Iowa Science Standards

Overview

In order to ensure our K-12 students are scientifically-literate, global citizens who are prepared for college and/or career success, Iowa adopted new science standards that describe what students in grades K-12 should know and be able to do as a result of instruction. These standards are arranged by grade level for K-8 and by content area for 9-12. Educators have the flexibility to arrange the standards in any order within a grade level and within high school course offerings to suit the needs of students and science programs.

The new science standards reflect our state's emphasis on giving all students the real-world knowledge and skills needed to be ready for success in college and in the workforce, regardless of the career paths they choose. These real-world connections will involve students engaging with scientific phenomena and designing solutions to authentic problems. In addition, the standards focus on deeper understanding of content and build coherently from kindergarten through grade 12 and the standards provide clear opportunities for clear connections to literacy and mathematics.

Iowa's science standards are three-dimensional performance expectations that include the interconnections of three-equally important, distinct dimensions to learning science – science and engineering practices, cross cutting concepts, and disciplinary core ideas. When students use these dimensions of science to make sense of scientific phenomenon or to solve problems, they are engaged in what is often referred to as three-dimensional (or 3D) learning.

Each Iowa science standard includes a science and engineering practice, a cross cutting concept and a disciplinary core idea. The partnering of a practice with a particular disciplinary core idea and a cross cutting concept does not predetermine how the three are linked in curriculum, instruction, or classroom assessment. However, all three dimensions of the standard are equally important; therefore, to be considered aligned, units of instruction should provide opportunities for students to meaningfully engage in all three dimensions.

Iowa Science Standards

Elementary (K-5) Booklet Materials

In this booklet, educators will find each Iowa science standard along with any corresponding clarification statements, assessment boundaries, foundation boxes, and evidence statements. The standards, clarification statements, assessment boundaries, and foundation boxes are provided by and re-printed from: NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press. These standards are arranged by grade level for K-8 (ETS standards are banded K-2, 3-5, and 6-8) and by content area for 9-12. Educators have the flexibility to arrange the standards in any order within a grade level (and within high school course offerings) to suit the needs of students and science programs. Example bundles by disciplinary core idea or by topic may be found at http://nextgenscience.org/.

Additional Information about the Iowa Science Standards:

- Iowa Core Explore the Core Standards at https://iowacore.gov/iowa-core/subject/science
- Iowa Core Science Page https://iowacore.gov/content/science-resources includes links to instructional and assessment resources for administrators, instructional coaches, and teachers and links to professional development resources and opportunities.
- The Next Generation Science Standards and related resources can be found at http://nextgenscience.org/

Iowa Science Standards

Kindergarten Standards
Foundation Boxes
Evidence Statements

K-PS2-1 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

K-PS2-1. **Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.** [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [*Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- With guidance, plan and conduct an investigation in collaboration with peers.

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Connections to the Nature of Science

Scientific Investigations Use a Variety of Methods

- Scientists use different ways to study the world.

Disciplinary Core Ideas

PS2.A: 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.

PS2.B: Types of Interactions

- When objects touch or collide, they push on one another and can change motion.

PS3.C: Relationship Between Energy and Forces

- A bigger push or pull makes things speed up or slow down more quickly. *(secondary)*

Crosscutting Concepts

Cause and Effect

- Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon to be investigated	
	a	With guidance, students collaboratively identify the phenomenon under investigation, which includes the following idea: the effect caused by different strengths and directions of pushes and pulls on the motion of an object.
	b	With guidance, students collaboratively identify the purpose of the investigation, which includes gathering evidence to support or refute student ideas about causes of the phenomenon by comparing the effects of different strengths of pushes and pulls on the motion of an object.
2	Identifying the evidence to address this purpose of the investigation	
	a	With guidance, students collaboratively develop an investigation plan to investigate the relationship between the strength and direction of pushes and pulls and the motion of an object (i.e., qualitative measures or expressions of strength and direction; e.g., harder, softer, descriptions* of "which way").
	b	Students describe* how the observations they make connect to the purpose of the investigation, including how the observations of the effects on object motion allow causal relationships between pushes and pulls and object motion to be determined
	c	Students predict the effect of the push of pull on the motion of the object, based on prior experiences.
3	Planning the investigation	
	a	In the collaboratively developed investigation plan, students describe*:
		i. The object whose motion will be investigated.
		ii. What will be in contact with the object to cause the push or pull.
		iii. The relative strengths of the push or pull that will be applied to the object to start or stop its motion or change its speed.
		iv. The relative directions of the push or pull that will be applied to the object.

		v.	How the motion of the object will be observed and recorded.
		vi.	How the push or pull will be applied to vary strength or direction.
4	Collecting the data		
	a	According to the investigation plan they developed, and with guidance, students collaboratively make observations that would allow them to compare the effect on the motion of the object caused by changes in the strength or direction of the pushes and pulls and record their data.	

K-PS2-2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

K-PS2-2. **Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*** [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [*Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended.	**PS2.A: 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. **ETS1.A: Defining Engineering Problems** • A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. *(secondary)*	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Observable features of the student performance by the end of the grade:			
1	Organizing data		
	a	With guidance, students organize given information using graphical or visual displays (e.g., pictures, pictographs, drawings, written observations, tables, charts). The given information students organize includes:	
		i.	The relative speed or direction of the object before a push or pull is applied (i.e., qualitative measures and expressions of speed and direction; e.g., faster, slower, descriptions* of "which way").
		ii.	The relative speed or direction of the object after a push or pull is applied.
		iii.	How the relative strength of a push or pull affects the speed or direction of an object (i.e., qualitative measures or expressions of strength; e.g., harder, softer).
2	Identifying relationships		
	a	Using their organization of the given information, students describe* relative changes in the speed or direction of the object caused by pushes or pulls from the design solution.	
3	Interpreting data		
	a	Students describe* the goal of the design solution.	
	b	Students describe* their ideas about how the push or pull from the design solution causes the change in the object's motion.	
	c	Based on the relationships they observed in the data, students describe* whether the push or pull from the design solution causes the intended change in speed or direction of motion of the object.	

K-PS3-1 Energy

Students who demonstrate understanding can:

K-PS3-1. **Make observations to determine the effect of sunlight on Earth's surface.** [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.] [*Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Make observations (firsthand or from media) to collect data that can be used to make comparisons.

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Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Scientists use different ways to study the world.

Disciplinary Core Ideas

PS3.B: Conservation of Energy and Energy Transfer

- Sunlight warms Earth's surface.

Crosscutting Concepts

Cause and Effect

- Events have causes that generate observable patterns.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon to be investigated	
	a	From the given investigation plan, students describe* (with guidance) the phenomenon under investigation, which includes the following idea: sunlight warms the Earth's surface.
	b	Students describe* (with guidance) the purpose of the investigation, which includes determining the effect of sunlight on Earth materials by identifying patterns of relative warmth of materials in sunlight and shade (e.g., sand, soil, rocks, water).
2	Identifying the evidence to address the purpose of the investigation	
	a	Based on the given investigation plan, students describe* (with guidance) the evidence that will result from the investigation, including observations of the relative warmth of materials in the presence and absence of sunlight (i.e., qualitative measures of temperature; e.g., hotter, warmer, colder).
	b	Students describe* how the observations they make connect to the purpose of the investigation.
3	Planning the investigation	
	a	Based on the given investigation plan, students describe* (with guidance):
		i. The materials on the Earth's surface to be investigated (e.g., dirt, sand, rocks, water, grass).
		ii. How the relative warmth of the materials will be observed and recorded.
4	Collecting the data	
	a	According to the given investigation plan and with guidance, students collect and record data that will allow them to:
		i. Compare the warmth of Earth materials placed in sunlight and the same Earth materials placed in shade.
		ii. Identify patterns of relative warmth of materials in sunlight and in shade (i.e., qualitative measures of temperature; e.g., hotter, warmer, colder).
		iii. Describe* that sunlight warms the Earth's surface.

K-PS3-2 Energy

Students who demonstrate understanding can:

K-PS3-2. **Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.*** [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.

Disciplinary Core Ideas

PS3.B: Conservation of Energy and Energy Transfer

- Sunlight warms Earth's surface.

Crosscutting Concepts

Cause and Effect

- Events have causes that generate observable patterns.

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students use given scientific information about sunlight's warming effect on the Earth's surface to collaboratively design and build a structure that reduces warming caused by the sun.
	b	With support, students individually describe*:
		i. The problem.
		ii. The design solution.
		iii. In what way the design solution uses the given scientific information.
2	Describing* specific features of the design solution, including quantification when appropriate	
	a	Students describe* that the structure is expected to reduce warming for a designated area by providing shade.
	b	Students use only the given materials and tools when building the structure.
3	Evaluating potential solutions	
	a	Students describe* whether the structure meets the expectations in terms of cause (structure blocks sunlight) and effect (less warming of the surface).

K-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

K-LS1-1. **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.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

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Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Scientists look for patterns and order when making observations about the world.

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms

- All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.

Crosscutting Concepts

Patterns

- Patterns in the natural and human designed world can be observed and used as evidence.

Observable features of the student performance by the end of the grade:			
1	Organizing data		
	a	With guidance, students organize the given data from observations (firsthand or from media) using graphical displays (e.g., pictures, charts), including:	
		i.	Different types of animals (including humans).
		ii.	Data about the foods different animals eat.
		iii.	Data about animals drinking water.
		iv.	Data about plants' need for water (e.g., observations of the effects on plants in a classroom or school when they are not watered, observations of natural areas that are very dry).
		v.	Data about plants' need for light (e.g., observations of the effect on plants in a classroom when they are kept in the dark for a long time; observations about the presence or absence of plants in very dark places, such as under rocks or porches).
2	Identifying relationships		
	a	Students identify patterns in the organized data, including that:	
		i.	All animals eat food.
			1. Some animals eat plants.
			2. Some animals eat other animals.
			3. Some animals eat both plants and animals.
			4. No animals do not eat food.
		ii.	All animals drink water.
		iii.	Plants cannot live or grow if there is no water.
		iv.	Plants cannot live or grow if there is no light.
3	Interpreting data		
	a	Students describe* that the patterns they identified in the data provide evidence that:	
		i.	Plants need light and water to live and grow.
		ii.	Animals need food and water to live and grow.
		iii.	Animals get their food from plants, other animals, or both.

K-ESS2-1 Earth's Systems

Students who demonstrate understanding can:

K-ESS2-1. **Use and share observations of local weather conditions to describe patterns over time.** [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

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Connections to Nature of Science

Science Knowledge is Based on Empirical Evidence

- Scientists look for patterns and order when making observations about the world.

Disciplinary Core Ideas

ESS2.D: Weather and Climate

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

Crosscutting Concepts

Patterns

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

Observable features of the student performance by the end of the grade:			
1	Organizing data		
	a	With guidance, students organize data from given observations (firsthand or from media) about local weather conditions using graphical displays (e.g., pictures, charts). The weather condition data include:	
		i.	The number of sunny, cloudy, rainy, windy, cool, or warm days.
		ii.	The relative temperature at various times of the day (e.g., cooler in the morning, warmer during the day, cooler at night).
2	Identifying relationships		
	a	Students identify and describe* patterns in the organized data, including:	
		i.	The relative number of days of different types of weather conditions in a month.
		ii.	The change in the relative temperature over the course of a day.
3	Interpreting data		
	a	Students describe* and share that:	
		i.	Certain months have more days of some kinds of weather than do other months (e.g., some months have more hot days, some have more rainy days).
		ii.	The differences in relative temperature over the course of a day (e.g., between early morning and the afternoon, between one day and another) are directly related to the time of day.

