

Science Standards

Grade 4-5

The science standards for grades 4-5 consist of nine Core Content Standards within the science domains. These standards should be learned during the two-year grade span, so that only four or five of them need to be learned *in depth* each year. Local school district curriculum teams will decide which of the areas will be learned at which grade level, depending on students' needs and interests.

As illustrated by the grid below, the three crosscutting EALRs of Systems, Inquiry, and Application are not to be learned in isolation, but rather in conjunction with content in the science domains. Not every topic needs to address all three crosscutting EALRs. But in any given year, content in Systems, Inquiry, and Application should be experienced in the context of several science lessons, so that students can see the commonalities among the fields of science.

Grades 4-5	EALR 1 Systems SYS	EALR 2 Inquiry INQ	EALR 3 Application APP
EALR 4 Domains of Science			
Physical Science PS1 Measurement of Force and Motion PS2 States of Matter PS3 Heat, Light, Sound, and Electricity Earth and Space Science ES1 Earth in Space ES2 Formation of Earth Materials ES3 Focus on Fossils Life Science LS1 Structures and Behaviors LS2 Food Webs LS3 Heredity and Adaptation	Complex Systems	Planning Investigations	Different Technologies

Standards for Grades 4-5

EALR 1: Systems

Big Idea: Systems (SYS)

Core Content: *Complex Systems*

In prior grades students learned to think systematically about how the parts of objects, plants, and animals are connected and work together. In grades 4-5 students learn that systems contain smaller (sub-) systems, and that systems are also parts of larger systems. The same ideas about systems and their parts learned in earlier grades apply to systems and subsystems. In addition, students learn about inputs and outputs and how to predict what may happen to a system if the system's inputs are changed. The concept of a hierarchy of systems provides a conceptual bridge for students to see the connections between mechanical systems (e.g., cities) and natural systems (e.g., ecosystems).

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 SYSA	Systems contain <i>subsystems</i> .	<ul style="list-style-type: none"> Identify at least one of the <i>subsystems</i> of an object, plant, or animal (e.g., an airplane contains <i>subsystems</i> for propulsion, landing, and control).
4-5 SYSB	A <i>system</i> can do things that none of its <i>subsystems</i> can do by themselves.	<ul style="list-style-type: none"> Specify how a <i>system</i> can do things that none of its <i>subsystems</i> can do by themselves (e.g., a forest <i>ecosystem</i> can sustain itself, while the trees, soil, plant, and animal <i>populations</i> cannot).
4-5 SYSC	Systems have <i>inputs</i> and <i>outputs</i> . Changes in <i>inputs</i> may change the <i>outputs</i> of a <i>system</i> .	<ul style="list-style-type: none"> <i>Describe</i> what goes into a <i>system</i> (<i>input</i>) and what comes out of a <i>system</i> (<i>output</i>) (e.g., when making cookies, <i>inputs</i> include sugar, flour, and chocolate chips; <i>outputs</i> are finished cookies). <i>Describe</i> the <i>effect</i> on a <i>system</i> if its <i>input</i> is changed (e.g., if sugar is left out, the cookies will not taste very good).
4-5 SYSD	One defective part can cause a <i>subsystem</i> to malfunction, which in turn will affect the <i>system</i> as a whole.	<ul style="list-style-type: none"> <i>Predict</i> what might happen to a <i>system</i> if a part in one or more of its <i>subsystems</i> is missing, broken, worn out, mismatched, or misconnected (e.g., a broken toe will affect the skeletal <i>system</i>, which can greatly reduce a person's ability to walk).*a

Mathematics Connections

*a 4.5.J, 5.6.J Make and test conjectures based on data (or information) collected from explorations and experiments.

EALR 2: Inquiry

Big Idea: Inquiry (INQ)

Core Content: *Planning Investigations*

In prior grades students learned to conduct different kinds of investigations. In grades 4-5 students learn to plan an investigation, which involves first selecting the appropriate kind of investigation to match the question being asked. One type of investigation is a controlled experiment (a “fair test”). Others include systematic observation, field studies, and models and simulations. Students can also collect, display, and interpret data; summarize results; draw conclusions from evidence; and communicate their findings. Students are aware that scientific explanations emphasize evidence, involve logical arguments, and are consistent with scientific principles and theories. Students are also expected to communicate their findings and to critique the investigations of others with respect and intellectual honesty. These capabilities are essential in preparing students for the more extensive and rigorous investigations that they will be planning and conducting in middle school.

