Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. **Crosscutting Concept** • **Cause and Effect -** Cause and effect relationships are routinely identified and used to explain change. **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**. **Science and Engineering Practice** • **Engaging in Argument from Evidence -** Construct an argument with evidence. **Disciplinary Core Idea** • **LS4.C: Adaptation -** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. **Crosscutting Concept** • **Cause and Effect -** Cause and effect relationships are routinely identified and used to explain change. **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. **Science and Engineering Practice** • **Engaging in Argument from Evidence -** Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. **Disciplinary Core Idea** • **LS4.D: Biodiversity and Humans -** Populations live in a variety of habitats, and change in those habitats affects the organisms living there. • **LS2.C: Ecosystem Dynamics, Functioning, and Resilience -** When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. **Crosscutting Concept** • **Systems and System Models -** A system can be described in terms of its components and their interactions.

<table>
<tr>
<td>Fossils

Bring Science Alive!
Unit 1: Environments and Living Things
Lessons 5-6

Suggested Time Frame: 15 days</td>
<td>3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.

Science and Engineering Practice
• Analyzing and Interpreting Data - Analyze and interpret data to make sense of phenomena using logical reasoning.
Disciplinary Core Idea
• LS4.A: Evidence of Common Ancestry and Diversity - Some kinds of plants and animals that once lived on Earth are no longer found anywhere.
• LS4.A: Evidence of Common Ancestry and Diversity - Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.
Crosscutting Concept
• Scale, Proportion, and Quantity - Observable phenomena exist from very short to very long time periods.</td>
</tr>
<tr>
<td>Inheritance and Variation of Traits

Bring Science Alive!
Unit 4: Life Cycles and Traits
Lessons 1 - 3

Suggested Time Frame: 16 days</td>
<td>3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.

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

Science and Engineering Practice
• Analyzing and Interpreting Data - Analyze and interpret data to make sense of phenomena using logical reasoning.
• Constructing Explanations and Designing Solutions - Use evidence to support an explanation.
Disciplinary Core Idea
• LS3.A: Inheritance of Traits - Many characteristics of organisms are inherited from their parents.
• LS3.A: Inheritance of Traits - Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.
• LS3.B: Variation of Traits - Different organisms vary in how they look and function because they have different inherited information.
• LS3.A: Inheritance of Traits - The environment also affects the traits that an organism develops.
Crosscutting Concept
• Patterns - Similarities and differences in patterns can be used to sort and classify natural phenomena.
• Cause and Effect - Cause and effect relationships are routinely identified and used to explain change.</td>
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Natural Selection **Bring Science Alive!** Unit 4: Life Cycles and Traits Lesson 4 Suggested Time Frame: 6 days	**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. **Science and Engineering Practice** • **Constructing Explanations and Designing Solutions -** Use evidence to construct an explanation **Disciplinary Core Idea** • **LS4.B: Natural Selection -** Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. **Crosscutting Concept** • **Cause and Effect -** Cause and effect relationships are routinely identified and used to explain change.
Life Cycles **Bring Science Alive!** Unit 4: Life Cycles and Traits Lessons 5-7 Suggested Time Frame: 22 days	**3-LS1-1. Develop models to describe that** organisms have unique and diverse life cycles **but all have in common** birth, growth, reproduction, and death. **Science and Engineering Practice** • **Developing and Using Models -** Develop models to describe phenomena **Disciplinary Core Idea** • **LS1.B: Growth and Development of Organisms -** Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. **Crosscutting Concept** • **Patterns -** Patterns of change can be used to make predictions.

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 (provided in the initial kits)				**Teacher/Student Provided Materials**	
Consumables Materials		Non-Consumables Materials		Teacher/Student Provided Materials	
Clay, modeling, pkg. 4		Balls, hi bounce 1" pkg/6		Dark Markers	
Balloons, round pkg/35		Forceps, pkg/6		Pencils	
Yarn		Nails, pkg/15		Rulers	
Batteries, size D, pkg/6		Rain Gauge		Scissors	
Bowls, foam, 12 ounce, pkg/25		Bowl, plastic, 6 quart		Stapler	
Coupon, Butterfly Habitat and Larvae		Cloth, wool		Water	
Cups, paper, 200 mL, pkg/25		Spring Toy, metal		Masking Tape	
Cardboard, corrugated, 30 cmX 30 cm		Meter Stick, folding		Glue	
Aluminum foil, roll		Box, cardboard		Newspaper	
Paper clips, large, box/100		Battery Holder, size D		Construction paper	
String, cotton		Magnets, Bar, pkg/2		Paper Towels	
Wire, insulated copper		Pulley with table clamp		Notebook or Printer Paper	
		Spring Scale		Boxes or tubs for 8 ½ x 11 paper	
		Thermometer		Plastic Cup	
		Container, plastic deli		Sunflower Seeds Unshelled	
		Lid for plastic deli container		Sand	
		Washers, metal, 3/4", box/100		Audio Recording Device	
		Stopwatch		Art supplies	
		Bin, plastic, shoe box size		Prop Box Unit 3 (weather related)	
				Weather Station building materials (yarn, chairs, books, etc.)	
				Black Butcher Paper	
				White Butcher Paper	
				Hand Lenses (optional)	
				Prop Box Unit 1	
				Bed sheet or Shower curtain (optional)	

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.