K-ESS2-2 Earth's Systems

Students who demonstrate understanding can:

K-ESS2-2. **Construct an argument supported by evidence for 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.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Construct an argument with evidence to support a claim.	**ESS2.E: Biogeology** • Plants and animals can change their environment. **ESS3.C: Human Impacts on Earth Systems** • Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. *(secondary)*	**Systems and System Models** • Systems in the natural and designed world have parts that work together.

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim to be supported about a phenomenon. In their claim, students include the idea that plants and animals (including humans) can change the environment to meet their needs.
2	Identifying scientific evidence	
	a	Students identify and describe* the given evidence to support the claim, including:
		i. Examples of plants changing their environments (e.g., plant roots lifting sidewalks).
		ii. Examples of animals (including humans) changing their environments (e.g., ants building an ant hill, humans clearing land to build houses, birds building a nest, squirrels digging holes to hide food).
		iii. Examples of plant and animal needs (e.g., shelter, food, room to grow).
3	Evaluating and critiquing evidence	
	a	Students describe* how the examples do or do not support the claim.
4	Reasoning and synthesis	
	a	Students support the claim and present an argument by logically connecting various needs of plants and animals to evidence about how plants/animals change their environments to meet their needs. Students include:
		i. Examples of how plants affect other parts of their systems by changing their environments to meet their needs (e.g., roots push soil aside as they grow to better absorb water).
		ii. Examples of how animals affect other parts of their systems by changing their environments to meet their needs (e.g., ants, birds, rabbits, and humans use natural materials to build shelter; some animals store food for winter).

K-ESS3-1 Earth and Human Activity

Students who demonstrate understanding can:

K-ESS3-1. **Use a model to represent the relationship between the needs of different plants and 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.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions. • Use a model to represent relationships in the natural world.	**ESS3.A: Natural Resources** • Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.	**Systems and System Models** • Systems in the natural and designed world have parts that work together.

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	From the given model (e.g., representation, diagram, drawing, physical replica, diorama, dramatization, storyboard) of a phenomenon involving the needs of living things and their environments, students identify and describe* the components that are relevant to their representations, including:	
		i.	Different plants and animals (including humans).
		ii.	The places where the different plants and animals live.
		iii.	The things that plants and animals need (e.g., water, air, and land resources such as wood, soil, and rocks).
2	Relationships		
	a	Students use the given model to represent and describe* relationships between the components, including:	
		i.	The relationships between the different plants and animals and the materials they need to survive (e.g., fish need water to swim, deer need buds and leaves to eat, plants need water and sunlight to grow).
		ii.	The relationships between places where different plants and animals live and the resources those places provide.
		iii.	The relationships between specific plants and animals and where they live (e.g., fish live in water environments, deer live in forests where there are buds and leaves, rabbits live in fields and woods where there is grass to eat and space for burrows for homes, plants live in sunny and moist areas, humans get resources from nature [e.g., building materials from trees to help them live where they want to live]).
3	Connections		
	a	Students use the given model to represent and describe*, including:	
		i.	Students use the given model to describe* the pattern of how the needs of different plants and animals are met by the various places in which they live (e.g., plants need sunlight so they are found in places that have sunlight; fish swim in water so they live in lakes, rivers, ponds, and oceans; deer eat buds and leaves so they live in the forest).
		ii.	Students use the given model to describe* that plants and animals, the places in which they live, and the resources found in those places are each part of a system, and that these parts of systems work together and allow living things to meet their needs.

K-ESS3-2 Earth and Human Activity

Students who demonstrate understanding can:

K-ESS3-2. **Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*** [Clarification Statement: Emphasis is on local forms of severe weather.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.

- Ask questions based on observations to find more information about the designed world.

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

- Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world.

Disciplinary Core Ideas

ESS3.B: Natural Hazards

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

ETS1.A: Defining and Delimiting an Engineering Problem

- Asking questions, making observations, and gathering information are helpful in thinking about problems. *(secondary)*

Crosscutting Concepts

Cause and Effect

- Events have causes that generate observable patterns.

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Connections to Engineering,Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- People encounter questions about the natural world every day.

Influence of Engineering, Technology, and Science on Society and the Natural World

- People depend on various technologies in their lives; human life would be very different without technology.

Observable features of the student performance by the end of the grade:			
1	Addressing phenomena of the natural world		
	a	Students formulate questions about local severe weather, the answers to which would clarify how weather forecasting can help people avoid the most serious impacts of severe weather events.	
2	Identifying the scientific nature of the question		
	a	Students' questions are based on their observations..	
3	Obtaining information		
	a	Students collect information (e.g., from questions, grade appropriate texts, media) about local severe weather warnings (e.g., tornado alerts, hurricane warnings, major thunderstorm warnings, winter storm warnings, severe drought alerts, heat wave alerts), including that:.	
		i.	There are patterns related to local severe weather that can be observed (e.g., certain types of severe weather happen more in certain places).
		ii.	Weather patterns (e.g., some events are more likely in certain regions) help scientists predict severe weather before it happens.
		iii.	Severe weather warnings are used to communicate predictions about severe weather.
		iv.	Weather forecasting can help people plan for, and respond to, specific types of local weather (e.g., responses: stay indoors during severe weather, go to cooling centers during heat waves; preparations: evacuate coastal areas before a hurricane, cover windows before storms).

K-ESS3-3 Earth and Human Activity

Students who demonstrate understanding can:

K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.* [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas.	**ESS3.C: Human Impacts on Earth Systems** • Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. **ETS1.B: Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.*(secondary)*	**Cause and Effect** • Events have causes that generate observable patterns.

Observable features of the student performance by the end of the grade:			
1	Communicating information		
	a	Students use prior experiences and observations to describe* information about:	
		i.	How people affect the land, water, air, and/or other living things in the local environment in positive and negative ways.
		ii.	Solutions that reduce the negative effects of humans on the local environment.
	b	Students communicate information about solutions that reduce the negative effects of humans on the local environment, including:	
		i.	Examples of things that people do to live comfortably and how those things can cause changes to the land, water, air, and/or living things in the local environment.
		ii.	Examples of choices that people can make to reduce negative impacts and the effect those choices have on the local environment.
	b	Students communicate the information about solutions with others in oral and/or written form (which include using models and/or drawings.	

K-2-ETS1-1 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Define a simple problem that can be solved through the development of a new or improved object or tool.	**ETS1.A: 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.	

Observable features of the student performance by the end of the grade:			
1	Addressing phenomena of the natural or designed world		
	a	Students ask questions and make observations to gather information about a situation that people want to change. Students' questions, observations, and information gathering are focused on:	
		i.	A given situation that people wish to change.
		ii.	Why people want the situation to change.
		iii.	The desired outcome of changing the situation.
2	Identifying the scientific nature of the question		
	a	Students' questions are based on observations and information gathered about scientific phenomena that are important to the situation.	
3	Identifying the problem to be solved		
	a	Students use the information they have gathered, including the answers to their questions, observations they have made, and scientific information, to describe* the situation people want to change in terms of a simple problem that can be solved with the development of a new or improved object or tool.	
4	Defining the features of the solution		
	a	With guidance, students describe* the desired features of the tool or object that would solve the problem, based on scientific information, materials available, and potential related benefits to people and other living things.	

K-2-ETS1-2 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop a simple model based on evidence to represent a proposed object or tool.	**ETS1.B: Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**Structure and Function** • The shape and stability of structures of natural and designed objects are related to their function(s).

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students develop a representation of an object and the problem it is intended to solve. In their representation, students include the following components:	
		i.	The object.
		ii.	The relevant shape(s) of the object.
		iii.	The function of the object.
	b	Students use sketches, drawings, or physical models to convey their representations.	
2	Relationships		
	a	Students identify relationships between the components in their representation, including:	
		i.	The shape(s) of the object and the object's function.
		ii.	The object and the problem is it designed to solve.
3	Connections		
	a	Students use their representation (simple sketch, drawing, or physical model) to communicate the connections between the shape(s) of an object, and how the object could solve the problem.	

K-2-ETS1-3 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended.	**ETS1.C: Optimizing the Design Solution** • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	With guidance, students use graphical displays (e.g., tables, pictographs, line plots) to organize given data from tests of two objects, including data about the features and relative performance of each solution.
2	Identifying relationships	
	a	Students use their organization of the data to find patterns in the data, including:
		i. How each of the objects performed, relative to:
		1. The other object.
		2. The intended performance.
		ii. How various features (e.g., shape, thickness) of the objects relate to their performance (e.g., speed, strength).
3	Interpreting data	
	a	Students use the patterns they found in object performance to describe*:
		i. The way (e.g., physical process, qualities of the solution) each object will solve the problem.
		ii. The strengths and weaknesses of each design.
		iii. Which object is better suited to the desired function, if both solve the problem.

Iowa Science Standards

First Grade Standards

Foundation Boxes

Evidence Statements

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

Students who demonstrate understanding can:

1-PS4-1. **Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.** [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Plan and conduct investigations collaboratively to produce evidence to answer a question.

- -

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations begin with a question.
- Scientists use different ways to study the world.

Disciplinary Core Ideas

PS4.A: Wave Properties

- Sound can make matter vibrate, and vibrating matter can make sound.

Crosscutting Concepts

Cause and Effect

- Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Observable features of the student performance by the end of the grade:			
1	Identifying the phenomenon under investigation		
	a	Students identify and describe* the phenomenon and purpose of the investigation, which include providing evidence to answer questions about the relationship between vibrating materials and sound.	
2	Identifying the evidence to address the purpose of the investigation		
	a	Students collaboratively develop an investigation plan and describe* the evidence that will result from the investigation, including:	
		i.	Observations that sounds can cause materials to vibrate.
		ii.	Observations that vibrating materials can cause sounds.
		iii.	How the data will provide evidence to support or refute ideas about the relationship between vibrating materials and sound.
	b	Students individually describe* (with support) how the evidence will address the purpose of the investigation.	
3	Planning the investigation		
	a	In the collaboratively developed investigation plan, students individually identify and describe*:	
		i.	The materials to be used.
		ii.	How the materials will be made to vibrate to make sound.
		iii.	How resulting sounds will be observed and described*.
		iv.	What sounds will be used to make materials vibrate.
		v.	How it will be determined that a material is vibrating.
4	Collecting the data		
	a	According to the investigation plan they develop, students collaboratively collect and record observations about:	
		i.	Sounds causing materials to vibrate.
		ii.	Vibratingmaterials causing sounds.