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 INQA Question	Scientific <i>investigations</i> involve asking and answering <i>questions</i> and comparing the answers with <i>evidence</i> from the real world.	<ul style="list-style-type: none"> Identify the <i>questions</i> being asked in an <i>investigation</i>. Gather scientific <i>evidence</i> that helps to answer a <i>question</i>. *a
4-5 INQB Investigate	Scientists plan and conduct different kinds of <i>investigations</i> , depending on the <i>questions</i> they are trying to answer. Types of <i>investigations</i> include systematic <i>observations</i> and descriptions, <i>field studies</i> , <i>models</i> , and <i>open-ended explorations</i> as well as <i>controlled experiments</i> .	<ul style="list-style-type: none"> Given a research <i>question</i>, plan an appropriate <i>investigation</i>, which may include systematic <i>observations</i>, <i>field studies</i>, <i>models</i>, <i>open-ended explorations</i>, or <i>controlled experiments</i>. Work collaboratively with other students to carry out a <i>controlled experiment</i>, selecting appropriate <i>tools</i> and demonstrating safe and careful use of equipment.
4-5 INQC Investigate	An <i>experiment</i> involves a <i>comparison</i> . For an <i>experiment</i> to be valid and fair, all of the things that can possibly change the outcome of the <i>experiment</i> should be kept the same, if possible.	<ul style="list-style-type: none"> Conduct or critique an <i>experiment</i>, noting when the <i>experiment</i> might not be fair because things that might change the outcome are not kept the same.
4-5 INQD Investigate	<i>Investigations</i> involve systematic collection and recording of relevant <i>observations</i> and data.	<ul style="list-style-type: none"> Gather, record, and organize data using appropriate units, tables, graphs, or maps.
4-5 INQE Investigate	Repeated <i>trials</i> are necessary for <i>reliability</i> .	<ul style="list-style-type: none"> <i>Explain that</i> additional <i>trials</i> are needed to ensure that the results are repeatable.
4-5 INQF Models	A scientific <i>model</i> is a simplified representation of an object, event, <i>system</i> , or process created to understand some aspect of the <i>natural world</i> . When learning from a <i>model</i> , it is important to realize that the <i>model</i> is not exactly the same as the thing being modeled.	<ul style="list-style-type: none"> Create a simple <i>model</i> to represent an event, <i>system</i>, or process. Use the <i>model</i> to learn something about the event, <i>system</i>, or process. <i>Explain how</i> the <i>model</i> is similar to and different from the thing being modeled.
4-5 INQG Explain	Scientific explanations emphasize <i>evidence</i> , have logically consistent arguments, and use known scientific <i>principles</i> , <i>models</i> , and <i>theories</i> .	<ul style="list-style-type: none"> <i>Generate</i> a conclusion from a scientific <i>investigation</i> and show how the conclusion is supported by <i>evidence</i> and other scientific <i>principles</i>. *c

Standards for Grades 4-5

Content Standards		Performance Expectations
4-5 INQH Communicate	Scientists communicate the results of their <i>investigations</i> verbally and in writing. They review and ask <i>questions</i> about the results of other scientists' work.	<ul style="list-style-type: none"> • Display the findings of an <i>investigation</i> using tables, graphs, or other visual means to represent the data accurately and meaningfully.*b • <i>Communicate</i> to peers the purpose, procedure, results, and conclusions of an <i>investigation</i>. • Respond non-defensively to comments and <i>questions</i> about their <i>investigation</i>. • Discuss differences in findings and conclusions reported by other students.
4-5 INQI Intellectual Honesty	Scientists report the results of their <i>investigations</i> honestly, even when those results show their predictions were wrong or when they cannot <i>explain</i> the results.	<ul style="list-style-type: none"> • <i>Explain</i> why records of <i>observations</i> must never be changed, even when the <i>observations</i> do not match expectations.

Mathematics Connections

*a	4.5.A, 5.6.A	Determine the question(s) to be answered, given a problem situation.
*b	5.5.C	Construct and interpret line graphs.
*c	4.5.J, 5.6.J	Make and test conjectures based on data (or information) collected from explorations and experiments.
*c	5.5.B	Determine and interpret the mean of a small data set of whole numbers.

Note: This standard is closely aligned to Core Processes 4.5 and 5.6.

