Science Scope & Sequence

Grades Pre-K to 5

Science – Pre-K

Because the NGSS program does not include Pre-K, we have adopted the Head Start Science approach, which is aligned to the National Science Education Standards of 1996.

The National Science Education Standards (National Research Council 1996) uses four basic categories: life science, physical science, earth/space science, and scientific inquiry. (Three other content areas focus on science and technology, science in personal and social perspectives, and the history and nature of science. However, these content areas are less relevant to young children's education).
Science for preschoolers can provide opportunities to experience and explore major concepts in the four categories and build a foundation for later learning:

- In the *life sciences*, major concepts include living and non-living, basic needs, the life cycle, diversity and variation and habitats.
- In *physical science*, as children explore structures, water, shadows, prisms and rolling things, they experience concepts including properties of objects and solid and liquid materials; how things move; and characteristics of sound and light.
- In *earth and space science*, as children investigate their environment, they begin to observe more closely what is under their feet such as soil, sand and human-made surfaces. As they look upwards, they notice the sky and the changes that take place and the seeming movement of the sun and moon.
- *Inquiry skills* are part of all that children do as they explore their world. They use their senses to observe and gather data; they think about their experiences and form new ideas; and they communicate what they are learning.

As well as the specific content of science, there are unifying themes and processes that span the sciences. These include change, patterns, and cause and effect. Regardless of the focus of children's exploration—whether in the life, physical, or earth/space sciences —teachers can highlight these themes. Watching plants grow and nails rust can be talked about in terms of change. A tap on a ball causes it to roll; a large block placed on top of a structure may cause it to fall. Using the language of cause and effect introduces children to this theme in the context of their work and play.

An effective science program is integrated with the total life of the classroom (Education Development Center [EDC] 2001). Teaching teams promote science knowledge through the intentional, careful planning of the environment, preparing focused learning experiences, extending children's play, and creating an integrated curriculum. Children can learn science when they wash a greasy dish, scoop out the insides of a pumpkin, ride down a slope on a tricycle or sled, or watch ants on a sidewalk. Children can also learn science when working with math and computers or when reading.

Guidelines	Physical Science	Earth & Space (Integrate with Social Studies 'Geography')	Life Sciences
Big Idea	The properties of materials affect how they are used.	Our weather changes over time.	We share our world with other living things.
Prompts to help create class understandings	• Materials have different properties • Materials can be classified according to their properties • Which properties are useful for different purposes	• Weather is observed in the sky and the air around us • Weather can be measured • Weather can be predicted	• What I can see around me • People and the environment are interdependent • Living and non-living things
Enduring understandings (Disciplinary Core Ideas)	• All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size or amount of substance).	• Earth's systems continually interact at different rates of time, affecting the Earth locally and globally • Water, energy from the sun, and wind are the main drivers of changing weather.	• People and the environment are interdependent • Everything around us is a living or nonliving thing. • Human beings are living things • Living things grow, eat, move, breathe, and change over time. • Some living things may not have all the above characteristics e.g plants.
Cross-cutting concepts	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 preschool 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.		

Science – KG (NGSS)

