

PS= Physical Science (Chemistry and Physics), LS=Life Science (Biology-Zoology, Botany), ES =Earth and Space Science (Geology, Environmental, Meteorology, Oceanography Astronomy)

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Disciplinary Core Idea (DCI) Arrangement of the Kettle Moraine Lutheran Federation Science Standards

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INTRODUCTION

Students in the Kettle Moraine Lutheran Federation know and believe that God created a working, perfect universe including the earth system in six twenty-four hour days and understand that God still preserves it today. This one absolute truth is the unifying connection between all science standards. Students in the KML Federation will understand that science is ongoing and inventive, and that scientific understandings have changed over time as new evidence is found. Students will also understand that while scientific understandings may change over time, God's Word is changeless. When studying a science-related problem, KML students will apply God's truths. They will predict future events or changes in the natural world, realizing that we are the caretakers of God's universe. They will state what they have learned from investigations, relating their inferences to Christian faith and scientific knowledge, and to the data they have collected. KML students will realize that the more they learn about science, the better they will understand God's universal organization. Students will understand science better when they connect and integrate the understandings and skills of the KML Science Standards into what they know about themselves, their faith, and the world around them.

The 2014 Kettle Moraine Lutheran Science Standards are based on the Next Generation Science Standards, a set of science standards adopted by many states of the U.S.A.. When portions of NGSS violated truths of Scripture, they were revised or explained so that they are consistent with our approach to scientific skills and truths as described above.

KML SCIENCE DEPARTMENT OUTCOMES

Graduates of the KML Federation will be:

1. GROWING CHRISTIANS who:
 - continue to study the changeless truths of Scripture.
 - evaluate changing scientific discoveries and theories in the light of God's Word.
2. PROCLAIMING CHRISTIANS who use God's truths to confidently and clearly share and defend their faith in God's creative work.
3. DISCERNING THINKERS who:
 - recognize the difference between God's unchanging Word and the relative truths of science.
 - identify, evaluate, integrate, and apply available scientific information and resources in solving problems.
4. SELF-DIRECTED and LIFELONG LEARNERS who research, evaluate, and use scientific information from a variety of sources to make God-pleasing decisions.
5. COLLABORATIVE CONTRIBUTORS who work both independently and cooperatively with their peers to solve problems.
6. SERVANT LEADERS who give glory to God by powerfully yet humbly influencing others by sharing and applying their scientific knowledge in service to God and others.
7. DEDICATED STEWARDS who:
 - thank God for his perfect creation.
 - recognize that the world was created for us to use to serve God and others.
 - properly care for God's creation.

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THREE DIMENSIONS

The National Research Council's (NRC) Framework describes a vision of what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence-based, model and theory building enterprise that continually extends, refines, and revises knowledge. It presents three dimensions that will be combined to form each standard:

Dimension 1: Practices

The practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems.

PRACTICES FOR K-12 SCIENCE CLASSROOMS

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Dimension 2: Crosscutting Concepts

Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. These concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields.

SEVEN CROSSCUTTING CONCEPTS OF THE FRAMEWORK

1. Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
2. Cause and effect: Mechanism and explanation. 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.
3. 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.
4. 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.
5. Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
6. Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
7. 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.

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Dimension 3: Disciplinary Core Ideas

Disciplinary core ideas have the power to focus K–12 science curriculum, instruction and assessments on the most important aspects of science.

Disciplinary Core Ideas

Physical Sciences

PS1: Matter and its interactions

PS2: Motion and stability: Forces and interactions

PS3: Energy

PS4: Waves and their applications in technologies for information transfer

Life Sciences

LS1: From molecules to organisms: Structures and processes

LS2: Ecosystems: Interactions, energy, and dynamics

LS3: Heredity: Inheritance and variation of traits

LS4: Biological evolution: Unity and diversity

Earth and Space Sciences

ESS1: Earth's place in the universe

ESS2: Earth's systems

ESS3: Earth and human activity

Engineering, Technology, and Applications of Science

ETS1: Engineering design

ETS2: Links among engineering, technology, science, and society

PHYSICAL SCIENCE - Students in the KML Federation will demonstrate an understanding of the order in God's physical creation. They will understand physical and chemical properties of matter, the storage modes of energy, and the ways in which matter and energy interact. God is a God of order, which he displays in all parts of his creation. Knowledge of this order and the systems which govern this order is basic to the study of all sciences. KML students will evaluate theories of atomic structure, develop an understanding of how matter and energy interact, and develop the ability to predict and describe physical and chemical changes that occur around us.