1-PS4-2 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

1-PS4-2. **Make observations to construct an evidence-based account that objects in darkness 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.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	**PS4.B: Electromagnetic Radiation** • Objects can be seen if light is available to illuminate them or if they give off their own light.	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Observable features of the student performance by the end of the grade:			
1	Articulating the explanation of phenomena		
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that when an object in the dark is lit (e.g., turning on a light in the dark space or from light the object itself gives off), it can be seen.	
	b	Students use evidence and reasoning to construct an evidence-based account of the phenomenon.	
2	Evidence		
	a	Students make observations (firsthand or from media) to serve as the basis for evidence, including:	
		i.	The appearance (e.g., visible, not visible, somewhat visible but difficult to see) of objects in a space with no light.
		ii.	The appearance (e.g., visible, not visible, somewhat visible but difficult to see) of objects in a space with light.
		iii.	The appearance (e.g., visible, not visible, somewhat visible but difficult to see) of objects (e.g., light bulbs, glow sticks) that give off light in a space with no other light.
	b	Students describe* how their observations provide evidence to support their explanation.	
3	Reasoning		
	a	Students logically connect the evidence to support the evidence-based account of the phenomenon. Students describe* lines of reasoning that include:	
		i.	The presence of light in a space causes objects to be able to be seen in that space.
		ii.	Objects cannot be seen if there is no light to illuminate them, but the same object in the same space can be seen if a light source is introduced.
		iii.	The ability of an object to give off its own light causes the object to be seen in a space where there is no other light.

1-PS4-3 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

1-PS4-3. **Plan and conduct investigations 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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Plan and conduct investigations collaboratively to produce evidence to answer a question.	**PS4.B: Electromagnetic Radiation** • 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.)	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Observable features of the student performance by the end of the grade:				
1	Identifying the phenomenon under investigation			
	a	Students identify and describe* the phenomenon and purpose of the investigation, which include:		
		i.	Answering a question about what happens when objects made of different materials (that allow light to pass through them in different ways) are placed in the path of a beam of light.	
		ii.	Designing and conducting an investigation to gather evidence to support or refute student ideas about putting objects made of different materials in the path of a beam of light.	
2	Identifying evidence to address the purpose of the investigation			
	a	Students collaboratively develop an investigation plan and describe* the data that will result from the investigation, including:		
		i.	Observations of the effect of placing objects made of different materials in a beam of light, including:	
			1.	A material that allows all light through results in the background lighting up.
			2.	A material that allows only some light through results in the background lighting up, but looking darker than when the material allows all light in.
			3.	A material that blocks all of the light will create a shadow.
			4.	A material that changes the direction of the light will light up the surrounding space in a different direction.
	b	Students individually describe* how these observations provide evidence to answer the question under investigation.		
3	Planning the investigation			
	a	In the collaboratively developed investigation plan, students individually describe* (with support):		
		i.	The materials to be placed in the beam of light, including:	
			1.	A material that allows all light through (e.g., clear plastic, clear glass).
			2.	A material that allows only some light through (e.g., clouded plastic, wax paper).
			3.	A material that blocks all of the light (e.g., cardboard, wood).

		4. A material that changes the direction of the light (e.g., mirror, aluminum foil).
		ii. How the effect of placing different materials in the beam of light will be observed and recorded.
		iii. The light source used to produce the beam of light.
4	Collecting the data	
	a	Students collaboratively collect and record observations about what happens when objects made of materials that allow light to pass through them in different ways are placed in the path of a beam of light, according to the developed investigation plan.

1-PS4-4 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

1-PS4-4. **Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*** [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [*Assessment Boundary: Assessment does not include technological details for how communication devices work.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Use tools and materials provided to design a device that solves a specific problem.

Disciplinary Core Ideas

PS4.C: Information Technologies and Instrumentation

- People also use a variety of devices to communicate (send and receive information) over long distances.

Crosscutting Concepts

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Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science, on Society and the Natural World

- People depend on various technologies in their lives; human life would be very different without technology.

Observable features of the student performance by the end of the grade:			
1	Using scientific knowledge to generate design solutions		
	a	Students describe* a given problem involving people communicating over long distances.	
	b	With guidance, students design and build a device that uses light or sound to solve the given problem.	
	c	With guidance, students describe* the scientific information they use to design the solution.	
2	Describing* specific features of the design solution, including quantification when appropriate		
	a	Students describe* that specific expected or required features of the design solution should include:	
		i.	The device is able to send or receive information over a given distance.
		ii.	The device must use light or sound to communicate.
	b	Students use only the materials provided when building the device.	
3	Evaluating potential solutions		
	a	Students describe* whether the device:	
		i.	Has the expected or required features of the design solution,
		ii.	Provides a solution to the problem involving people communicating over a distance by using light or sound.
	b	Students describe* how communicating over long distances helps people.	

1-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

1-LS1-1. **Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*** [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Use materials to design a device that solves a specific problem or a solution to a specific problem.

Disciplinary Core Ideas

LS1.A: 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.

LS1.D: 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.

Crosscutting Concepts

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s).

- -

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering and Technology on Society and the Natural World

- Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.

Observable features of the student performance by the end of the grade:			
1	Using scientific knowledge to generate design solutions		
	a	Students describe* the given human problem to be solved by the design.	
	b	With guidance, students use given scientific information about plants and/or animals to design the solution, including:	
		iii.	How external structures are used to help the plant and/or animal grow and/or survive.
		iv.	How animals use external structures to capture and convey different kinds of information they need.
		v.	How plants and/or animals respond to information they receive from the environment.
	c	Students design a device (using student-suggested materials) that provides a solution to the given human problem by mimicking how plants and/or animals use external structures to survive, grow, and/or meet their needs. This may include:	
		i.	Mimicking the way a plant and/or animal uses an external structure to help it survive, grow, and/or meet its needs.
		ii.	Mimicking the way an external structure of an animal captures and conveys information.
		iii.	Mimicking the way an animal and/or plant responds to information from the environment.

2	Describing* specific features of the design solution, including quantification when appropriate	
	a	Students describe* the specific expected or required features in their designs and devices, including:
		i. The device provides a solution to the given human problem.
		ii. The device mimic plant and/or animal external parts, and/or animal information-processing
		iii. The device use the provided materials to develop solutions.
3	Evaluating potential solutions	
	a	Students describe* how the design solution is expected to solve the human problem.
	b	Students determine and describe* whether their device meets the specific required features.

1-LS1-2 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

1-LS1-2. **Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.** [Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

- Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world.

- -

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Scientists look for patterns and order when making observations about the world.

Disciplinary Core Ideas

LS1.B: 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.

Crosscutting Concepts

Patterns

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Observable features of the student performance by the end of the grade:			
1	Obtaining information		
	a	Students use grade-appropriate books and other reliable media to obtain the following scientific information:	
		i.	Information about the idea that both plants and animals can have offspring.
		ii.	Information about behaviors of animal parents that help offspring survive (e.g., keeping offspring safe from predators by circling the young, feeding offspring).
		iii.	Information about behaviors of animal offspring that help the offspring survive (e.g., crying, chirping, nuzzling for food).
2	Evaluating information		
	a	Students evaluate the information to determine and describe* the patterns of what animal parents and offspring do to help offspring survive (e.g., when a baby cries, the mother feeds it; when danger is present, parents protect offspring; some young animals become silent to avoid predators).	

1-LS3-1 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.

Disciplinary Core Ideas

LS3.A: 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.

LS3.B: Variation of Traits

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

Crosscutting Concepts

Patterns

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Observable features of the student performance by the end of the grade:			
1	Articulating the explanation of phenomena		
	a	Students articulate a statement that relates a given phenomenon to a scientific idea, including the idea that young plants and animals are like, but not exactly like, their parents (not to include animals that undergo complete metamorphoses, such as insects or frogs).	
	b	Students use evidence and reasoning to construct an evidence-based account of the phenomenon.	
2	Evidence		
	a	Students describe* evidence from observations (firsthand or from media) about patterns of features in plants and animals, including:	
		i.	Key differences between different types of plants and animals (e.g., features that distinguish dogs versus those that distinguish fish, oak trees vs. bean plants).
		ii.	Young plants and animals of the same type have similar, but not identical features (e.g., size and shape of body parts, color and/or type of any hair, leaf shape, stem rigidity).
		iii.	Adult plants and animals (i.e., parents) of the same type have similar, but not identical features (e.g., size and shape of body parts, color and/or type of any hair, leaf shape, stem rigidity).
		iv.	Patterns of similarities and differences in features between parents and offspring.
3	Reasoning		
	a	Students logically connect the evidence of observed patterns in features to support the evidence-based account by describing* chains of reasoning that include:	
		i.	Young plants and animals are very similar to their parents.
		ii.	Young plants and animals are not exactly the same as their parents.
		iii.	Similarities and differences in features are evidence that young plants and animals are very much, but not exactly, like their parents.
		iv.	Similarities and differences in features are evidence that although individuals of the same type of animal or plant are recognizable as similar, they can also vary in many ways.

1-ESS1-1 Earth's Place in the Universe

Students who demonstrate understanding can:

1-ESS1-1. **Use observations of the sun, moon, and stars to describe patterns that can be predicted.** [Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [*Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.	**ESS1.A: The Universe and its Stars** • Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.	**Patterns** • Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. - ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes natural events happen today as they happened in the past. • Many events are repeated.

Observable features of the student performance by the end of the grade:			
1	Organizing data		
	a	With guidance, students use graphical displays (e.g., picture, chart) to organize data from given observations (firsthand or from media), including:	
		i.	Objects (i.e., sun, moon, stars) visible in the sky during the day.
		ii.	Objects (i.e., sun, moon, stars) visible in the sky during the night.
		iii.	The position of the sun in the sky at various times during the day.
		iv.	The position of the moon in the sky at various times during the day or night.
2	Identifying relationships		
	a	Students identify and describe* patterns in the organized data, including:	
		i.	Stars are not seen in the sky during the day, but they are seen in the sky during the night.
		ii.	The sun is at different positions in the sky at different times of the day, appearing to rise in one part of the sky in the morning and appearing to set in another part of the sky in the evening.
		iii.	The moon can be seen during the day and at night, but the sun can only be seen during the day.
		iv.	The moon is at different positions in the sky at different times of the day or night, appearing to rise in one part of the sky and appearing to set in another part of the sky.
3	Interpreting data		
	a	Students use the identified patterns of the motions of objects in the sky to provide evidence that future appearances of those objects can be predicted (e.g., if the moon is observed to rise in one part of the sky, a prediction can be made that the moon will move across the sky and appear to set in a different portion of the sky; if the sun is observed to rise in one part of the sky, a prediction can be made about approximately where the sun will be at different times of day).	
	b	Students use patterns related to the appearance of objects in the sky to provide evidence that future appearances of those objects can be predicted (e.g., when the sun sets and can no longer be seen, a prediction can be made that the sun will rise again in the morning; a prediction can be made that stars will only be seen at night).	

1-ESS1-2 Earth's Place in the Universe

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Make observations (firsthand or from media) to collect data that can be used to make comparisons.

Disciplinary Core Ideas

ESS1.B: Earth and the Solar System

- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

Crosscutting Concepts

Patterns

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.