EALR 3: **Application**

Big Idea: **Application (APP)**

Core Content: ***Different Technologies***

In earlier grades, students learned to design a solution to a simple problem, using an elementary version of the technological design process. In grades 4-5 students learn to distinguish between science and technology and to work individually and collaboratively to produce a product of their own design. They learn that people in different cultures use different materials and technologies to meet their same daily needs and increase their understanding of tools and materials. Students also develop their abilities to define problems that can be solved by modifying or inventing technologies, to create and test their designs, and to communicate what they learned. These capabilities help students understand the value of science and technology to meet human needs and provide them with valuable skills for everyday life.

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 APPA	<i>Technology</i> involves changing the <i>natural world</i> to meet human needs or wants.	<ul style="list-style-type: none"> Describe ways that people use <i>technology</i> to meet their needs and wants (e.g., text messages to communicate with friends, use bicycles or cars for transportation).
4-5 APPB	People in different <i>cultures</i> all around the world use different materials or <i>technologies</i> to solve the same problems.	<ul style="list-style-type: none"> Give examples of how people around the world use different materials or technologies to solve the same problem (e.g., people in different countries use different materials to build their houses).
4-5 APPC	Problems of moderate complexity can be solved using the <i>technological design process</i> . This process begins by defining and researching the problem to be solved.	<ul style="list-style-type: none"> Define a problem and list several <i>criteria</i> for a successful <i>solution</i>. Research the problem to better understand the need and to see how others have solved similar problems.
4-5 APPD	Scientists and engineers often work in teams with other individuals to <i>generate</i> different <i>ideas</i> for solving a problem.	<ul style="list-style-type: none"> Work with other students to <i>generate</i> possible <i>solutions</i> to a problem and agree on the most promising <i>solution</i> based on how well each different idea meets the <i>criteria</i> for a successful <i>solution</i>.^{*a}
4-5 APPE	Possible <i>solutions</i> should be tested to see if they solve the problem. Building a <i>model</i> or prototype is one way to test a possible <i>solution</i> .	<ul style="list-style-type: none"> Use suitable <i>tools</i>, techniques, and materials to make a drawing or build a <i>model</i> or prototype of the proposed <i>design</i>. Test the <i>solution</i> to see how well that <i>solution</i> solves the problem. Modify the <i>design</i>, if necessary.^{*a}
4-5 APPF	<i>Solutions</i> to problems must be communicated, if the problem is to be solved.	<ul style="list-style-type: none"> <i>Communicate</i> the <i>solution</i>, results of any tests, and modifications persuasively, using oral, written, and/or pictorial representations of the process and product.
4-5 APPG	Science and technology have greatly improved food quality and quantity, transportation, health, sanitation, and communication.	<ul style="list-style-type: none"> <i>Describe</i> specific ways that science and technology have improved the quality of the students' lives.

Standards for Grades 4-5

	Content Standards	Performance Expectations
4-5 APPH	People of all ages, interests, and abilities engage in a variety of scientific and technological work.	<ul style="list-style-type: none">• <i>Describe</i> several activities or careers that require people to <i>apply</i> their knowledge and abilities in <i>science, technology, engineering, and mathematics</i>.

Mathematics Connections

*a 4.5.H, 5.6.H Analyze and evaluate whether a solution is reasonable and mathematically correct, and answers the question.

EALR 4: Physical Science

Big Idea: Force and Motion (PS1)

Core Content: *Measurement of Force and Motion*

In prior grades students learned that forces work not only to push and pull objects, but also to affect objects when they are dropped or thrown. In grades 4-5 students learn how to use basic tools to measure the fundamental quantities of force, time, and distance. Force can be measured with a spring scale. Distance and time can be measured by a variety of methods, and the results can be used to *compare* the motion of two objects. Focusing on accuracy of measurement, recording of data and logical conclusions from the data provide the foundation for future years when students will undertake more complex *investigations*.