Guidelines	Forces and Interactions: Pushes and Pulls	Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment	Weather and Climate	Engineering Design
Big Idea	Forces help us to move and make things work.	Ecosystems are made up of living things that are interdependent in order to thrive.	Weather has an impact on our lives and environment.	People design and manipulate resources in order to satisfy needs and wants.
Essential questions	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?	This 'Engineering Design' column is not meant to guide a stand-alone unit of work on engineering. The understandings and benchmarks are designed to prompt teacher thinking about how to incorporate the principles of good engineering into the strands.
Prompts to help create class understandings	• What makes our body parts move? • What makes things move? • What makes things stop moving? • What happens if you push or pull harder? • How do you make something move in the direction you want it to?	• What do we need to live and grow? • How do we use other animals? • How do we use plants? • What do plants need to live? • How do we change the places where we live? • Why do we change the places where we live?	• What does the sun do to our sandpit? • How can we change the effect of the sun on our sandpit? • In what ways does the weather change in Yaoundé? • What are the warmest and coolest times of day? • What are the weather trends in Yaoundé over time?	• Why do we organise and store things in our classroom? • How do we organise and store things in our classroom? • Design another way to arrange our room.
Enduring understandings (Disciplinary Core Ideas)	**Forces and Motion** • Pushes and pulls can have different strengths and directions. • Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. **Types of Interactions** When objects touch or collide, they push on one another and can change motion. **Relationship Between Energy and Forces** A bigger push or pull makes things speed up or slow down more quickly. **Defining Engineering Problems** A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.	**Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. **Biogeology** Plants and animals can change their environment. **Natural Resources** Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. **Human Impacts on Earth Systems** Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. **Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**Conservation of Energy and Energy Transfer** Sunlight warms Earth's surface. **Weather and Climate** Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. **Natural Hazards** Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. **Defining and Delimiting an Engineering Problem** Asking questions, making observations, and gathering information are helpful in thinking about problems.	**Defining and Delimiting Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution, it is important to clearly understand the problem. **Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. **Optimizing the Design Solution** Because there is always more than one possible solution to a problem, it is useful to compare and test designs.
Cross-cutting concepts	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.			
Benchmarks	**Students who demonstrate understanding can:** • 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:	**Students who demonstrate understanding can:** • Use observations to describe patterns of what plants and animals (including 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.] • Construct an argument supported by evidence for	**Students who demonstrate understanding can:** • 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.] • Use tools and materials to design and build a structure that will reduce the warming effect of	**Students who demonstrate understanding can:** • 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. • 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. • Analyze data from tests of two objects designed to

	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.] • 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.]	how plants and animals (including 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.] • Use a model to represent the relationship between the needs of different plants or animals (including 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.] • 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.]	sunlight on an area.* [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.] • 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.] • 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.]	solve the same problem to compare the strengths and weaknesses of how each performs.

Science – Grade 1 (NGSS)

Guidelines	Waves: Light and Sound	Structure, Function, and Information Processing	Space Systems: Patterns and Cycles	Engineering Design
Big Idea	Understanding the properties of light and sound enables people to create and use tools and systems in their everyday lives.	Plants and/or animals use their external parts to help them survive, grow, and meet their needs. Parents behave in certain ways to help their offspring survive.	Our solar system is connected to life on earth.	People solve problems by designing, manipulating, and creating resources in order to satisfy their needs and wants.
Essential questions	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?	This 'Engineering Design' column is not meant to guide a stand-alone unit of work on engineering. The understandings and benchmarks are designed to prompt teacher thinking about how to incorporate the principles of good engineering into the strands.
Prompts to help create class understandings	• Light allows us to see. • Light travels and can be redirected. • Light behaves differently for different materials. • Sound is directly associated with vibration. • Sound travels and can be redirected. • Light and sound are used for communication.	• The external parts of animals and plants are used in different ways. • External parts help organisms to survive and grow. • Everyone and everything is similar but unique. • All living things have protective behaviors.	• There are patterns to our cycle of day and night. • The amount of daylight changes throughout the year. • Celestial bodies, other than our sun, can mostly be seen towards or at nighttime.	• What are our needs and wants? • What resources are necessary to meet our needs? • What resources help to satisfy our wants? • How can we obtain the resources for our needs and wants?
Enduring understandings (Disciplinary Core Ideas)	**Wave Properties** Sound can make matter vibrate, and vibrating matter can make sound. **Electromagnetic Radiation** • Objects can be seen if light is available to illuminate them or if they give off their own light. • Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) **Information Technologies and Instrumentation** People also use a variety of devices to communicate (send and receive information) over long distances.	**Structure and Function** All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. **Growth and Development of Organisms** Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. **Information Processing** Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. **Inheritance of Traits** Young animals are very much, but not exactly, like their parents. Plants also are very much, but not exactly, like their parents. **Variation of Traits** Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.	**The Universe and its Stars** Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. **Earth and the Solar System** Seasonal patterns of sunrise and sunset can be observed, described, and predicted.	**Defining and Delimiting Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution, it is important to clearly understand the problem. **Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. **Optimizing the Design Solution** Because there is always more than one possible solution to a problem, it is useful to compare and test designs.
Cross-cutting concepts	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.			
Benchmarks	**Students who demonstrate understanding can:** • 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	**Students who demonstrate understanding can:** • 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	**Students who demonstrate understanding can:** • 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	**Students who demonstrate understanding can:** • 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.