LIFE SCIENCE - Students in the KML Federation will understand the unity of structure and function in all of God's created beings. They will demonstrate an understanding of the characteristics and structures of living things, the processes of life, and how living things interact with one another and their environment. They will enhance their natural curiosity about living things and their environment through the study of the structure and function of living things, ecosystems, life cycles, energy movement, energy change, and changes in populations within a species. Students will appreciate the design of organisms by an all-powerful Creator. Understanding similar structures and processes in different organisms will demonstrate the unity of this design. The study of interactions between and among organisms and their environment will yield a special appreciation for and stimulate informed choices regarding the role of all of God's created things. Finally, KML students will recognize the vast responsibility that God has placed upon them as the crown of his creation to properly manage his creation and exercise stewardship regarding it.

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KML students will understand and evaluate the theory of evolution, natural selection, and biological classification in the light of the truths of God's Word. KML students will be able to clearly explain that from the Biblical account of creation in Genesis we know and believe that God created a mature Earth in six normal days with morning and evening.

Evolution means change. Scientific observations have shown that organisms have the ability to change and adapt. Evolution can be defined as the change in genetic material between generations. These changes can be attributed to mutations, gene flow and drift, and natural selection, which are examples of observational science and can be shown to occur. Recognizing these types of changes in organisms doesn't contradict the truths of the Biblical creation account.

Evolution is also known as a theory of the origin of life which has evolved from non-living molecules to the array of living things in the universe over millions or billions of years. KML students will recognize that this theory was developed by some scientists who reject the literal interpretation of the Biblical creation account. Others who ascribe to this theory deny the work of God (and anything beyond the material world). Using experimentally determined principles of genetics, KML students will account for the changes and variations that occur within living things. They will understand that when scientists use experimental evidence to extrapolate back in time they will draw different conclusions/interpretations depending on the assumptions they make and beliefs they have. KML students will learn these evolutionary principles to enable them to participate in higher level science education. Understanding the complexity of living organisms and the changes they undergo and knowing and believing the Biblical creation account will enable KML students to defend their faith and be better witnesses of our God's creative and redemptive work.

EARTH AND SPACE SCIENCE - Students in the KML Federation will demonstrate an understanding of the structure and systems of the Earth and other bodies in the universe and their interactions. By studying the Earth, its composition, history from creation, and the processes that continue to shape it, students gain a better understanding of the planet on which they live. In addition, all bodies in space: including the Earth, are influenced by forces acting throughout the solar system and the universe. Studying the universe and understanding geologic, oceanographic, meteorological, and astronomical processes give the students a greater knowledge and appreciation of the universe around them. KML students will describe God's power over nature as described in the Bible, comprehend that God created a working universe including the earth system in six twenty-four hour days and understand that God still preserves it today. They will contrast the theories of the evolution of the universe and evaluate them in the light of Scripture.

SCIENCE APPLICATIONS/ENGINEERING - Students in the KML Federation will demonstrate an understanding of the relationship between science and technology and the ways in which that relationship influences human activities. Science and technology complement each other. Science helps drive technology and technology provides science with tools for investigations, inquiry, and analysis. Together, science and technology applications provide solutions to human problems, needs, and aspirations. Students should understand that God has blessed our lives with advances in science and technology. KML students will evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of a problem KML students will also describe how major scientific and technological changes have impacted work,

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leisure, and the home and are blessings from God.

SCIENCE IN SOCIAL AND PERSONAL PERSPECTIVES - Students in the KML Federation will use scientific information and skills to make God-pleasing decisions about themselves, and the world in which they live. An important purpose of science education is to give students a means to understand and act on personal, economic, social, political, and international issues. Knowledge and methodology of earth and space, life and environmental, and physical sciences facilitate analysis of topics related to personal health, environment, and management of resources. This knowledge, together with Christian faith, helps students evaluate courses of action. KML students will identify when local and state issues, technology, and advancement of science interfere with God's plan for creation and suggest alternative approaches.