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 PS1A	The <i>weight</i> of an object is a measure of how strongly it is pulled down toward the ground by <i>gravity</i> . A spring scale can measure the pulling <i>force</i> .	<ul style="list-style-type: none"> Use a spring scale to measure the <i>weights</i> of several objects accurately. <i>Explain that the weight</i> of an object is a measure of the <i>force</i> of <i>gravity</i> on the object. Record the measurements in a table.*a
4-5 PS1B	The relative <i>speed</i> of two objects can be determined in two ways: (1) If two objects travel for the same amount of time, the object that has traveled the greatest distance is the fastest. (2) If two objects travel the same distance, the object that takes the least time to travel the distance is the fastest.	<ul style="list-style-type: none"> Measure the distance that an object travels in a given interval of time and <i>compare</i> it with the distance that another object moved in the same interval of time to determine which is fastest.*b Measure the time it takes two objects to travel the same distance and determine which is fastest.*c

Mathematics Connections

- *a 3.5.C Estimate, measure, and *compare* weight and mass, using appropriate-size U.S. customary and metric units.
- *b 2.3.C Measure length to the nearest whole unit in both metric and U.S. customary units.
- *c 4.4.C Estimate and determine elapsed time, using a calendar, a digital clock, and an analog clock.

Standards for Grades 4-5

EALR 4: Physical Science

Big Idea: Matter: Properties and Change (PS2)

Core Content: *States of Matter*

In prior grades students learned to identify different physical properties of matter and to realize that an object may be made from several different types of materials. In grades 4-5 students learn that a given substance may exist in different states—solid, liquid, and gas—and that many substances can be changed from one state to another. This understanding of matter lays the foundation for later explanations of matter in terms of atomic theory.

Content Standards		Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 PS2A	Substances can exist in different physical states—solid, liquid, and gas. Many substances can be changed from one state to another by heating or cooling.	<ul style="list-style-type: none"> Explain that water is still the same substance when it is frozen as ice or evaporated and becomes a gas.¹
4-5 PS2B	Air is a gas. Air fills a closed container completely. Wind is moving air.	<ul style="list-style-type: none"> Explain that a balloon expands when you blow air into it because blowing air into the balloon creates greater air pressure inside the balloon than outside the balloon. Describe how the wind can move things (e.g., wind can move the branches of trees when it blows and moves sailboats through the water).
4-5 PS2C	The total amount of matter is conserved (stays the same) when it undergoes a physical change such as when an object is broken into tiny pieces, when a solid is dissolved in a liquid, or when matter changes state (solid, liquid, gas).	<ul style="list-style-type: none"> Explain that dissolved substances have not disappeared, and cite evidence to determine that the substance is still there (e.g., sprinkle sugar on cereal, add milk, and you can taste it even though you can no longer see the sugar). Predict that the weight² of a sample of water will be nearly the same before and after it is frozen or melted. Explain why the weight will be almost the same.*a If an object is weighed, then broken into small pieces, predict that the small pieces will weigh the same as the large piece. Explain why the weight will be the same.*a

Mathematics Connections

*a 4.5.J, 5.6.J Make and test conjectures based on data (or information) collected from explorations and experiments.

Note: At this age and grade level, the term “steam” is acceptable as a replacement for “water vapor.”

Note: Although the correct term is “mass,” elementary school students are not expected to distinguish between the terms “mass” and “weight.”

EALR 4: Physical Science**Big Idea: Energy: Transfer, Transformation and Conservation (PS3)****Core Content: Heat, Light, Sound, and Electricity**

In prior grades students learned to identify several different forms of energy. In grades 4-5 students build on their intuitive understanding of energy and learn how heat, light, sound, and electrical energy are generated and can be transferred from place to place. For example, they can observe that energy of motion can be transferred from one object to another. They can observe how heat energy is generated and moves from a warmer to a cooler place, and how sound can be produced by vibrations in the throat or guitar strings or other forms of vibration. They can also see that electrical energy can do many things, including producing light, heat, and sound, and can make things move. This introduction to the many forms of energy helps to prepare students for later studies of energy transformation and conservation.