Observable features of the student performance by the end of the grade:			
1	Identifying the phenomenon under investigation		
	a	Students identify and describe* the phenomenon and purpose of the investigation, which include the following idea: the relationship between the amount of daylight and the time of year.	
2	Identifying evidence to address the purpose of the investigation		
	a	Based on the given plan for the investigation, students (with support) describe* the data and evidence that will result from the investigation, including observations (firsthand or from media) of relative length of the day (sunrise to sunset) throughout the year.	
	b	Students individually describe* how these observations could reveal the pattern between the amount of daylight and the time of year (i.e., relative lightness and darkness at different relative times of the day and throughout the year).	
3	Planning the investigation		
	a	Based on the given investigation plan, students describe* (with support):	
		i.	How the relative length of the day will be determined (e.g., whether it will be light or dark when waking in the morning, at breakfast, when having dinner, or going to bed at night).
		ii.	When observations will be made and how they will be recorded, both within a day and across the year.
4	Collecting the data		
	a	According to the given investigation plan, students collaboratively make and record observations about the relative length of the day in different seasons to make relative comparisons between the amount of daylight at different times of the year (e.g., summer, winter, fall, spring).	

K-2-ETS1-1 **Engineering Design**

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions.

- Ask questions based on observations to find more information about the natural and/or designed world(s).
- Define a simple problem that can be solved through the development of a new or improved object or tool.

Disciplinary Core Ideas

ETS1.A: 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.

Crosscutting Concepts

Observable features of the student performance by the end of the grade:		
1	Addressing phenomena of the natural or designed world	
	a	Students ask questions and make observations to gather information about a situation that people want to change. Students' questions, observations, and information gathering are focused on:
		iv. A given situation that people wish to change.
		v. Why people want the situation to change.
		vi. The desired outcome of changing the situation.
2	Identifying the scientific nature of the question	
	a	Students' questions are based on observations and information gathered about scientific phenomena that are important to the situation.
3	Identifying the problem to be solved	
	a	Students use the information they have gathered, including the answers to their questions, observations they have made, and scientific information, to describe* the situation people want to change in terms of a simple problem that can be solved with the development of a new or improved object or tool.
4	Defining the features of the solution	
	a	With guidance, students describe* the desired features of the tool or object that would solve the problem, based on scientific information, materials available, and potential related benefits to people and other living things.

K-2-ETS1-2 **Engineering Design**

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop a simple model based on evidence to represent a proposed object or tool.	**ETS1.B: Developing Possible Solutions** • Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**Structure and Function** • The shape and stability of structures of natural and designed objects are related to their function(s).

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students develop a representation of an object and the problem it is intended to solve. In their representation, students include the following components:	
		iv.	The object.
		v.	The relevant shape(s) of the object.
		vi.	The function of the object.
	b	Students use sketches, drawings, or physical models to convey their representations.	
2	Relationships		
	a	Students identify relationships between the components in their representation, including:	
		iii.	The shape(s) of the object and the object's function.
		iv.	The object and the problem is it designed to solve.
3	Connections		
	a	Students use their representation (simple sketch, drawing, or physical model) to communicate the connections between the shape(s) of an object, and how the object could solve the problem.	

K-2-ETS1-3 **Engineering Design**

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended.	**ETS1.C: Optimizing the Design Solution** • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	

Observable features of the student performance by the end of the grade:			
1	Organizing data		
	a	With guidance, students use graphical displays (e.g., tables, pictographs, line plots) to organize given data from tests of two objects, including data about the features and relative performance of each solution.	
2	Identifying relationships		
	a	Students use their organization of the data to find patterns in the data, including:	
		iii.	How each of the objects performed, relative to:
			3. The other object.
			4. The intended performance.
		iv.	How various features (e.g., shape, thickness) of the objects relate to their performance (e.g., speed, strength).
3	Interpreting data		
	a	Students use the patterns they found in object performance to describe*:	
		iv.	The way (e.g., physical process, qualities of the solution) each object will solve the problem.
		v.	The strengths and weaknesses of each design.
		vi.	Which object is better suited to the desired function, if both solve the problem.

Iowa Science Standards

Second Grade Standards
Foundation Boxes
Evidence Statements

2-PS1-1 Matter and Its Interactions

Students who demonstrate understanding can:

2-PS1-1. **Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.** [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.	**PS1.A: 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.	**Patterns** • Patterns in the natural and human designed world can be observed.

Observable features of the student performance by the end of the grade:			
1	Identifying the phenomenon under investigation		
	a	Students identify and describe* the phenomenon under investigation, which includes the following idea: different kinds of matter have different properties, and sometimes the same kind of matter has different properties depending on temperature.	
	b	Students identify and describe* the purpose of the investigation, which includes answering a question about the phenomenon under investigation by describing* and classifying different kinds of materials by their observable properties.	
2	Identifying the evidence to address the purpose of the investigation		
	a	Students collaboratively develop an investigation plan and describe* the evidence that will be collected, including the properties of matter (e.g., color, texture, hardness, flexibility, whether is it a solid or a liquid) of the materials that would allow for classification, and the temperature at which those properties are observed.	
	b	Students individually describe* that:	
		v.	The observations of the materials provide evidence about the properties of different kinds of materials.
		vi.	Observable patterns in the properties of materials provide evidence to classify the different kinds of materials.
3	Planning the investigation		
	a	In the collaboratively developed investigation plan, students include:	
		vi.	Which materials will be described* and classified (e.g., different kinds of metals, rocks, wood, soil, powders).
		vii.	Which materials will be observed at different temperatures, and how those temperatures will be determined (e.g., using ice to cool and a lamp to warm) and measured (e.g., qualitatively or quantitatively).
		viii.	How the properties of the materials will be determined.
		ix.	How the materials will be classified (i.e., sorted) by the pattern of the properties.
	b	Students individually describe* how the properties of materials, and the method for classifying them, are relevant to answering the question.	
4	Collecting the data		
	a	According to the developed investigation plan, students collaboratively collect and record data on the properties of the materials.	

2-PS1-2 Matter and Its Interactions

Students who demonstrate understanding can:

2-PS1-2. **Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [*Assessment Boundary: Assessment of quantitative measurements is limited to length.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended.	**PS1.A: Structure and Properties of Matter** • Different properties are suited to different purposes.	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes. - - - - - - - - - - - - - - - - ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science, on Society and the Natural World** • Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	Using graphical displays (e.g., pictures, charts, grade-appropriate graphs), students use the given data from tests of different materials to organize those materials by their properties (e.g., strength, flexibility, hardness, texture, ability to absorb).
2	Identifying relationships	
	a	Students describe* relationships between materials and their properties (e.g., metal is strong, paper is absorbent, rocks are hard, sandpaper is rough).
	b	Students identify and describe* relationships between properties of materials and some potential uses purpose (e.g., hardness is good for breaking objects or supporting objects; roughness is good for keeping objects in place; flexibility is good to keep a materials from breaking, but not good for keeping materials rigidly in place).
3	Interpreting data	
	a	Students describe* which properties allow a material to be well suited for a given intended use (e.g., ability to absorb for cleaning up spills, strength for building material, hardness for breaking a nut).
	b	Students use their organized data to support or refute their ideas about which properties of materials allow the object or tool to be best suited for the given intended purpose relative to the other given objects/tools (e.g., students could support the idea that hardness allows a wooden shelf to be better suited for supporting materials placed on it than a sponge would be, based on the patterns relating property to a purpose; students could refute an idea that a thin piece of glass is better suited to be a shelf than a wooden plank would be because it is harder than the wood by using data from tests of hardness and strength to give evidence that the glass is less strong than the wood) .
	c	Students describe* how the given data from the test provided evidence of the suitability of different materials for the intended purpose.

2-PS1-3 Matter and Its Interactions

Students who demonstrate understanding can:

2-PS1-3. **Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.** [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	**PS1.A: Structure and Properties of Matter** • Different properties are suited to different purposes. • A great variety of objects can be built up from a small set of pieces.	**Energy and Matter** • Objects may break into smaller pieces and be put together into larger pieces, or change shapes.

Observable features of the student performance by the end of the grade:		
1	Articulating the explanation of phenomena	
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that an object made of a small set of pieces can be disassembled and made into a new object.
	b	Students use evidence and reasoning to construct an evidence-based account of the phenomenon.
2	Evidence	
	a	Students describe* evidence from observations (firsthand or from media), including:
		i. The characteristics (e.g., size, shape, arrangement of parts) of the original object.
		ii. That the original object was disassembled into pieces.
		iii. That the pieces were reassembled into a new object or objects.
		iv. The characteristics (e.g., size, shape, arrangement of parts) of the new object or objects.
3	Reasoning	
	a	Students use reasoning to connect the evidence to support an explanation. Students describe* a chain of reasoning that includes:
		i. The original object was disassembled into its pieces and is reassembled into a new object or objects.
		ii. Many different objects can be built from the same set of pieces.
		iii. Compared to the original object, the new object or objects can have different characteristics, even though they were made of the same set of pieces.

2-PS1-4 Matter and Its Interactions

Students who demonstrate understanding can:

2-PS1-4. **Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.** [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence
Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).

- Construct an argument with evidence to support a claim.

- -

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Science searches for cause and effect relationships to explain natural events.

Disciplinary Core Ideas

PS1.B: Chemical Reactions

- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

Crosscutting Concepts

Cause and Effect

- Events have causes that generate observable patterns.

Observable features of the student performance by the end of the grade:			
1	Supported claims		
	a	Students make a claim to be supported about a phenomenon. In their claim, students include the idea that some changes caused by heating or cooling can be reversed and some cannot.	
2	Identifying scientific evidence		
	a	Students describe* the given evidence, including:	
		i.	The characteristics of the material before heating or cooling.
		ii.	The characteristics of the material after heating or cooling.
		iii.	The characteristics of the material when the heating or cooling is reversed.
3	Evaluating and critiquing the evidence		
	a	Students evaluate the evidence to determine:	
		i.	The change in the material after heating (e.g., ice becomes water, an egg becomes solid, solid chocolate becomes liquid).
		ii.	Whether the change in the material after heating is reversible (e.g., water becomes ice again, a cooked egg remains a solid, liquid chocolate becomes solid but can be a different shape).
		iii.	The change in the material after cooling (e.g., when frozen, water becomes ice, a plant leaf dies).
		iv.	Whether the change in the material after cooling is reversible (e.g., ice becomes water again, a plant leaf does not return to normal).
	b	Students describe* whether the given evidence supports the claim and whether additional evidence is needed.	
4	Reasoning and synthesis		
	a	Students use reasoning to connect the evidence to the claim. Students describe* the following chain of reasoning:	
		i.	Some changes caused by heating or cooling can be reversed by cooling or heating (e.g., ice that is heated can melt into water, but the water can be cooled and can freeze back into ice [and vice versa]).
		ii.	Some changes caused by heating or cooling cannot be reversed by cooling or heating (e.g., a raw egg that is cooked by heating cannot be turned back into a raw egg by cooling the cooked egg, cookie dough that is baked does not return to its uncooked form when cooled, charcoal that is formed by heating wood does not return to its original form when cooled

2-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

2-LS2-1. **Plan and conduct an investigation to determine if plants need sunlight and water to grow.** [*Assessment Boundary: Assessment is limited to testing one variable at a time.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- Plants depend on water and light to grow.

Crosscutting Concepts

Cause and Effect

- Events have causes that generate observable patterns.