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By the end of eighth grade all KML students will be able to:

PHYSICAL SCIENCE

1. Develop a model to describe the **atomic composition** (relating to the periodic table of elements) of simple molecules and extended structures to predict results of chemical and physical changes and to explain how the total number of atoms does not change and thus mass is conserved.
2. Plan and carry out investigations to provide evidence that changes in an object's **motion** depend on the sum of the **forces** (gravitational, normal, tension, electric, magnetic) on the object, the mass of the object, and transfers of momentum from collisions and/or transfers of energy.
3. Develop a model that predicts and describes the relationships among the **energy transferred** to or from an object and the average kinetic energy of the object and its particles by the changes in motion and/or the state of matter.
4. Analyze and interpret data to describe how the characteristics (speed, frequency, wavelength, amplitude) of **waves** (light, sound, mechanical) are reflected, absorbed or transmitted through various materials to transmit energy and information.

EARTH SCIENCE

1. Use a mental model (deeply ingrained assumptions, generalizations or even pictures or images that influence how we understand the world and how we take action) of the **motion of the sun, Earth and moon** to explain seasons and eclipses.
2. Analyze and interpret data to explain how **water** influences weather, circulates in the ocean and shapes the Earth's surface.
3. Obtain, evaluate and communicate information regarding the ways in which **human activities impact Earth's systems and resources** (land, energy, minerals and water).

LIFE SCIENCE

1. Develop and use models to understand the structure and function of **cells, organs, tissues, organ systems, and whole organisms**.
2. Construct explanations for the **change in genetic materials** between generations of organisms.
3. Analyze and interpret data to provide evidence for the **effects of resource availability on the interactions of organisms with each other and the environment**.

INQUIRY ATTAINMENT TARGETS

1. I can describe how experimental evidence and creative thinking have been combined to provide a scientific explanation.
2. I choose an appropriate way to answer a scientific question.
3. I can select from a range of sources of information.
4. I can identify key factors in a fair test investigation.
5. I can make predictions using scientific knowledge and understanding
6. I can choose apparatus for a range of tasks and plan to use it effectively.
7. I can make a series of observations, comparisons or measurements with accuracy.
8. I am beginning to repeat observations and measurements, then offer simple explanations for any differences.
9. I can record observations and measurements systematically and, where appropriate, present data as line graphs.
10. I can draw conclusions linked to the evidence and am beginning to relate these to my scientific knowledge and understanding.
11. I can make practical suggestions about how my working methods could be improved.
12. I can use scientific language and conventions to share collected data.

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Elementary Standards

Students in kindergarten through fifth grade begin to develop an understanding of the four disciplinary core ideas: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s). The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain more complex phenomena in the four disciplines as they progress to middle school and high school. While the performance expectations shown in kindergarten through fifth grade couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

Kindergarten

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.

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, animals and 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.

K-2-ETS1 Engineering Design

Students who demonstrate understanding can:

- K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
- K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
- K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

K-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

- 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.** [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.]
- K-PS2-2. 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.*** [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]

K-PS3 Energy

Students who demonstrate understanding can:

- K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface.** [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.]
- K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.*** [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]

K-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

- K-LS1-1. Use observations to describe patterns of what plants, animals and humans need to survive.** [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]

K-ESS2 Earth's Systems

Students who demonstrate understanding can:

- K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.** [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.]
- K-ESS2-1. Construct an argument supported by evidence for how plants, animals and humans can change the environment to meet their needs.** [Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.]

K-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

- K-ESS3-1. Use a model to represent the relationship between the needs of different plants, animals and humans and the places they live.** [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]
- K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*** [Clarification Statement: Emphasis is on local forms of severe weather.]
- K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*** [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]

First Grade

The performance expectations in first grade help students formulate answers to questions such as: “What happens when materials vibrate? What happens when there is no light? What are some ways plants and animals meet their needs so that they can survive and grow? How are parents and their children similar and different? What objects are in the sky and how do they seem to move?” First grade performance expectations include PS4, LS1, LS3, and ESS1 Disciplinary Core Ideas from the NRC Framework. Students are expected to develop understanding of the relationship between sound and vibrating materials as well as between the availability of light and ability to see objects. The idea that light travels from place to place can be understood by students at this level through determining the effect of placing objects made with different materials in the path of a beam of light. Students are also expected to develop understanding of how plants and animals use their external parts to help them survive, grow, and meet their needs as well as how behaviors of parents and offspring help the offspring survive. The understanding is developed that young plants and animals are like, but not exactly the same as, their parents. Students are able to observe, describe, and predict some patterns of the movement of objects in the sky. The crosscutting concepts of patterns; cause and effect; structure and function; 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 first grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

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

Students who demonstrate understanding can:

- 1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.** [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]
- 1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.** [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]
- 1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.** [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]
- 1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*** [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string “telephones,” and a pattern of drum beats.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]

1-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*

[Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.]