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 PS3A	Energy has many forms, such as <i>heat</i> , light, sound, <i>motion</i> , and electricity.	<ul style="list-style-type: none"> Identify different forms of <i>energy</i> (e.g., <i>heat</i>, light, sound, <i>motion</i>, electricity) in a <i>system</i>.
4-5 PS3B	Energy can be <i>transferred</i> from one place to another.	<ul style="list-style-type: none"> Draw and label diagrams showing several ways that <i>energy</i> can be <i>transferred</i> from one place to another (e.g., sound energy passing through <i>air</i>, electrical energy through a wire, <i>heat</i> energy conducted through a frying pan, light energy through space).
4-5 PS3C	<i>Heat</i> energy can be <i>generated</i> a number of ways and can move (<i>transfer</i>) from one place to another. <i>Heat energy</i> is <i>transferred</i> from warmer things to colder things.	<ul style="list-style-type: none"> Identify several ways to <i>generate heat</i> energy (e.g., lighting a match, rubbing hands together, or mixing different kinds of chemicals together). Give examples of two different ways that <i>heat</i> energy can move from one place to another, and <i>explain</i> which direction the <i>heat</i> moves (e.g., when placing a pot on the stove, <i>heat</i> moves from the hot burner to the cooler pot).
4-5 PS3D	Sound energy can be <i>generated</i> by making things vibrate.	<ul style="list-style-type: none"> Demonstrate how sound can be <i>generated</i> by vibrations, and <i>explain how</i> sound energy is <i>transferred</i> through the <i>air</i> from a source to an observer.
4-5 PS3E	Electrical energy in <i>circuits</i> can be changed to other forms of energy, including light, <i>heat</i> , sound, and <i>motion</i> . <i>Electric circuits</i> require a complete loop through conducting materials in which an electric current can pass.	<ul style="list-style-type: none"> Connect wires to produce a complete circuit involving a battery and at least one other electrical component to produce observable change (e.g., light a bulb, sound a buzzer, and make a bell ring). Repair an <i>electric circuit</i> by completing a closed loop. <i>Describe</i> how electrical energy is <i>transferred</i> from one place to another, and how it is <i>transformed</i> from electrical energy to different kinds of energy in the circuit above.

Standards for Grades 4-5

EALR 4: Earth and Space Science

Big Idea: Earth in Space (ES1)

Core Content: *Earth in Space*

In prior grades students learned that observing and recording the position and appearance of objects in the sky make it possible to discover patterns of motion. In grades 4-5 students learn the full implications of the spherical-Earth concept and Earth's place in the Solar System. The upper elementary years are an excellent time for study of the Earth in space because students have the intellectual capacity to grasp the spherical-Earth concept and the relationship between the Earth and Sun. This major set of concepts is a stepping-stone to a later understanding of all concepts in astronomy and space science and an essential element to further understanding of how the Earth and other planets formed.

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 ES1A	Earth is approximately <i>spherical</i> in shape. Things on or near the Earth are pulled toward Earth's center by the <i>force</i> of <i>gravity</i> .	<ul style="list-style-type: none"> Give <i>evidence</i> to support the <i>idea</i> that Earth is <i>spherical</i> in shape (e.g., research Earth images from space, shape of Earth's shadow on the Moon during an <i>eclipse</i> of the Moon). Draw how objects would fall when dropped from various places around Earth, demonstrating that all things fall "down" toward Earth's center.
4-5 ES1B	Earth's daily spin relative to the Sun causes night and day.	<ul style="list-style-type: none"> Use a physical <i>model</i> or diagram to show that Earth's spin causes night and day.
4-5 ES1C	Earth's nearly circular yearly <i>orbit</i> around the Sun causes us to see different <i>constellations</i> at different times of year.	<ul style="list-style-type: none"> Use a physical <i>model</i> or diagram to show how the different <i>constellations</i> are visible in different seasons, as a consequence of Earth <i>orbiting</i> the sun.
4-5 ES1D	The Sun is a star. It is the central and largest body in our <i>Solar System</i> . The Sun appears much brighter and larger in the sky than other stars because it is many thousands of times closer to Earth.	<ul style="list-style-type: none"> Identify that our <i>Solar System</i> contains only one star, the Sun. <i>Explain that</i> the Sun appears brighter and larger than any other star because it is very close to us.

EALR 4: Earth and Space Science**Big Idea: Earth Systems, Structures, and Processes (ES2)****Core Content: Formation of Earth Materials**

In prior years, students learned that water plays an essential role in Earth systems, including shaping landforms and weather. In grades 4-5 students learn how Earth materials change and how they can be used for various purposes. They learn that Earth materials include solid rocks and soil, water, and gases of the atmosphere. People use many of these materials as resources to meet their needs. One of the most important Earth resources is soil, since people depend on fertile soil to grow food. The processes that produce soils offer an excellent opportunity for students to understand how Earth materials change gradually over time, and provide a solid grounding for later study of landforms and large-scale changes of Earth's surface that students will learn in middle school.