Observable features of the student performance by the end of the grade:			
1	Identifying the phenomenon under investigation		
	a	Students identify and describe* the phenomenon and purpose of the investigation, which include answering a question about whether plants need sunlight and water to grow.	
2	Identifying the evidence to address the purpose of the investigation		
	a	Students describe* the evidence to be collected, including:	
		i.	Plant growth with both light and water.
		ii.	Plant growth without light but with water.
		iii.	Plant growth without water but with light.
		iv.	Plant growth without water and without light.
	b	Students describe* how the evidence will allow them to determine whether plants need light and water to grow.	
3	Planning the investigation		
	a	Students collaboratively develop an investigation plan. In the investigation plan, students describe* the features to be part of the investigation, including:	
		i.	The plants to be used.
		ii.	The source of light.
		iii.	How plants will be kept with/without light in both the light/dark test and the water/no water test.
		iv.	The amount of water plants will be given in both the light/dark test and the water/no water test.
		v.	How plant growth will be determined (e.g., observations of plant height, number and size of leaves, thickness of the stem, number of branches).
	b	Students individually describe* how this plan allows them to answer the question.	
4	Collecting the data		
	a	According to the investigation plan developed, students collaboratively collect and record data on the effects on plant growth by:	
		i.	Providing both light and water,
		ii.	Withholding light but providing water,
		iii.	Withholding water but providing light, or
		iv.	Withholding both water and light.

2-LS2-2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

- Develop a simple model based on evidence to represent a proposed object or tool.

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- Plants depend on animals for pollination or to move their seeds around.

ETS1.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.*(secondary)*

Crosscutting Concepts

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s).

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students develop a simple model that mimics the function of an animal in seed dispersal or pollination of plants. Students identify the relevant components of their model, including those components that mimic the natural structure of an animal that helps it disperse seeds (e.g., hair that snares seeds, squirrel cheek pouches that transport seeds) or that mimic the natural structure of an animal that helps it pollinate plants (e.g., bees have fuzzy bodies to which pollen sticks, hummingbirds have bills that transport pollen). The relevant components of the model include:	
		i.	Relevant structures of the animal.
		ii.	Relevant structures of the plant.
		iii.	Pollen or seeds from plants.
2	Relationships		
	a	In the model, students describe* relationships between components, including evidence that the developed model mimics how plant and animal structures interact to move pollen or disperse seeds.	
		i.	Students describe* the relationships between components that allow for movement of pollen or seeds.
		ii.	Students describe* the relationships between the parts of the model they are developing and the parts of the animal they are mimicking.
3	Connections		
	a	Students use the model to describe*:	
		i.	How the structure of the model gives rise to its function.
		ii.	Structure-function relationships in the natural world that allow some animals to disperse seeds or pollinate plants.

2-LS4-1 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • Make observations (firsthand or from media) to collect data which can be used to make comparisons. - ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Scientists look for patterns and order when making observations about the world.	**LS4.D: 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.	

Observable features of the student performance by the end of the grade:			
1	Identifying the phenomenon under investigation		
	a	Students identify and describe* the phenomenon and purpose of the investigation, which includes comparisons of plant and animal diversity of life in different habitats.	
2	Identifying the evidence to address the purpose of the investigation		
	a	Based on the given plan for the investigation, students describe* the following evidence to be collected:	
		i.	Descriptions* based on observations (firsthand or from media) of habitats, including land habitats (e.g., playground, garden, forest, parking lot) and water habitats (e.g., pond, stream, lake).
		ii.	Descriptions* based on observations (firsthand or from media) of different types of living things in each habitat (e.g., trees, grasses, bushes, flowering plants, lizards, squirrels, ants, fish, clams).
		iii.	Comparisons of the different types of living things that can be found in different habitats.
	b	Students describe* how these observations provide evidence for patterns of plant and animal diversity across habitats.	
3	Planning the investigation		
	a	Based on the given investigation plan, students describe* how the different plants and animals in the habitats will be observed, recorded, and organized.	
4	Collecting the data		
	a	Students collect, record, and organize data on different types of plants and animals in the habitats.	

2-ESS1-1 Earth's Place in the Universe

Students who demonstrate understanding can:

2-ESS1-1. **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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Make observations from several sources to construct an evidence-based account for natural phenomena.	**ESS1.C: The History of Planet Earth** • Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.	**Stability and Change** • Things may change slowly or rapidly.

Observable features of the student performance by the end of the grade:			
1	Articulating the explanation of phenomena		
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that Earth events can occur very quickly or very slowly.	
	b	Students use evidence and reasoning to construct an evidence-based account of the phenomenon.	
2	Evidence		
	a	Students describe* the evidence from observations (firsthand or from media; e.g., books, videos, pictures, historical photos), including:	
		i.	That some Earth events occur quickly (e.g., the occurrence of flood, severe storm, volcanic eruption, earthquake, landslides, erosion of soil).
		ii.	That some Earth events occur slowly.
		iii.	Some results of Earth events that occur quickly.
		iv.	Some results of Earth events that occur very slowly (e.g., erosion of rocks, weathering of rocks).
		v.	The relative amount of time it takes for the given Earth events to occur (e.g., slowly, quickly, hours, days, years).
	b	Students make observations using at least three sources	
3	Reasoning		
	a	Students use reasoning to logically connect the evidence to construct an evidence-based account. Students describe* their reasoning, including:	
		i.	In some cases, Earth events and the resulting changes can be directly observed; therefore those events must occur rapidly.
		ii.	In other cases, the resulting changes of Earth events can be observed only after long periods of time; therefore these Earth events occur slowly, and change happens over a time period that is much longer than one can observe.

2-ESS2-1 Earth's Systems

Students who demonstrate understanding can:

2-ESS2-1. **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.***[Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Compare multiple solutions to a problem.

Disciplinary Core Ideas

ESS2.A: Earth Materials and Systems

- Wind and water can change the shape of the land.

ETS1.C: Optimizing the Design Solution

- Because there is always more than one possible solution to a problem, it is useful to compare and test designs. *(secondary)*

Crosscutting Concepts

Stability and Change

- Things may change slowly or rapidly.

- -

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Developing and using technology has impacts on the natural world.

- -

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World

- Scientists study the natural and material world.

Observable features of the student performance by the end of the grade:			
1	Using scientific knowledge to generate design solutions		
	a	Students describe* the given problem, which includes the idea that wind or water can change the shape of the land by washing away soil or sand.	
	b	Students describe* at least two given solutions in terms of how they slow or prevent wind or water from changing the shape of the land.	
2	Describing* specific features of the design solution, including quantification where appropriate		
	a	Students describe* the specific expected or required features for the solutions that would solve the given problem, including:	
		i.	Slowing or preventing wind or water from washing away soil or sand.
		ii.	Addressing problems created by both slow and rapid changes in the environment (such as many mild rainstorms or a severe storm and flood).
3	Evaluating potential solutions		
	a	Students evaluate each given solution against the desired features to determine and describe* whether and how well the features are met by each solution.	
	b	Using their evaluation, students compare the given solutions to each other.	

2-ESS2-2 Earth's Systems

Students who demonstrate understanding can:

2-ESS2-2. **Develop a model to represent the shapes and kinds of land and bodies of water in an area.** [*Assessment Boundary: Assessment does not include quantitative scaling in models.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop a model to represent patterns in the natural world.	**ESS2.B: 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.	**Patterns** • Patterns in the natural world can be observed.

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop a model (i.e., a map) that identifies the relevant components, including components that represent both land and bodies of water in an area.
2	Relationships	
	a	In the model, students identify and describe* relationships between components using a representation of the specific shapes and kinds of land (e.g., playground, park, hill) and specific bodies of water (e.g., creek, ocean, lake, river) within a given area.
	b	Students use the model to describe* the patterns of water and land in a given area (e.g., an area may have many small bodies of water; an area may have many different kinds of land that come in different shapes).
3	Connections	
	a	Students describe* that because they can map the shapes and kinds of land and water in any area, maps can be used to represent many different types of areas.

2-ESS2-3 Earth's Systems

Students who demonstrate understanding can:

2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question.	**ESS2.C: 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.	**Patterns** • Patterns in the natural world can be observed.

Observable features of the student performance by the end of the grade:			
1	Obtaining information		
	a	Students use books and other reliable media as sources for scientific information to answer scientific questions about:	
		i.	Where water is found on Earth, including in oceans, rivers, lakes, and ponds.
		ii.	The idea that water can be found on Earth as liquid water or solid ice (e.g., a frozen pond, liquid pond, frozen lake).
		iii.	Patterns of where water is found, and what form it is in.
2	Evaluating Information		
	a	Students identify which sources of information are likely to provide scientific information (e.g., versus opinion).	

K-2-ETS1-1 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Define a simple problem that can be solved through the development of a new or improved object or tool.	**ETS1.A: 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.	

Observable features of the student performance by the end of the grade:		
1	Addressing phenomena of the natural or designed world	
	a	Students ask questions and make observations to gather information about a situation that people want to change. Students' questions, observations, and information gathering are focused on:
		vii. A given situation that people wish to change.
		viii. Why people want the situation to change.
		ix. The desired outcome of changing the situation.
2	Identifying the scientific nature of the question	
	a	Students' questions are based on observations and information gathered about scientific phenomena that are important to the situation.
3	Identifying the problem to be solved	
	a	Students use the information they have gathered, including the answers to their questions, observations they have made, and scientific information, to describe* the situation people want to change in terms of a simple problem that can be solved with the development of a new or improved object or tool.
4	Defining the features of the solution	
	a	With guidance, students describe* the desired features of the tool or object that would solve the problem, based on scientific information, materials available, and potential related benefits to people and other living things.

K-2-ETS1-2 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

- Develop a simple model based on evidence to represent a proposed object or tool.

Disciplinary Core Ideas

ETS1.B: Developing Possible Solutions

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

Crosscutting Concepts

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s).

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students develop a representation of an object and the problem it is intended to solve. In their representation, students include the following components:	
		vii.	The object.
		viii.	The relevant shape(s) of the object.
		ix.	The function of the object.
	b	Students use sketches, drawings, or physical models to convey their representations.	
2	Relationships		
	a	Students identify relationships between the components in their representation, including:	
		v.	The shape(s) of the object and the object's function.
		vi.	The object and the problem is it designed to solve.
3	Connections		
	a	Students use their representation (simple sketch, drawing, or physical model) to communicate the connections between the shape(s) of an object, and how the object could solve the problem.	

K-2-ETS1-3 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended.	**ETS1.C: Optimizing the Design Solution** • Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	

Observable features of the student performance by the end of the grade:

1	Organizing data	
	a	With guidance, students use graphical displays (e.g., tables, pictographs, line plots) to organize given data from tests of two objects, including data about the features and relative performance of each solution.
2	Identifying relationships	
	a	Students use their organization of the data to find patterns in the data, including:
		v. How each of the objects performed, relative to:
		5. The other object.
		6. The intended performance.
		vi. How various features (e.g., shape, thickness) of the objects relate to their performance (e.g., speed, strength).
3	Interpreting data	
	a	Students use the patterns they found in object performance to describe*:
		vii. The way (e.g., physical process, qualities of the solution) each object will solve the problem.
		viii. The strengths and weaknesses of each design.
		ix. Which object is better suited to the desired function, if both solve the problem.

Iowa Science Standards

Third Grade Standards
Foundation Boxes
Evidence Statements

3-PS2-1 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

3-PS2-1. **Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [*Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

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Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations use a variety of methods, tools, and techniques.

Disciplinary Core Ideas

PS2.A: Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)

PS2.B: Types of Interactions

- Objects in contact exert forces on each other.