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

[Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]

1-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.] [Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.]

1-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

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

[Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.]

1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year. [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.]

K-2-ETS1 Engineering Design

Students who demonstrate understanding can:

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Second Grade

The performance expectations in second grade help students formulate answers to questions such as: “How does land change and what are some things that cause it to change? What are the different kinds of land and bodies of water? How are materials similar and different from one another, and how do the properties of the materials relate to their use? What do plants need to grow? How many types of living things live in a place?” Second grade performance

expectations include PS1, LS2, LS4, ESS1, ESS2, and ETS1 Disciplinary Core Ideas from the NRC Framework. Students are expected to develop an understanding of what plants need to grow and how plants depend on animals for seed dispersal and pollination. Students are also expected to compare the diversity of life in different habitats. An understanding of observable properties of materials is developed by students at this level through analysis and classification of different materials. Students are able to apply their understanding of the idea that wind and water can change the shape of the land to compare design solutions to slow or prevent such change. Students are able to use information and models to identify and represent the shapes and kinds of land and bodies of water in an area and where water is found on Earth. The crosscutting concepts of patterns; cause and effect; energy and matter; structure and function; stability and change; 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 second grade performance expectations, students are expected to demonstrate grade- appropriate proficiency in 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.

2-PS1 Matter and its Interactions

Students who demonstrate understanding can:

- 2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.** [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]
- 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]
- 2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.** [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]
- 2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.** [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

2-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

- 2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.** [Assessment Boundary: Assessment is limited to testing one variable at a time.]
- 2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.***

2-LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

- 2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.** [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]

2-ESS1 Earth's Place in the Universe

- 2-ESS1-1. Make observations from media to construct an evidence-based account that Earth events can occur quickly or slowly.** [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.]

2-ESS2 Earth's Systems

- 2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*** [Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]
- 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.** [Assessment Boundary: Assessment does not include quantitative scaling in models.]
- 2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.**

K-2-ETS1 Engineering Design

Students who demonstrate understanding can:

- K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
- K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
- K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education

Third Grade

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 may also affect the traits that get passed on to future generations, 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. 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.

3-5 ETS1 – Engineering and Design

Students who demonstrate understanding can:

- 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.**
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**
- 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**

3-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

- 3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.]
- 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]
- 3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]
- 3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.** [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

3-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

- 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.** [Clarification Statement: Changes organisms go through during their life form a pattern.] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.]

3-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

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

3-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

- 3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.** [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does

not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.]

- 3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.** [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]

3-LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

- 3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived.** [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms. When conclusions drawn from the analysis of fossils through fallible scientific methods are proposed, we put our faith in the truths of Scripture.] [Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types.]
- 3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.** [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]
- 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.** [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]
- 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 be affected.*** [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

3-ESS2 Earth's Systems

Students who demonstrate understanding can:

- 3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data at this grade level could include average temperature, precipitation, and wind direction.] [Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.]
- 3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.**

3-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

- 3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*** [Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.]

Fourth Grade

The performance expectations in fourth grade help students formulate answers to questions such as: "What are waves and what are some things they can do? How can water, ice, wind and vegetation change the land? What patterns of Earth's features can be determined with the use of maps? How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals? What is energy and how is it related to motion? How is energy transferred? How can energy be used to solve a problem?" Fourth grade performance expectations include PS3, PS4, LS1, ESS1, ESS2, ESS3, and ETS1 Disciplinary Core Ideas from the NRC Framework. Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move. Students are expected to develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. Fourth graders are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of patterns; cause and effect; energy and matter; 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 fourth grade 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, 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.

3-5 ETS1 – Engineering and Design

Students who demonstrate understanding can:

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

4-PS3 Energy

Students who demonstrate understanding can:

- 4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.** [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]
- 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** [Assessment Boundary: Assessment does not include quantitative measurements of energy.]
- 4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]
- 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]

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

Students who demonstrate understanding can:

- 4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]
- 4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.**
[Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]
- 4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.***
[Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

4-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

- 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]
- 4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.** [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

4-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

- 4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape.** [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock. These changes to the Earth God created may be the rapid result of events like flooding, earthquakes or volcanic eruptions or slow changes since Creation due to the movement of glaciers or erosion caused by wind and water.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers.]