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 ES2A	Earth materials include solid rocks and soil, water, and <i>gases</i> of the atmosphere. Materials have different <i>physical</i> and <i>chemical properties</i> which make them useful in different ways. Earth materials provide many of the resources that humans use.	<ul style="list-style-type: none"> • <i>Describe</i> Earth materials and list their <i>physical</i> and <i>chemical properties</i>. • <i>Explain how</i> the <i>properties</i> of an Earth material make it useful for certain purposes, but not useful for other purposes (e.g., rocks are heavy and strong so they are good for building walls, but they are not as useful as lighter materials for roofs). • Give examples of <i>human-made</i> materials, including those that are changed only a little (e.g., wood and stones used for building) and those that look very different from the raw materials (e.g., metal, ceramics, and plastics).
4-5 ES2B	<i>Weathering</i> is the breaking down of rock into pebbles and sand caused by physical processes such as heating, cooling, and pressure, and chemical processes such as acid rain.	<ul style="list-style-type: none"> • <i>Describe</i> and give examples of the physical and chemical processes of <i>weathering</i> of rock.
4-5 ES2C	<i>Erosion</i> is the movement of Earth materials by processes such as <i>wind</i> , water, ice, and <i>gravity</i> .	<ul style="list-style-type: none"> • <i>Describe</i> the <i>forces</i> of water and <i>wind</i> as major causes of <i>erosion</i>. • Identify local examples where <i>erosion</i> has occurred and <i>describe</i> the processes that most likely caused the <i>erosion</i>.
4-5 ES2D	<i>Soils</i> are formed by <i>weathering</i> and <i>erosion</i> , decay of plant <i>matter</i> , settling of volcanic ash, transport by rain through streams and rivers, and <i>deposition</i> of <i>sediments</i> in valleys, riverbeds, and lakes.	<ul style="list-style-type: none"> • <i>Explain how</i> the formation of soils is related to the following processes: <i>weathering</i> of rock; decay of plant <i>matter</i>; settling of volcanic ash; transport by rain, streams, and rivers; <i>deposition</i> of <i>sediments</i> in rivers and lakes.
4-5 ES2E	Soils are often found in layers, with each layer having a different chemical composition and different physical <i>properties</i> .	<ul style="list-style-type: none"> • <i>Compare</i> different layers in soil with respect to physical <i>properties</i> (e.g., color, texture, particle size, amount of dead plant and animal material, capacity for holding water).
4-5 ES2F	<i>Erosion</i> plays an important role in the formation of soil, but too much <i>erosion</i> can wash away fertile soil from <i>ecosystems</i> and farms.	<ul style="list-style-type: none"> • <i>Explain</i> the role that <i>erosion</i> plays in forming soils and how <i>erosion</i> can also deplete soils. • <i>Describe</i> methods people use to reduce soil <i>erosion</i>.

Standards for Grades 4-5

EALR 4: Earth and Space Science

Big Idea: Earth History (ES3)

Core Content: *Focus on Fossils*

In prior years, students learned that fossils represent the remains of plants and animals that lived long ago. In grades 4-5 students learn that fossils also provide evidence of environmental conditions that existed when the fossils formed. Most fossils are imprints formed when plants or animals died in a watery environment and were covered with mud that eventually hardened into rock. Fossils can also form in other ways, as when dissolved minerals seep into a piece of wood and harden into rock, or an animal is frozen in ice that never thaws. Fossils provide evidence of the kinds of plants and animals that lived on Earth in the past, as well as environmental conditions that prevailed at the time the fossils formed.

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 ES3A	Different kinds of events caused the formation of different kinds of <i>fossils</i> .	<ul style="list-style-type: none"> <i>Describe</i> an event that could cause the formation of a given <i>fossil</i> (e.g., the plant or animal may have been buried in <i>sediment</i> that hardened into rock and left an imprint, or dissolved minerals may have seeped into a piece of wood and hardened into rock).^{*a}
4-5 ES3B	By studying the kinds of plant and animal <i>fossils</i> in a layer of rock, it is possible to <i>infer</i> what the <i>environment</i> was like at the time and where the layer formed.	<ul style="list-style-type: none"> <i>Infer</i> from a picture of several fossils in a layer of rock the <i>environmental</i> conditions that existed when the <i>fossils</i> were formed (e.g., fish <i>fossils</i> would indicate that a body of water existed at the time the <i>fossils</i> formed).^{*a}

Mathematics Connections

^{*a} 4.5.J, 5.6.J Make and test conjectures based on data (or information) collected from explorations and experiments.

Note: This standard overlaps very closely with Life Science: *Evolution* at the 4th-5th grade level.