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	Students identify and describe* the phenomenon under investigation, which includes the effects of different forces on an object's motion (e.g., starting, stopping, or changing direction).
	b	Students describe* the purpose of the investigation, which includes producing data to serve as the basis for evidence for how balanced and unbalanced forces determine an object's motion.
2	Identifying the evidence to address the purpose of the investigation	
	a	Students collaboratively develop an investigation plan. In the investigation plan, students describe* the data to be collected, including:
		i. The change in motion of an object at rest after:
		1. Different strengths and directions of balanced forces (forces that sum to zero) are applied to the object.
		2. Different strengths and directions of unbalanced forces (forces that do not sum to zero) are applied to the object (e.g., strong force on the right, weak force or the left).
		ii. What causes the forces on the object.
	b	Students individually describe* how the evidence to be collected will be relevant to determining the effects of balanced and unbalanced forces on an object's motion.
3	Planning the investigation	
	a	In the collaboratively developed investigation plan, students describe* how the motion of the object will be observed and recorded, including defining the following features:

		i.	The object whose motion will be investigated.
		ii.	The objects in contact that exert forces on each other.
		iii.	Changing one variable at a time (e.g., control strength and vary the direction, or control direction and vary the strength).
		iv.	The number of trials that will be conducted in the investigation to produce sufficient data.
	b	Students individually describe* how their investigation plan will allow them to address the purpose of the investigation.	
4	Collecting the data		
	a	Students collaboratively collect and record data according to the investigation plan they developed, including data from observations and/or measurements of:	
		i.	An object at rest and the identification of the forces acting on the object.
		ii.	An object in motion and the identification of the forces acting on the object.

3-PS2-2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

3-PS2-2. **Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [*Assessment Boundary: Assessment does not include technical terms such as period and frequency.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

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Connections to Nature of Science

Science Knowledge is Based on Empirical Evidence

- Science findings are based on recognizing patterns.

Disciplinary Core Ideas

PS2.A: Forces and Motion

- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (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.)

Crosscutting Concepts

Patterns

- Patterns of change can be used to make predictions.

Observable features of the student performance by the end of the grade:			
1	Identifying the phenomenon under investigation		
	a	From the given investigation plan, students identify and describe* the phenomenon under investigation, which includes observable patterns in the motion of an object.	
	b	Students identify and describe* the purpose of the investigation, which includes providing evidence for an explanation of the phenomenon that includes the idea that patterns of motion can be used to predict future motion of an object.	
2	Identifying the evidence to address the purpose of the investigation		
	a	Based on a given investigation plan, students identify and describe* the data to be collected through observations and/or measurements, including data on the motion of the object as it repeats a pattern over time (e.g., a pendulum swinging, a ball moving on a curved track, a magnet repelling another magnet).	
	b	Students describe* how the data will serve as evidence of a pattern in the motion of an object and how that pattern can be used to predict future motion.	
3	Planning the investigation		
	a	From the given investigation plan, students identify and describe* how the data will be collected, including how:	
		i.	The motion of the object will be observed and measured.
		ii.	Evidence of a pattern in the motion of the object will be identified from the data on the motion of the object.
		iii.	The pattern in the motion of the object can be used to predict future motion.
4	Collecting the data		
	a	Students make observations and/or measurements of the motion of the object, according to the given investigation plan, to identify a pattern that can be used to predict future motion.	

3-PS2-3 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

3-PS2-3. **Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [*Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated based on patterns such as cause and effect relationships.	**PS2.B: Types of Interactions** • Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.	**Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change.

Observable features of the student performance by the end of the grade:			
1	Addressing phenomena of the natural world		
	a	Students ask questions that arise from observations of two objects not in contact with each other interacting through electric or magnetic forces, the answers to which would clarify the cause-and-effect relationships between:	
		i.	The sizes of the forces on the two interacting objects due to the distance between the two objects.
		ii.	The relative orientation of two magnets and whether the force between the magnets is attractive or repulsive.
		iii.	The presence of a magnet and the force the magnet exerts on other objects.
		iv.	Electrically charged objects and an electric force.
2	Identifying the scientific nature of the question		
	a	Students' questions can be investigated within the scope of the classroom.	

3-PS2-4 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.* [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple problem that can be solved through the development of a new or improved object or tool.

Disciplinary Core Ideas

PS2.B: Types of Interactions

- Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

Crosscutting Concepts

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Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.

Observable features of the student performance by the end of the grade:			
1	Identifying the problem to be solved		
	a	Students identify and describe* a simple design problem that can be solved by applying a scientific understanding of the forces between interacting magnets.	
	b	Students identify and describe* the scientific ideas necessary for solving the problem, including:	
		i.	Force between objects do not require that those objects be in contact with each other
		ii.	The size of the force depends on the properties of objects, distance between the objects, and orientation of magnetic objects relative to one another.
2	Defining the criteria and constraints		
	a	Students identify and describe* the criteria (desirable features) for a successful solution to the problem.	
	b	Students identify and describe* the constraints (limits) such as:	
		i.	Time.
		ii.	Cost.
		iii.	Materials.

3-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

3-LS1-1. **Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.** [Clarification Statement: Changes organisms go through during their life form a pattern.] [*Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop models to describe phenomena. - ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science findings are based on recognizing patterns.	**LS1.B: Growth and Development of Organisms** • Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.	**Patterns** • Patterns of change can be used to make predictions.

Observable features of the student performance by the end of the grade:		
1	Components of the model	
	a	Students develop models (e.g., conceptual, physical, drawing) to describe* the phenomenon. In their models, students identify the relevant components of their models including:
		i. Organisms (both plant and animal).
		ii. Birth.
		iii. Growth.
		iv. Reproduction.
		v. Death.
2	Relationships	
	a	In the models, students describe* relationships between components, including:
		i. Organisms are born, grow, and die in a pattern known as a life cycle.
		ii. Different organisms' life cycles can look very different.
		iii. A causal direction of the cycle (e.g., without birth, there is no growth; without reproduction, there are no births).
3	Connections	
	a	Students use the models to describe* that although organisms can display life cycles that look different, they all follow the same pattern.
	b	Students use the models to make predictions related to the phenomenon, based on patterns identified among life cycles (e.g., prediction could include that if there are no births, deaths will continue and eventually there will be no more of that type of organism).

3-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct an argument with evidence, data, and/or a model.	**LS2.D: Social Interactions and Group Behavior** • Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size *(Note: Moved from K–2)*.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.

Observable features of the student performance by the end of the grade:			
1	Supported claims		
	a	Students make a claim to be supported about a phenomenon. In their claim, students include the idea that some animals form groups and that being a member of that group helps each member survive.	
2	Identifying scientific evidence		
	a	Students describe* the given evidence, data, and/or models necessary to support the claim, including:	
		i.	Identifying types of animals that form or live in groups of varying sizes.
		ii.	Multiple examples of animals in groups of various sizes:
			1. Obtaining more food for each individual animal compared to the same type of animal looking for food individually.
			2. Displaying more success in defending themselves than those same animals acting alone.
			3. Making faster or better adjustments to harmful changes in their ecosystem than would those same animals acting alone.
3	Evaluating and critiquing evidence		
	a	Students evaluate the evidence to determine its relevance, and whether it supports the claim that being a member of a group has a survival advantage.	
	b	Students describe* whether the given evidence is sufficient to support the claim and whether additional evidence is needed.	
4	Reasoning and synthesis		
	a	Students use reasoning to construct an argument connecting the evidence, data and/or models to the claim. Students describe* the following reasoning in their argument:	
		i.	The causal evidence that being part of a group can have the effect of animals being more successful in obtaining food, defending themselves, and coping with change supports the claim that being a member of a group helps animals survive.
		ii.	The causal evidence that an animal losing its group status can have the effect of the animal obtaining less food, not being able to defend itself, and not being able to cope with change supports the claim that being a member of a group helps animals survive.

3-LS3-1 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

3-LS3-1. **Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.** [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [*Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning.

Disciplinary Core Ideas

LS3.A: Inheritance of Traits

- Many characteristics of organisms are inherited from their parents.

LS3.B: Variation of Traits

- Different organisms vary in how they look and function because they have different inherited information.

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort and classify natural phenomena.

Observable features of the student performance by the end of the grade:			
1	Organizing data		
	a	Students organize the data (e.g., from students' previous work, grade-appropriate existing datasets) using graphical displays (e.g., table, chart, graph). The organized data include:	
		i.	Traits of plant and animal parents.
		ii.	Traits of plant and animal offspring.
		iii.	Variations in similar traits in a grouping of similar organisms.
2	Identifying relationships		
	a	Students identify and describe* patterns in the data, including:	
		i.	Similarities in the traits of a parent and the traits of an offspring (e.g., tall plants typically have tall offspring).
		ii.	Similarities in traits among siblings (e.g., siblings often resemble each other).
		iii.	Differences in traits in a group of similar organisms (e.g., dogs come in many shapes and sizes, a field of corn plants have plants of different heights).
		iv.	Differences in traits of parents and offspring (e.g., offspring do not look exactly like their parents).
		v.	Differences in traits among siblings (e.g., kittens from the same mother may not look exactly like their mother).
3	Interpreting data		
	a	Students describe* that the pattern of similarities in traits between parents and offspring, and between siblings, provides evidence that traits are inherited.	
	b	Students describe* that the pattern of differences in traits between parents and offspring, and between siblings, provides evidence that inherited traits can vary.	
	c	Students describe* that the variation in inherited traits results in a pattern of variation in traits in groups of organisms that are of a similar type.	

3-LS3-2 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Use evidence (e.g., observations, patterns) to support an explanation.	**LS3.A: Inheritance of Traits** • Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. **LS3.B: Variation of Traits** • The environment also affects the traits that an organism develops.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.

Observable features of the student performance by the end of the grade:			
1	Articulating the explanation of phenomena		
	a	Students identify the given explanation to be supported, including a statement that relates the phenomenon to a scientific idea, including that many inherited traits can be influenced by the environment.	
2	Evidence		
	a	Students describe* the given evidence that supports the explanation, including:	
		i.	Environmental factors that vary for organisms of the same type (e.g., amount or food, amount of water, amount of exercise an animal gets, chemicals in the water) that may influence organisms' traits.
		ii.	Inherited traits that vary between organisms of the same type (e.g., height or weight of a plant or animal, color or quantity of the flowers).
		iii.	Observable inherited traits of organisms in varied environmental conditions
3	Reasoning		
	a	Students use reasoning to connect the evidence and support an explanation about environmental influences on inherited traits in organisms. In their chain of reasoning, students describe* a cause-and-effect relationship between a specific causal environmental factor and its effect of a given variation in a trait (e.g., not enough water produces plants that are shorter and have fewer flowers than plants that had more water available).	

3-LS4-1 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-1. **Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived 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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning.

Disciplinary Core Ideas

LS4.A: Evidence of Common Ancestry and Diversity

- Some kinds of plants and animals that once lived on Earth are no longer found anywhere. *(Note: moved from K-2)*
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.

Crosscutting Concepts

Scale, Proportion, and Quantity

- Observable phenomena exist from very short to very long time periods.

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Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems.