4-ESS2 Earth's Systems

Students who demonstrate understanding can:

- 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]
- 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

4-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

- 4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]
- 4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

Fifth Grade

The performance expectations in fifth grade help students formulate answers to questions such as: “When matter changes, does its weight change? How much water can be found in different places on Earth? Can new substances be created by combining other substances? How does matter cycle through ecosystems? Where does the energy in food come from and what is it used for? How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?”

Fifth grade performance expectations include PS1, PS2, PS3, LS1, LS2, ESS1, ESS2, and ESS3 Disciplinary Core Ideas from the NRC Framework. Students are able to describe that matter is made of particles too small to be seen through the development of a model. Students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved. Students determine whether the mixing of two or more substances results in new substances. Through the development of a model using an example, students are able to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. They describe and graph data to provide evidence about the distribution of water on Earth. Students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment and that energy in animals’ food was once energy from the sun. Students are expected to develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. The crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; energy and matter; and systems and systems models are called out as organizing concepts for these disciplinary core ideas. In the fifth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, engaging in argument from evidence, and obtaining, evaluating, and communicating information; and to use these practices to demonstrate understanding of the core ideas.

3-5 ETS1 – Engineering and Design

Students who demonstrate understanding can:

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

5-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

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

[Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]

5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that forms new substances.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.]

5-PS1-3. Make observations and measurements to identify materials based on their properties. [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]

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

5-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

- 5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.** [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]

5-PS3 Energy

Students who demonstrate understanding can:

- 5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.** [Clarification Statement: Examples of models could include diagrams, and flow charts.]

5-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

- 5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.** [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]

5-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

- 5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.** [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

5-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

- 5-ESS1-1. Support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth.** [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]
- 5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [Assessment Boundary: Assessment does not include causes of seasons.]

5-ESS2 Earth Systems

Students who demonstrate understanding can:

- 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]
- 5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]

5-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

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

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education.

Middle School Physical Science

Students in middle school continue to develop understanding of four core ideas in the physical sciences. The middle school performance expectations in the Physical Sciences build on the K – 5 ideas and capabilities to allow learners to explain phenomena central to the physical sciences but also to the life sciences and earth and space science. The performance expectations in physical science blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain real world phenomena in the physical, biological, and earth and space sciences. In the physical sciences, performance expectations at the middle school level focus on students developing understanding of several scientific practices. These include developing and using models, planning and conducting investigations, analyzing and interpreting data, using mathematical and computational thinking, and constructing explanations; and to use these practices to demonstrate understanding of the core ideas. Students are also expected to demonstrate understanding of several of engineering practices including design and evaluation.

The performance expectations in **PS1: Matter and its Interactions** help students to formulate an answer to the question, “How do atomic and molecular interactions explain the properties of matter that we see and feel?” by building understanding of what occurs at the atomic and molecular scale. In middle school, the PS1 Disciplinary Core Idea from the NRC Framework is broken down into two sub-ideas: the structure and properties of matter, and chemical reactions. By the end of middle school, students will be able to apply understanding that pure substances have characteristic physical and chemical properties and are made from a single type of atom or molecule. They will be able to provide molecular level accounts to explain states of matters and changes between states, that chemical reactions involve regrouping of atoms to form new substances, and that atoms rearrange during chemical reactions. Students are also able to apply an understanding of the design and the process of optimization in engineering to chemical reaction systems. The crosscutting concepts of patterns; cause and effect; scale, proportion and quantity; energy and matter; structure and function; interdependence of science, engineering, and technology; and influence of science, engineering and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the PS1 performance expectations, students are expected to demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information. Students use these scientific and engineering practices to demonstrate understanding of the disciplinary core ideas.

The performance expectations in **PS2: Motion and Stability: Forces and Interactions** focuses on helping students understand ideas related to why some objects will keep moving, why objects fall to the ground and why some materials are attracted to each other while others are not. Students answer the question, “How can one describe physical interactions between objects and within systems of objects?” At the middle school level, the PS2 Disciplinary Core Idea from the NRC Framework is broken down into two sub-ideas: Forces and Motion and Types of interactions. By the end of middle school, students will be able to apply Newton’s Third Law of Motion to relate forces to explain the motion of objects. Students also apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while others repel. In particular,