EALR 4: Life Science**Big Idea: Structures and Functions of Living Organisms (LS1)****Core Content: Structures and Behaviors**

In prior years, students learned that all plants and animals have life cycles. In grades 4-5 students learn that plants and animals have different structures that work together to respond to various internal and external needs. Students compare various human and animal structures and reflect on how the different structures enable the organism to respond to external and internal needs. Students also learn that healthy body structures depend on good nutrition. These concepts are stepping-stones to later understanding of how structures are built up from cells.

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 LS1A	Plants and animals can be sorted according to their structures and behaviors.	<ul style="list-style-type: none"> Sort plants and animals according to their structures (e.g., presence of hair, feathers, or scales on their skin) and behaviors (e.g., grazing, hunting, or diving for food).
4-5 LS1B	Each animal has different structures and behaviors that serve different <i>functions</i> .	<ul style="list-style-type: none"> List parts of an animal's body and <i>describe</i> how it helps the animal meet its basic needs (e.g., the bones support the body so it can move; the blood carries food and oxygen throughout the body). <i>Describe</i> the <i>function</i> of a given animal behavior (e.g., salmon swim upstream to spawn, owls hunt at night when prey are vulnerable).^{*a}
4-5 LS1C	Certain structures and behaviors enable plants and animals to respond to changes in their <i>environment</i> .	<ul style="list-style-type: none"> Give examples of how plants and animals respond to their <i>environment</i> (e.g., many plants grow toward the light, animals hide when they see a predator).
4-5 LS1D	Plants and animals have structures and behaviors that respond to internal needs.	<ul style="list-style-type: none"> Give examples of how plants and animals respond to internal needs (e.g., plants wilt when they don't have water; animals seek food when they are hungry).
4-5 LS1E	Nutrition is essential to health. Various kinds of foods are necessary to build and maintain body structures. Individuals have responsibility for their own health and food choices.	<ul style="list-style-type: none"> <i>Describe</i> how various types of foods contribute to the maintenance of healthy body structures. Based on the above list, develop a balanced plan for eating that will allow you to build and maintain your body.

Mathematics Connections

^{*a} 4.5.J, 5.6.J Make and test conjectures based on data (or information) collected from explorations and experiments.

Standards for Grades 4-5

EALR 4: Life Science

Big Idea: Ecosystems (LS2)

Core Content: *Food Webs*

In prior grades students learned that ecosystems include both plant and animal populations as well as nonliving resources, and that plants and animals depend on one another and on the nonliving resources in their ecosystem to survive. In grades 4-5 students learn how ecosystems change and how these changes affect the capacity of an ecosystem to support populations. Some changes in ecosystems are caused by the organisms themselves. The ability of any organism to survive will depend on its characteristics and behaviors. Humans also play an important role in many ecosystems and may reduce negative impacts through thoughtful use of natural resources. Concepts related to ecosystems, including food webs, make it possible for students to understand the interrelationships among various forms of life and between living things and their environment.

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 LS2A	An <i>ecosystem</i> includes all of the plant and animal <i>populations</i> and nonliving resources in a given area. Plants and animals depend on one another and the nonliving resources in their <i>ecosystem</i> to help them survive.	<ul style="list-style-type: none"> Identify the living and nonliving parts of an ecosystem. Give examples to show how the plants and animals depend on one another for survival (e.g., worms <i>decompose</i> waste and return <i>nutrients</i> to the soil, which helps plants grow). <i>Describe</i> how the plants and animals in an <i>ecosystem</i> depend on nonliving resources.
4-5 LS2B	Plants make their own food using energy from the sun. Animals get food by eating plants and/or other animals that eat plants. Plants make it possible for animals to use the energy of sunlight.	<ul style="list-style-type: none"> <i>Explain that</i> plants make their own food, and animals, including humans, get food by eating plants and/or eating other animals.
4-5 LS2C	Plants and animals are related in <i>food webs</i> with <i>producers</i> (plants that make their own food), <i>consumers</i> (animals that eat <i>producers</i> and/or other animals), and <i>decomposers</i> (primarily bacteria and fungi) that break down wastes and dead <i>organisms</i> , and return <i>nutrients</i> to the soil.	<ul style="list-style-type: none"> Draw a simple <i>food web</i> given a list of three <i>common organisms</i>. Draw arrows properly and identify the <i>producers</i> and <i>consumers</i>. <i>Compare</i> the roles of <i>producers</i>, <i>consumers</i>, and <i>decomposers</i> in an <i>ecosystem</i>.
4-5 LS2D	<i>Ecosystems</i> can change slowly or rapidly. Big changes over a short period of time can have a major impact on the <i>ecosystem</i> and the <i>populations</i> of plants and animals living there.	<ul style="list-style-type: none"> <i>Apply</i> knowledge of a plant or animal's <i>relationship</i> to its <i>ecosystem</i> and to other plants and animals to <i>predict</i> whether and how a slow or rapid change in the <i>ecosystem</i> might affect the <i>population</i> of that plant or animal.*a
4-5 LS2E	All plants and animals change the <i>ecosystem</i> where they live. If this change reduces another organism's access to resources, that <i>organism</i> may move to another location or die.	<ul style="list-style-type: none"> <i>Describe</i> how one <i>population</i> may affect other plants and/or animals in the <i>ecosystem</i> (e.g., increase in Scotch Broom replaces native plants normally eaten by butterfly caterpillars, reducing the butterfly <i>population</i>).