Observable features of the student performance by the end of the grade:			
1	Organizing data		
	a	Students use graphical displays (e.g., table, chart, graph) to organize the given data, including data about:	
		i.	Fossils of animals (e.g., information on type, size, type of land on which it was found).
		ii.	Fossils of plants (e.g., information on type, size, type of land on which it was found).
		iii.	The relative ages of fossils (e.g., from a very long time ago).
		iv.	Existence of modern counterparts to the fossilized plants and animals and information on where they currently live.
2	Identifying relationships		
	a	Students identify and describe* relationships in the data, including:	
		i.	That fossils represent plants and animals that lived long ago.
		ii.	The relationships between the fossils of organisms and the environments in which they lived (e.g., marine organisms, like fish, must have lived in water environments).
		iii.	The relationships between types of fossils (e.g., those of marine animals) and the current environments where similar organisms are found.
		iv.	That some fossils represent organisms that lived long ago and have no modern counterparts.
		v.	The relationships between fossils of organisms that lived long ago and their modern counterparts.
		vi.	The relationships between existing animals and the environments in which they currently live.
3	Interpreting data		
	a	Students describe* that:	
		i.	Fossils provide evidence of organisms that lived long ago but have become extinct (e.g., dinosaurs, mammoths, other organisms that have no clear modern counterpart).
		ii.	Features of fossils provide evidence of organisms that lived long ago and of what types of environments those organisms must have lived in (e.g., fossilized seashells indicate shelled organisms that lived in aquatic environments).

		iii.	By comparing data about where fossils are found and what those environments are like, fossilized plants and animals can be used to provide evidence that some environments look very different now than they did a long time ago (e.g., fossilized seashells found on land that is now dry suggest that the area in which those fossils were found used to be aquatic; tropical plant fossils found in Antarctica, where tropical plants cannot live today, suggests that the area used to be tropical).

3-LS4-2 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Use evidence (e.g., observations, patterns) to construct an explanation.	**LS4.B: Natural Selection** • Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.

Observable features of the student performance by the end of the grade:			
1	Articulating the explanation of phenomena		
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.	
	b	Students use evidence and reasoning to construct an explanation for the phenomenon.	
2	Evidence		
	a	Students describe* the given evidence necessary for the explanation, including:	
		i.	A given characteristic of a species (e.g., thorns on a plant, camouflage of an animal, the coloration of moths).
		ii.	The patterns of variation of a given characteristic among individuals in a species (e.g., longer or shorter thorns on individual plants, dark or light coloration of animals).
		iii.	Potential benefits of a given variation of the characteristic (e.g., the light coloration of some moths makes them difficult to see on the bark of a tree).
3	Reasoning		
	a	Students use reasoning to logically connect the evidence to support the explanation for the phenomenon. Students describe* a chain of reasoning that includes:	
		i.	That certain variations in characteristics make it harder or easier for an animal to survive, find mates, and reproduce (e.g., longer thorns prevent predators more effectively and increase the likelihood of survival; light coloration of some moths provides camouflage in certain environments, making it more likely that they will live long enough to be able to mate and reproduce).
		ii.	That the characteristics that make it easier for some organisms to survive, find mates, and reproduce give those organisms an advantage over other organisms of the same species that don't have those traits.
		iii.	That there can be a cause-and-effect relationship between a specific variation in a characteristic (e.g., longer thorns, coloration of moths) and its effect on the ability of the individual organism to survive and reproduce (e.g., plants with longer thorns are less likely to be eaten, darker moths are less likely to be seen and eaten on dark trees).

3-LS4-3 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-3. **Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.** [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct an argument with evidence.	**LS4.C: Adaptation** • For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.

Observable features of the student performance by the end of the grade:			
1	Supported claims		
	a	Students make a claim to be supported about a phenomenon. In their claim, students include the idea that in a particular habitat, some organisms can survive well, some can survive less well, and some cannot survive at all.	
2	Identifying scientific evidence		
	a	Students describe* the given evidence necessary for supporting the claim, including:	
		i.	Characteristics of a given particular environment (e.g., soft earth, trees and shrubs, seasonal flowering plants).
		ii.	Characteristics of a particular organism (e.g., plants with long, sharp leaves; rabbit coloration).
		iii.	Needs of a particular organism (e.g., shelter from predators, food, water).
3	Evaluating and critiquing evidence		
	a	Students evaluate the evidence to determine:	
		i.	The characteristics of organisms that might affect survival.
		ii.	The similarities and differences in needs among at least three types of organisms.
		iii.	How and what features of the habitat meet the needs of each of the organisms (i.e., the degree to which a habitat meets the needs of an organism).
		iv.	How and what features of the habitat do not meet the needs of each of the organisms (i.e., the degree to which a habitat does not meet the needs of an organism).
	b	Students evaluate the evidence to determine whether it is relevant to and supports the claim.	
	c	Students describe* whether the given evidence is sufficient to support the claim, and whether additional evidence is needed.	
4	Reasoning and synthesis		
	a	Students use reasoning to construct an argument, connecting the relevant and appropriate evidence to the claim, including describing* that any particular environment meets different organisms' needs to different degrees due to the characteristics of that environment and the needs of the organisms. Students describe* a chain of reasoning in their argument, including the following cause-and-effect relationships:	
		i.	If an environment fully meets the needs of an organism, that organism can survive well within that environment.
		ii.	If an environment partially meets the needs of an organism, that organism can survive less well (e.g., lower survival rate, increased sickliness, shorter lifespan) than organisms whose needs are met within that environment.

		iii.	If an environment does not meet the needs of the organism, that organism cannot survive within that environment.
		iv.	Together, the evidence suggests a causal relationship within the system between the characteristics of a habitat and the survival of organisms within it.

3-LS4-4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-4. **Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.*** [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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.*(secondary)*

LS4.D: Biodiversity and Humans

- Populations live in a variety of habitats, and change in those habitats affects the organisms living there.

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions.

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Connections to Engineering, Technology, and Applications of Science

Interdependence of Engineering, Technology, and Science on Society and the Natural World

- Knowledge of relevant scientific concepts and research findings is important in engineering.

Observable features of the student performance by the end of the grade:				
1	Supported claims			
	a	Students make a claim about the merit of a given solution to a problem that is caused when the environment changes, which results in changes in the types of plants and animals that live there.		
2	Identifying scientific evidence			
	a	Students describe* the given evidence about how the solution meets the given criteria and constraints. This evidence includes:		
		i.	A system of plants, animals, and a given environment within which they live before the given environmental change occurs.	
		ii.	A given change in the environment.	
		iii.	How the change in the given environment causes a problem for the existing plants and animals living within that area.	
		iv.	The effect of the solution on the plants and animals within the environment.	
		v.	The resulting changes to plants and animals living within that changed environment, after the solution has been implemented.	
3	Evaluating and critiquing evidence			
	a	Students evaluate the solution to the problem to determine the merit of the solution. Students describe* how well the proposed solution meets the given criteria and constraints to reduce the impact of the problem created by the environmental change in the system, including:		
		i.	How well the proposed solution meets the given criteria and constraints to reduce the impact of the problem created by the environmental change in the system, including:	
			1.	How the solution makes changes to one part (e.g., a feature of the environment) of the system, affecting the other parts of the system (e.g., plants and animals).
			2.	How the solution affects plants and animals.

	b	Students evaluate the evidence to determine whether it is relevant to and supports the claim.
	c	Students describe* whether the given evidence is sufficient to support the claim, and whether additional evidence is needed.

3-ESS2-1 Earth's Systems

Students who demonstrate understanding can:

3-ESS2-1. **Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data 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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.	**ESS2.D: Weather and Climate** • Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.	**Patterns** • Patterns of change can be used to make predictions.

Observable features of the student performance by the end of the grade:			
1	Organizing data		
	a	Students use graphical displays (e.g., table, chart, graph) to organize the given data by season using tables, pictographs, and/or bar charts, including:	
		i.	Weather condition data from the same area across multiple seasons (e.g., average temperature, precipitation, wind direction).
		ii.	Weather condition data from different areas (e.g., hometown and nonlocal areas, such as a town in another state).
2	Identifying relationships		
	a	Students identify and describe* patterns of weather conditions across:	
		i.	Different seasons (e.g., cold and dry in the winter, hot and wet in the summer; more or less wind in a particular season).
		ii.	Different areas (e.g., certain areas (defined by location, such as a town in the Pacific Northwest), have high precipitation, while a different area (based on location or type, such as a town in the Southwest) have very little precipitation).
3	Interpreting data		
	a	Students use patterns of weather conditions in different seasons and different areas to predict:	
		x.	The typical weather conditions expected during a particular season (e.g., “In our town in the summer it is typically hot, as indicated on a bar graph over time, while in the winter it is typically cold; therefore, the prediction is that next summer it will be hot and next winter it will be cold.”).
		xi.	The typical weather conditions expected during a particular season in different areas.

3-ESS2-2 Earth's Systems

Students who demonstrate understanding can:

3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Obtain and combine information from books and other reliable media to explain phenomena.

Disciplinary Core Ideas

ESS2.D: Weather and Climate

- Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

Crosscutting Concepts

Patterns

- Patterns of change can be used to make predictions.

Observable features of the student performance by the end of the grade:			
1	Obtaining information		
	a	Students use books and other reliable media to gather information about:	
		i.	Climates in different regions of the world (e.g., equatorial, polar, coastal, mid-continental).
		ii.	Variations in climates within different regions of the world (e.g., variations could include an area’s average temperatures and precipitation during various months over several years or an area’s average rainfall and temperatures during the rainy season over several years).
2	Evaluating information		
	a	Students combine obtained information to provide evidence about the climate pattern in a region that can be used to make predictions about typical weather conditions in that region.	
3	Communicating information		
	a	Students use the information they obtained and combined to describe*:	
		i.	Climates in different regions of the world.
		ii.	Examples of how patterns in climate could be used to predict typical weather conditions.
		iii.	That climate can vary over years in different regions of the world.

3-ESS3-1 Earth and Human Activity

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Disciplinary Core Ideas

ESS3.B: Natural Hazards

- A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. *(Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)*

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change.

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Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones).

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Connections to Nature of Science

Science is a Human Endeavor

- Science affects everyday life.

Observable features of the student performance by the end of the grade:			
1	Supported claims		
	a	Students make a claim about the merit of a given design solution that reduces the impact of a weather-related hazard.	
2	Identifying scientific evidence		
	a	Students describe* the given evidence about the design solution, including evidence about:	
		i.	The given weather-related hazard (e.g., heavy rain or snow, strong winds, lightning, flooding along river banks).
		ii.	Problems caused by the weather related hazard (e.g., heavy rains cause flooding, lightning causes fires).
		iii.	How the proposed solution addresses the problem (e.g., dams and levees are designed to control flooding, lightning rods reduce the chance of fires) [note: mechanisms are limited to simple observable relationships that rely on logical reasoning].
3	Evaluating and critiquing evidence		
	a	Students evaluate the evidence using given criteria and constraints to determine:	
		i.	How the proposed solution addresses the problem, including the impact of the weather-related hazard after the design solution has been implemented.
		ii.	The merits of a given solution in reducing the impact of a weather-related hazard (i.e., whether the design solution meets the given criteria and constraints].
		iii.	The benefits and risks a given solution poses when responding to the societal demand to reduce the impact of a hazard.