students will develop understanding that gravitational interactions are always attractive but that electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Students are also able to apply an engineering practice and concept to solve a problem caused when objects collide. The crosscutting concepts of cause and effect; system and system models; stability and change; and the influence of science, engineering, and technology on society and the natural world serve as organizing concepts for these disciplinary core ideas. In the PS2 performance expectations, students are expected to demonstrate proficiency in asking questions, planning and carrying out investigations, and designing solutions, and engaging in argument; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **PS3: Energy** help students formulate an answer to the question, "How can energy be transferred from one object or system to another?" At the middle school level, the PS3 Disciplinary Core Idea from the NRC Framework is broken down into four sub-core ideas: Definitions of Energy, Conservation of Energy and Energy Transfer, the Relationship between Energy and Forces, and Energy in Chemical Process and Everyday Life. Students develop their understanding of important qualitative ideas about energy including that the interactions of objects can be explained and predicted using the concept of transfer of energy from one object or system of objects to another, and the total change of energy in any system is always equal to the total energy transferred into or out of the system. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions in a field. Students will also come to know the difference between energy and temperature, and begin to develop an understanding of the relationship between force and energy. Students are also able to apply an understanding of design to the process of energy transfer. The crosscutting concepts of scale, proportion, and quantity; systems and system models; and energy are called out as organizing concepts for these disciplinary core ideas. The performance expectations in PS3 expect students to demonstrate proficiency in developing and using models, planning investigations, analyzing and interpreting data, and designing solutions, and engaging in argument from evidence; and to use these practices to demonstrate understanding of the core ideas in PS3.

The performance expectations in **PS4: Waves and Their Applications in Technologies for Information Transfer** help students formulate an answer to the question, "What are the characteristic properties of waves and how can they be used?" At the middle school level, the PS4 Disciplinary Core Idea from the NRC Framework is broken down into Wave Properties, Electromagnetic Radiation, and Information Technologies and Instrumentation. Students are able to describe and predict characteristic properties and behaviors of waves when the waves interact with matter. Students can apply an understanding of waves as a means to send digital information. The crosscutting concepts of patterns and structure and function are used as organizing concepts for these disciplinary core ideas. The performance expectations in PS4 focus on students demonstrating proficiency in developing and using models, using mathematical thinking, and obtaining, evaluating and communicating information; and to use these practices to demonstrate understanding of the core ideas.

Middle School Life Science

Students in middle school develop understanding of key concepts to help them make sense of life science. The ideas build upon students' science understanding from earlier grades and from the disciplinary core ideas, science and engineering practices, and crosscutting concepts of other experiences with physical and earth sciences. There are four life science disciplinary core ideas in middle school: 1) From Molecules to Organisms: Structures and Processes, 2) Ecosystems: Interactions, Energy, and Dynamics, 3) Heredity: Inheritance and Variation of Traits, 4) Biological Evolution: Unity and Diversity. The performance expectations in middle school blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge across the science disciplines. While the performance expectations in middle school life science couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many science and engineering practices integrated in the performance expectations.

The performance expectations in **LS1: From Molecules to Organisms: Structures and Processes** help students formulate an answer to the question, "How can one explain the ways cells contribute to the function of living organisms." The LS1 Disciplinary Core Idea from the NRC Framework is organized into four sub-ideas: Structure and Function, Growth and Development of Organisms, Organization for Matter and Energy Flow in Organisms, and Information Processing. Students can gather information and use this information to support explanations of the structure and function relationship of cells. They can communicate understanding of cell theory. They have a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organism. The understanding of cells provides a context for the plant process of photosynthesis and the movement of matter and energy needed for the cell. Students can construct an explanation for how environmental and genetic factors affect growth of organisms. They can connect this to the role of animal behaviors in reproduction of animals as well as the dependence of some plants on animal behaviors for their reproduction. Crosscutting concepts of cause and effect, structure and function, and matter and energy are called out as organizing concepts for the core ideas about processes of living organisms.

The performance expectations in **LS2: Interactions, Energy, and Dynamics Relationships in Ecosystems** help students formulate an answer to the question, "How does a system of living and non-living things operate to meet the needs of the organisms in an ecosystem?" The LS2 Disciplinary Core Idea is divided into three sub-ideas: Interdependent Relationships in Ecosystems; Cycles of Matter and Energy Transfer in Ecosystems; and Ecosystem Dynamics, Functioning, and Resilience. Students can analyze and interpret data, develop models, and construct arguments and demonstrate a deeper understanding of resources and the cycling of matter and the flow of energy in ecosystems. They can also study patterns of the interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on population. They evaluate competing design solutions for maintaining biodiversity and ecosystem services.