Standards for Grades 4-5

Content Standards		Performance Expectations
4-5 LS2F	People affect <i>ecosystems</i> both positively and negatively.	<ul style="list-style-type: none"> • <i>Describe</i> ways that humans can improve the health of <i>ecosystems</i> (e.g., recycling wastes, establishing rain gardens, planting native <i>species</i> to prevent flooding and <i>erosion</i>). • <i>Describe</i> ways that humans can harm the health of <i>ecosystems</i> (e.g., overuse of fertilizers, littering, not recycling)

Mathematics Connections

*a 4.5.J, 5.6.J Make and test conjectures based on data (or information) collected from explorations and experiments.

Standards for Grades 4-5

EALR 4: Life Science

Big Idea: Biological Evolution (LS3)

Core Content: *Heredity and Adaptation*

In prior grades students learned about variations in inherited characteristics. In grades 4-5 students learn that some differences in inherited characteristics may help plants and animals survive and reproduce. Sexual reproduction results in offspring that are never identical to either of their parents and therefore contributes to a species' ability to adapt to changing conditions. Heredity is a key feature of living plants and animals that enables changes in characteristics to be passed on and for species to change over time. Fossils provide evidence of what ancient extinct plants and animals looked like.

	Content Standards	Performance Expectations
	<i>Students know that:</i>	<i>Students are expected to:</i>
4-5 LS3A	In any <i>ecosystem</i> , some <i>populations</i> of <i>organisms</i> thrive and grow, some decline, and others do not survive at all.	<ul style="list-style-type: none"> List some reasons why some <i>populations</i> may not survive as well as others.*a <i>Evaluate</i> similar <i>populations</i> in an <i>ecosystem</i> with regard to their ability to thrive and grow (e.g., bird <i>populations</i> with differently colored feathers). *a
4-5 LS3B	Plants and animals inherit many <i>characteristics</i> from their parents. Some inherited <i>characteristics</i> allow <i>organisms</i> to better survive and reproduce in a given <i>ecosystem</i> .	<ul style="list-style-type: none"> <i>Communicate</i> that plants and animals inherit many <i>characteristics</i> (e.g., color of a flower or number of limbs at birth) from the parents of the plant or animal. Give examples to illustrate an inherited <i>characteristic</i> that would enable an <i>organism</i> to better survive and reproduce in a given <i>ecosystem</i>.
4-5 LS3C	Some <i>characteristics</i> and behaviors result from an individual plant's or animal's <i>interactions</i> with the <i>environment</i> and are not passed from one <i>generation</i> to the next by <i>heredity</i> .	<ul style="list-style-type: none"> Use an example to <i>explain</i> that some <i>characteristics</i> or behaviors result from an individual plant's or animal's <i>interactions</i> with the <i>environment</i> and are not passed from one <i>generation</i> to the next by <i>heredity</i> (e.g., trees can lose a limb, animals can have accidents that cause scars, people can exercise and build muscles).
4-5 LS3D	<i>Fossils</i> provide <i>evidence</i> that many plant and animal <i>species</i> are <i>extinct</i> and that <i>species</i> have changed over time.	<ul style="list-style-type: none"> <i>Compare</i> and <i>contrast</i> <i>fossils</i> with one another and with living plants and animals to illustrate that <i>fossils</i> provide <i>evidence</i> that plant and animal <i>species</i> have changed over time.

Mathematics Connections

*a 4.4.F Describe and *compare* the likelihood of events.