	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.] • 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.] • 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.] • 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.]	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.] • 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).] • 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.]	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.] • 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.]	• 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. • Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Science – Grade 2 (NGSS)

Guidelines	Structure and Properties of Matter	Interdependent Relationships in Ecosystems	Earth's Systems: Processes that Shape the Earth	Engineering Design
Big Idea	Different properties of matter are suited to different purposes.	Ecosystems are made up of living things that are interdependent in order to thrive.	The natural features of the Earth have been formed over time and are still changing.	By questioning, observing and gathering information, a new or improved object or tool can be developed to solve a problem.
Essential questions	How are materials similar and different to 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?	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?	This 'Engineering Design' column is not meant to guide a stand-alone unit of work on engineering. The understandings and benchmarks are designed to prompt teacher thinking about how to incorporate the principles of good engineering into the strands.
Prompts to help create class understandings	• There are many different materials in our environment. • Materials can be described by their observable properties. • Materials can be grouped according to their properties. • Changes in temperature can cause changes in properties. • Materials can be used for different purposes.	• Ecosystems are made up of many different organisms and non-living materials. • Different habitats have a variety of different species. • Plants and animals use each other for different purposes. • Everything in our environment affects others in some way. • Changing one part of an ecosystem can affect the rest of the system.	• Our planet is very old. • Our planet has many different geographical forms. • Geographical forms have been shaped by different forces. • Maps and globes can show where different geographical forms are. • Forces causing fast and slow changes to our planet can be classified.	• Systems, utilities and tools can be improved over time. • Solutions can be represented graphically and through models. • Designs should be tested and compared.
Enduring understandings (Disciplinary Core Ideas)	**Structure and Properties of Matter** • Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. • Different properties are suited to different purposes. • A great variety of objects can be built up from a small set of pieces. **Chemical Reactions** Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.	**Interdependent Relationships in Ecosystems** • Plants depend on water and light to grow. • Plants depend on animals for pollination or to move their seeds around. **Biodiversity and Humans** There are many different kinds of living things in any area, and they exist in different places on land and in water. **Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**The History of Planet Earth** Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. **Earth Materials and Systems** Wind and water can change the shape of the land. **Plate Tectonics and Large-Scale System Interactions** Maps show where things are located. One can map the shapes and kinds of land and water in any area. **The Roles of Water in Earth's Surface Processes** Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. **Optimizing the Design Solution** Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	**Defining and Delimiting Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. • Asking questions, making observations, and gathering information are helpful in thinking about problems. • Before beginning to design a solution, it is important to clearly understand the problem. **Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. **Optimizing the Design Solution** Because there is always more than one possible solution to a problem, it is useful to compare and test designs.
Cross-cutting concepts	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 second 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, 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.			
Benchmarks	**Students who demonstrate understanding can:** • 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.] • 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	**Students who demonstrate understanding can:** • 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.] • Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. • 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	**Students who demonstrate understanding can:** • Use information from several sources to provide evidence 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.] • 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	**Students who demonstrate understanding can:** • 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. • 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. • Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

	Boundary: Assessment of quantitative measurements is limited to length.] • 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.] • 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.]	plant names in specific habitats.]	windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.] • 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.] • Obtain information to identify where water is found on Earth and that it can be solid or liquid.	

Science – Grade 3 (NGSS)