The performance expectations in **LS3: Heredity: Inheritance and Variation of Traits** help students formulate an answer to the question, "How do living organisms pass traits from one generation to the next?" The LS3 Disciplinary Core Idea from the NRC Framework includes two sub-ideas: Inheritance of Traits, and Variation of Traits. Students can use models to describe

ways gene mutations and sexual reproduction contribute to genetic variation. Crosscutting concepts of cause and effect and structure and function provide students with a deeper understanding of how gene structure determines differences in the functioning of organisms.

LS4: Evaluating Evolutionary Theory in the Light of God's Word

Knowing the truths of Scripture, KML Federation elementary school students will understand and evaluate the theory of evolution, natural selection, and biological classification. Using accepted concepts of genetics, KML Federation elementary school students can provide a scientific explanation for the observable changes and variations that occur within a species.

The performance expectations in **LS4** will help students assess proposed scientific answers to the question, "What evidence shows that different species are related?" in the light of God's Word and through scientific methods. The LS4 Disciplinary Core Idea involves four sub-ideas: Evidence of Common Ancestry and Diversity, Natural Selection, Adaptation, and Biodiversity and Humans. Students will be able to use Biblical truths to critique explanations for genetic variations, processes of natural selection and evolution. Additionally, students can explain changes in the populations of species by identifying traits necessary for surviving in a specific environment. The crosscutting concepts of cause and effect and systems and system models play an important role in students' understanding of the ability of living things to adapt to their surroundings. KML Federation elementary students will be discerning thinkers equipped to effectively evaluate scientific theories regarding the changes that occur in living things using their faith in God's Word as the ultimate source of truth and the final authority in all aspects of their lives.

Middle School Earth and Space Sciences

Students in middle school continue to develop their understanding of the three disciplinary core ideas in the Earth and Space Sciences. The middle school performance expectations in Earth Space Science build on the elementary school ideas and skills and allow middle school students to explain more in-depth phenomena central not only to the earth and space sciences, but to life and physical sciences as well. These performance expectations blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain ideas across the science disciplines. While the performance expectations shown in middle school earth and space science couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

The performance expectations in **ESS1: Earth's Place in the Universe**, help KML students formulate an answer to the question: "What is Earth's place in the Universe, What makes up our solar system and how can the motion of Earth explain seasons and eclipses, and How do people figure out that the Earth and life on Earth have changed through time?" The ESS1 Disciplinary Core Idea from the NRC Framework is broken down into three sub-ideas: the universe and its stars, Earth and the solar system and the history of planet Earth. Students examine the Earth's place in relation to the solar system, Milky Way galaxy, and universe. KML students will study the history of the Earth starting with the inerrant historical account found in the Bible in which God tells us that He created the earth in six solar days (*Exodus 20:11 In six days the Lord made the heavens and the earth, the sea, and all that is in them.*) and that He sent a global flood as he promised (*Genesis 6:17 I am going to bring floodwaters on the earth to destroy all life under the heavens, every creature that has the breath of life in it. Everything on earth will perish.*). Scientific methods can be used to study God's created universe today. Engineering and technology play a large role in obtaining and analyzing data. Scientists and KML students examine this data to understand the workings of the solar system and universe. There is a strong emphasis on a systems approach, using models of the solar system to explain astronomical and other observations of the cyclic patterns of eclipses, tides, and seasons. There is also a strong connection to engineering through the instruments and technologies that have allowed us to explore the objects in our solar system and obtain the data that support the theories that explain the formation and evolution of the universe. Students examine geoscience data in order to understand the processes and events in Earth's history. The crosscutting concepts of patterns, scale, proportion, and quantity, and systems and systems modeling are called out as organizing concepts for these disciplinary core ideas. In the ESS1 performance expectations, students are expected to demonstrate proficiency in developing and using models, analyzing data, and constructing explanations and designing solutions; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **ESS2: Earth's Systems**, help students formulate an answer to questions such as: "How do the materials in and on Earth's crust change over time, How does the movement of tectonic plates impact the surface of Earth, How does water influence weather, circulate in the oceans, and shape Earth's surface, What factors interact and influence weather, and How have living organisms changed the Earth and how have Earth's changing conditions impacted living organisms?" The ESS2 Disciplinary Core Idea from the NRC Framework is broken down into five sub-ideas: Earth materials and systems, plate tectonics and large-scale system interactions, the roles of water in Earth's surface processes, weather and

climate, and biogeology. Students understand how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. Students investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data. Of special importance in both topics are the ways that geoscience processes provide resources needed by society but also cause natural hazards that present risks to society; both involve technological challenges, for the identification and development of resources. Students develop understanding of the factors that control weather. A systems approach is also important here, examining the feedbacks between systems as

energy from the sun is transferred between systems and circulates through the ocean and atmosphere. The crosscutting concepts of patterns, cause and effect, scale proportion and quantity, systems and system models, energy and matter, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the ESS2 performance expectations, students are expected to demonstrate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, and constructing explanations; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **ESS3: Earth and Human Activity** help students formulate an answer to questions such as: "How is the availability of needed natural resources related to naturally occurring processes, How can natural hazards be predicted, How do human activities affect Earth systems, How do we know our global climate is changing?" The ESS3 Disciplinary Core Idea from the NRC Framework is broken down into four sub-ideas: natural resources, natural hazards, human impact on Earth systems, and global climate change. Students understand the ways that human activities impacts Earth's other systems. Students use many different practices to understand the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts of their development. The crosscutting concepts of patterns, cause and effect, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the ESS3 performance expectations, students are expected to demonstrate proficiency in asking questions, developing and using models, analyzing and interpreting data, constructing explanations and designing solutions and engaging in argument; and to use these practices to demonstrate understanding of the core ide

MS-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

- MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]
- MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.** [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with HCl.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]
- MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]
- MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.** [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]
- MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.**[Clarification: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.][Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]
- MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*** [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device]

MS-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

- MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*** [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]
- MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]
- MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.** [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]
- MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.** [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]
- MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.]

MS-PS3 Energy

Students who demonstrate understanding can:

- MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.** [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]
- MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.** [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]
- MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*** [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]
- MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]
- MS-PS3-5. Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

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

Students who demonstrate understanding can:

- MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.** [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]
- MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.** [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]
- MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.** [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]

MS-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

- MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.** [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living cells, and understanding that living things may be made of one cell or many and varied cells.]
- MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.** [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]
- MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.** [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]
- MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.** [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds; and, creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]
- MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.** [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]
- MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.** [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]

- MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.** [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]
- MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.** [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]
- MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.** [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]
- MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]
- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.** [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]
- MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*** [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

MS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

- MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may have an impact on the structure and function in the organism.** [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]
- MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.** [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

MS-LS4 Biological Evolution: Unity and Diversity

In order to best prepare our students to be discerning thinkers, effectively proclaiming their faith, KML strives to expose our students to the current theories of the scientific community. Scripture is the foundation of Truth. When scientific conclusions and theories contradict these truths, KML students will reject those theories and rely on their faith in the inerrant Word of God. KML students will also evaluate data with scientific methods, understanding that these methods have limits and that data can be interpreted in multiple ways depending on the assumptions that a scientist makes.

Below are the standards, science and engineering practices, disciplinary core ideas and crosscutting concepts surrounding biological evolution as published in the Next Generation Science Standards (NGSS). KML students will not be expected to meet these specific standards, but will be equipped to evaluate the evidence proposed to support these statements in light of God's Word.

Students who demonstrate understanding can:

- MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.** [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]
- MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.** [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]
- MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.** [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]
- MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.** [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]
- MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.** [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]
- MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.** [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.]

MS-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

- MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.** [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]
- MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.** [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as their school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]
- MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.** [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.]
- MS-ESS1-4. Utilize the historical account found in Scripture to evaluate assumptions that are used to draw conclusions about Earth's history.** [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Frequently, incorrect assumptions result in incorrect conclusions as scientists analyze the rock strata and develop geologic time scales. For example, the assumption that the Earth was formed by natural process and has changed at a uniform rate since its formation results in the conclusion that the Earth has been evolving for millions of years.]

MS-ESS2 Earth's Systems

Students who demonstrate understanding can:

- MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.** [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]
- MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.** [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]
- MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.** [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]
- MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.** [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]
- MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.** [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]
- MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.** [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]

MS-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

- MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.** [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]
- MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.** [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]
- MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.** [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]
- MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.** [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]
- MS-ESS3-5. Ask questions to evaluate evidence of the factors that have caused the rise in global temperatures over the past century.** [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperature.]

MS-ETS1 Engineering Design

Students who demonstrate understanding can:

- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**

- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**

- MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.**

- MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.**