Guidelines	Forces and Interactions	Interdependent Relationships in Ecosystems	Inheritance and Variation of Traits: Life Cycles and Traits	Weather and Climate	Engineering Design
Big Idea	Forces help us to move, stop and change direction.	The Earth's ecosystems are interrelated and are continually changing.	There are many similarities and differences between organisms.	Weather has an impact on our lives and environment.	The success of a physical construct is determined by its design, purpose and materials of construction.
Essential questions	How do equal and unequal forces on an object affect the object? How can magnets be used?	How do organisms vary in their traits? What happens to organisms when their environment changes?	How are plants, animals, and environments of the past similar or different from current plants, animals, and environments?	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?	This 'Engineering Design' column is not meant to guide a stand-alone unit of work on engineering. The understandings and benchmarks are designed to prompt teacher thinking about how to incorporate the principles of good engineering into the strands.
Prompts to help create class understandings	• The effect of one force can be negated by another force. • Combined forces are either in or out of balance. • The direction an object moves in is caused by a combination of forces.	• The components of ecosystems are living and non-living things. • Communities consist of interdependent organisms in a given place. • Changes to the environment cause changes to ecosystems.	• Groups have traits and behaviours that help them to survive and reproduce. • Traits and behaviours can be inherited or a response to the environment. • Birth, life, reproduction and death are a life cycle.	• The patterns in weather are useful to our daily lives. • Weather affects our quality of life. • We can adapt to protect ourselves from the effect of natural hazards.	• Proper research informs good design. • Good design needs to cater for multiple stresses on functionality. • Testing is crucial to determining the quality of design and function.
Enduring understandings (Disciplinary Core Ideas)	**Forces and Motion** • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) • The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) **Types of Interactions** • Objects in contact exert forces on each other. • Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	**Ecosystem Dynamics, Functioning, and Resilience** When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. **Social Interactions and Group Behavior** Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. **Evidence of Common Ancestry and Diversity** • Some kinds of plants and animals that once lived on Earth are no longer found anywhere. • Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. **Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. **Biodiversity and Humans** Populations live in a variety of habitats, and change in those habitats affects the organisms living there.	**Growth and Development of Organisms** Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. **Inheritance of Traits** • Many characteristics of organisms are inherited from their parents. • Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. **Variation of Traits** • Different organisms vary in how they look and function because they have different inherited information. • The environment also affects the traits that an organism develops. **Natural Selection** Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.	**Weather and Climate** • Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. • Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. **Natural Hazards** A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.	**Defining and Delimiting Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. **Developing Possible Solutions** • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.
Cross-cutting concepts	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 third 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, 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.				

Benchmarks	Students who demonstrate understanding can:	Students who demonstrate understanding can:	Students who demonstrate understanding can:	Students who demonstrate understanding can:	Students who demonstrate understanding can:
	• 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.] • 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.] • 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.] • 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.]	• Construct an argument that some animals form groups that help members survive. • Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. [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.] [Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.] • 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.] • Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. [Clarification Statement: Examples 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.]	• 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.] • 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.] • 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.] • 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.]	• Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. [Clarification Statement: Examples of data 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.] • Obtain and combine information to describe climates in different regions of the world. • 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.]	• Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. • 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. • 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.

Science – Grade 4 (NGSS)

Guidelines	Energy	Waves: Waves and Information	Structure, Function, and Information Processing	Earth's Systems: Processes that Shape the Earth	Engineering Design
Big Idea	Energy may be converted from one form to another and stored in various ways.	The behaviour of waves allows them to be used for communications.	The internal and external structures of plants and animals support survival, growth, behavior and reproduction.	Geological processes can result in observable changes to the Earth's surface.	The success of a solution is dependent upon design, materials, context, standards and performance.
Essential questions	What is energy and how is it related to motion? How is energy transferred? How can energy be used to solve a problem?	What are waves and what are some things they can do?	How do internal and external structures support the survival, growth, behavior and reproduction of plants and animals?	How can water, ice, wind and vegetation change the land? What patterns of Earth's features can be determined with the use of maps?	This 'Engineering Design' column is not meant to guide a stand-alone unit of work on engineering. The understandings and benchmarks are designed to prompt teacher thinking about how to incorporate the principles of good engineering into the strands.
Prompts to help create class understandings	• There are several forms of energy. • Energy is constantly transformed from one form to another. • The total energy in a system is conserved and never lost.	• Waves can have different heights and lengths.. • Waves transport energy. • Information can be transmitted using these different properties.	• Plants and animals have internal and external structures. • Structures can have one or more functions. • Each function of a structure has a purpose. • Information is received through structures and processed to guide actions.	• The forces acting on the Earth are applied through a variety of media. • These forces are created by various processes. • The processes and forces cause changes to the Earth's appearance.	• Proper research informs good design. • Good design needs to cater for multiple stresses on functionality. • Testing is crucial to determining the quality of design and function. • Testing requires performance standards.
Enduring understandings (Disciplinary Core Ideas)	**Definitions of Energy** • The faster a given object is moving, the more energy it possesses. • Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **Conservation of Energy and Energy Transfer** • Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. • Light also transfers energy from place to place. • Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. **Relationship Between Energy and Forces** When objects collide, the contact forces transfer energy so as to change the objects' motions. **Energy in Chemical Processes and Everyday Life** The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. **Natural Resources**	**Wave Properties** • Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. • Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). **Information Technologies and Instrumentation** Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. **Optimizing The Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	**Electromagnetic Radiation** An object can be seen when light reflected from its surface enters the eyes. **Structure and Function** Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. **Information Processing** Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.	**The History of Planet Earth** Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. **Earth Materials and Systems** Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. **Plate Tectonics and Large-Scale System Interactions** The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. **Biogeology** Living things affect the physical characteristics of their regions. **Natural Hazards** A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts.	**Defining and Delimiting Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. **Developing Possible Solutions** • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

	Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. **Defining Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.			**Designing Solutions to Engineering Problems** Testing a solution involves investigating how well it performs under a range of likely conditions.	
Cross-cutting concepts	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 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, 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.				
Benchmarks	**Students who demonstrate understanding can:** • 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.] • 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.] • 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.] • 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.] • Obtain and combine information to describe that energy and fuels are derived	**Students who demonstrate understanding can:** •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.] •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.]	**Students who demonstrate understanding can:** • 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.] • 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.] • 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.]	**Students who demonstrate understanding can:** • Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.] • 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.] • 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.] • Generate and compare multiple solutions	**Students who demonstrate understanding can:** • Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. • 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. • 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.

	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.]			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.]	

Science – Grade 5 (NGSS)

Guidelines	Structure and Properties of Matter	Matter and Energy in Organisms and Ecosystems	Earth's Systems	Space Systems: Stars and the Solar System	Engineering Design
Big Idea	Matter exists in different forms and can undergo changes.	Life is sustained by the transfer of matter and energy between plants, animals, decomposers and the environment	The Earth's systems and components are interrelated and are continually changing	The relationships between the sun, the moon and the earth affect how we live on our planet	Different solutions need to be tested in order to determine which of them best solves the problem.
Essential questions	When matter changes, does its weight change? 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 much water can be found in different places on Earth?	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?	This 'Engineering Design' column is not meant to guide a stand-alone unit of work on engineering. The understandings and benchmarks are designed to prompt teacher thinking about how to incorporate the principles of good engineering into the strands.
Prompts to help create class understandings	• Matter consists of particles that are too small to observe directly. • Matter can change form. • Different combinations of matter create different substances. • The total matter in a system is conserved and never lost.	• Energy flows through an ecosystem. • Matter cycles through an ecosystem. • Food is a source of energy. • Matter provides the constituents needed for food. • Energy from the sun is the foundation of almost all food chains.	• The Earth consists of a number of systems. • The systems of the earth affect each other. • Variations in the presence, extent and form of water affect the materials and processes of a given location. • Humans affect and can control their impact on Earth's systems.	• The universe is made up of different objects interacting in a vacuum called Space. • Objects in Space are classified according to their properties and behaviors. • Our planet is part of a solar system. • Our solar system has patterns of movement that cause day, night and seasons. • Earth exerts a gravitational force on objects.	• The success of a solution is dependent upon design, materials, context, standards and performance. • For results to be valid, different solutions need to be tested under the same conditions. • For results to be valid, a particular test must be independently replicated.
Enduring understandings (Disciplinary Core Ideas)	**Structure and Properties of Matter** • Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. • Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) **Chemical Reactions** • When two or more different substances are mixed, a new substance with different properties may be formed. • No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)	**Energy in Chemical Processes and Everyday Life** The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). **Organization for Matter and Energy Flow in Organisms** • Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. • Plants acquire their material for growth chiefly from air and water. **Interdependent Relationships in Ecosystems** The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly	**Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. **The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. **Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	**Types of Interactions** The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. **The Universe and its Stars** The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. **Earth and the Solar System** The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.	**Defining and Delimiting Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. **Developing Possible Solutions** • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

		introduced species can damage the balance of an ecosystem. **Cycles of Matter and Energy Transfer in Ecosystems** Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment.			
Cross-cutting concepts	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 fifth 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, 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.				
Benchmarks	**Students who demonstrate understanding can:** • 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.] • 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 form new substances.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.] • 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.] • Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	**Students who demonstrate understanding can:** • 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.] • 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.] • 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.]	**Students who demonstrate understanding can:** • 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.] • 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.] • Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	**Students who demonstrate understanding can:** • 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.] • Support an argument that differences in the apparent brightness of the sun compared to other 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, and stage).] • 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.]	**Students who demonstrate understanding can:** • Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. • 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. • 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.