3-5-ETS1-1 **Engineering Design**

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	**ETS1.A: 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.	**Influence of Science, Engineering, and Technology on Society and the Natural World** • People's needs and wants change over time, as do their demands for new and improved technologies.

Observable features of the student performance by the end of the grade:			
1	Identifying the problem to be solved		
	a	Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.	
	b	The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.	
	c	Students describe* that people's needs and wants change over time.	
2	Defining the boundaries of the system		
	a	Students define the limits within which the problem will be addressed, which includes addressing something people want and need at the current time.	
3	Defining the criteria and constraints		
	a	Based on the situation people want to change, students specify criteria (required features) of a successful solution.	
	b	Students describe* the constraints or limitations on their design, which may include:	
		i.	Cost.
		ii.	Materials.
		iii.	Time.

3-5-ETS1-2 **Engineering Design**

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.

Disciplinary Core Ideas

ETS1.B: 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.

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.
	b	Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.
	c	Students specify how each design solution solves the problem.
	d	Students share ideas and findings with others about design solutions to generate a variety of possible solutions.
	e	Students describe* the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design [note: emphasis is on what is necessary for designing solutions, not on a step-wise process].
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe*:
		i. The given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
		ii. How the criteria and constraints will be used to generate and test the design solutions.
3	Evaluating potential solutions	
	a	Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.
	b	Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.

3-5-ETS1-3 **Engineering Design**

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	**ETS1.B: Developing Possible Solutions** • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **ETS1.C: 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.	

Observable features of the student performance by the end of the grade:			
1	Identifying the purpose of the investigation		
	a	Students describe* the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.	
2	Identifying the evidence to be address the purpose of the investigation		
	a	Students describe* the evidence to be collected, including:	
		i.	How well the model/prototype performs against the given criteria and constraints.
		ii.	Specific aspects of the prototype or model that do not meet one or more of the criteria or constraints (i.e., failure points or difficulties).
		iii.	Aspects of the model/prototype that can be improved to better meet the criteria and constraints.
	b	Students describe* how the evidence is relevant to the purpose of the investigation.	
3	Planning the investigation		
	a	Students create a plan for the investigation that describes* different tests for each aspect of the criteria and constraints. For each aspect, students describe*:	
		i.	The specific criterion or constraint to be used.
		ii.	What is to be changed in each trial (the independent variable).
		iii.	The outcome (dependent variable) that will be measured to determine success.
		iv.	What tools and methods are to be used for collecting data.
		v.	What is to be kept the same from trial to trial to ensure a fair test.
4	Collecting the data		
	a	Students carry out the investigation, collecting and recording data according to the developed plan.	

Iowa Science Standards

Fourth Grade Standards
Foundation Boxes
Evidence Statements

4-PS3-1 Energy

Students who demonstrate understanding can:

4-PS3-1. **Use evidence to construct an explanation relating the speed of an object to the energy of that object.** [*Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.*

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Use evidence (e.g., measurements, observations, patterns) to construct an explanation.	**PS3.A: Definitions of Energy** • The faster a given object is moving, the more energy it possesses.	**Energy and Matter** • Energy can be transferred in various ways and between objects.

Observable features of the student performance by the end of the grade:			
1	Articulating the explanation of phenomena		
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that the speed of a given object is related to the energy of the object (e.g., the faster an object is moving, the more energy it possesses).	
	b	Students use the evidence and reasoning to construct an explanation for the phenomenon.	
2	Evidence		
	a	Students identify and describe* the relevant given evidence for the explanation, including:	
		iv.	The relative speed of the object (e.g., faster vs. slower objects).
		v.	Qualitative indicators of the amount of energy of the object, as determined by a transfer of energy from that object (e.g., more or less sound produced in a collision, more or less heat produced when objects rub together, relative speed of a ball that was stationary following a collision with a moving object, more or less distance a stationary object is moved).
3	Reasoning		
	a	Students use reasoning to connect the evidence to support an explanation for the phenomenon. In the explanation, students describe* a chain of reasoning that includes:	
		i.	Motion can indicate the energy of an object.
		ii.	The faster a given object is moving, the more observable impact it can have on another object (e.g., a fast-moving ball striking something (a gong, a wall) makes more noise than does the same ball moving slowly and striking the same thing).
		iii.	The observable impact of a moving object interacting with its surroundings reflects how much energy was able to be transferred between objects and therefore relates to the energy of the moving object.
		iv.	Because faster objects have a larger impact on their surroundings than objects moving more slowly, they have more energy due to motion (e.g., a fast-moving ball striking a gong makes more noise than a slow-moving ball doing the same thing because it has more energy that can be transferred to the gong, producing more sound). [Note: This refers only to relative bulk motion energy, not potential energy, to remain within the DCI.]
		v.	Therefore, the speed of an object is related to the energy of the object.

4-PS3-2 Energy

Students who demonstrate understanding can:

4-PS3-2. **Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

Disciplinary Core Ideas

PS3.A: Definitions of Energy

- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

PS3.B: 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.

Crosscutting Concepts

Energy and Matter

- Energy can be transferred in various ways and between objects.

Observable features of the student performance by the end of the grade:			
1	Identifying the phenomenon under investigation		
	a	From the given investigation plan, students describe* the phenomenon under investigation, which includes the following ideas:	
		i.	The transfer of energy, including:
			1. Collisions between objects.
			2. Light traveling from one place to another.
			3. Electric currents producing motion, sound, heat, or light.
			4. Sound traveling from one place to another.
			5. Heat passing from one object to another.
			6. Motion, sound, heat, and light causing a different type of energy to be observed after an interaction (e.g., in a collision between two objects, one object may slow down or stop, the other object may speed up, and the objects and surrounding air may be heated; a specific sound may cause the movement of an object; the energy associated with the motion of an object, via an electrical current, may be used to turn on a light).
	b	Students describe* the purpose of the investigation, which includes providing evidence for an explanation of the phenomenon, including the idea that energy can be transferred from place to place by:	
		i.	Moving objects.

		ii.	Sound.
		iii.	Light.
		iv.	Heat.
		v.	Electric currents.
2	Identifying the evidence to address the purpose of the investigation		
	a	From the given investigation plan, students describe* the data to be collected that will serve as the basis for evidence, including:	
		iii.	The motion and collision of objects before and after an interaction (e.g., when a given object is moving fast, it can move another object farther than when the same object is moving more slowly).
		iv.	The relative presence of sound, light, or heat (including in the surrounding air) before and after an interaction (e.g. shining a light on an object can increase the temperature of the object; a sound can move an object).
		v.	The presence of electric currents flowing through wires causally linking one form of energy output (e.g., a moving object) to another form of energy output (e.g., another moving object; turning on a light bulb).
	b	Students describe* how their observations will address the purpose of the investigation, including how the observations will provide evidence that energy, in the form of light, sound, heat, and motion, can be transferred from place to place by sound, light, heat, or electric currents (e.g., in a system in which the motion of an object generates an observable electrical current to turn on a light, energy (from the motion of an object) must be transferred to another place (energy in the form of the light bulb) via the electrical current, because the motion doesn't cause the light bulb to light up if the wire is not completing a circuit between them; when a light is directed at an object, energy (in the form of light) must be transferred from the source of the light to its destination and can be observed in the form of heat, because if the light is blocked, the object isn't warmed.	
3	Planning the investigation		
	a	From the given investigation plan, students identify and describe* how the data will be observed and recorded, including the tools and methods for collecting data on:	
		i.	The motion and collision of objects, including any sound or heat producing the motion/collision, or produced by the motion/collision.
		ii.	The presence of energy in the form of sound, light, or heat in one place as a result of sound, light, or heat in a different place.
		iii.	The presence of electric currents in wires and the presence of energy (in the form of sound, light, heat, or motion resulting from the flow of electric currents through a device).
	b	Students describe* the number of trials, controlled variables, and experimental set up.	
4	Collecting the data		
	a	Students make and record observations according to the given investigation plan to provide evidence that:	
		iii.	Energy is present whenever there are moving objects, sound, light, or heat.
		iv.	That energy has been transferred from place to place (e.g., a bulb in a circuit is not lit until a switch is closed and it lights, indicating that energy is transferred through electric current in a wire to light the bulb; a stationary ball is struck by a moving ball, causing the stationary ball to move and the moving ball to slow down, indicating that energy has been transferred from the moving ball to the stationary one).

4-PS3-3 Energy

Students who demonstrate understanding can:

4-PS3-3. **Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.	**PS3.A: Definitions of Energy** • Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **PS3.B: 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. **PS3.C: Relationship Between Energy and Forces** • When objects collide, the contact forces transfer energy so as to change the objects' motions.	**Energy and Matter** • Energy can be transferred in various ways and between objects.

Observable features of the student performance by the end of the grade:				
1	Addressing phenomena of the natural world			
	a	Students ask questions about the changes in energy that occur when objects collide, the answers to which would clarify:		
		i.	A qualitative measure of energy (e.g., relative motion, relative speed, relative brightness) of the object before the collision.	
		ii.	The mechanism of energy transfer during the collision, including:	
			1.	The transfer of energy by contact forces between colliding objects that results in a change in the motion of the objects.
			2.	The transfer of energy to the surrounding air when objects collide resulting in sound and heat.
	b	Students predict reasonable outcomes about the changes in energy that occur after objects collide, based on patterns linking object collision and energy transfer between objects and the surrounding air.		
2	Identifying the scientific nature of the question			
	a	Students ask questions that can be investigated within the scope of the classroom or an outdoor environment.		

4-PS3-4 Energy

Students who demonstrate understanding can:

4-PS3-4. **Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [*Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Apply scientific ideas to solve design problems.

Disciplinary Core Ideas

PS3.B: Conservation of Energy and Energy Transfer

- 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.

PS3.D: 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.

ETS1.A: 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.*(secondary)*

Crosscutting Concepts

Energy and Matter

- Energy can be transferred in various ways and between objects.

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Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Engineers improve existing technologies or develop new ones.

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Connections to Nature of Science

Science is a Human Endeavor

- Most scientists and engineers work in teams.
- Science affects everyday life.

Observable features of the student performance by the end of the grade:			
1	Using scientific knowledge to generate design solutions		
	a	Given a problem to solve, students collaboratively design a solution that converts energy from one form to another. In the design, students:	
		i.	Specify the initial and final forms of energy (e.g., electrical energy, motion, light).
		ii.	Identify the device by which the energy will be transformed (e.g., a light bulb to convert electrical energy into light energy, a motor to convert electrical energy into energy of motion).
2	Describing* criteria and constraints, including quantification when appropriate		
	a	Students describe* the given criteria and constraints of the design, which include:	
		iv.	Criteria:

		1. The initial and final forms of energy.
		2. Description* of how the solution functions to transfer energy from one form to another.
		v. Constraints:
		1. The materials available for the construction of the device.
		2. Safety considerations.
3	Evaluating potential solutions	
	a	Students evaluate the proposed solution according to how well it meets the specified criteria and constraints of the problem.
4	Modifying the design solution	
	a	Students test the device and use the results of the test to address problems in the design or improve its functioning.

4-PS4-1 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

4-PS4-1. **Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [*Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle.

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Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science findings are based on recognizing patterns.

Disciplinary Core Ideas

PS4.A: 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. *(Note: This grade band endpoint was moved from K–2.)*
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students develop a model (e.g., diagrams, analogies, examples, abstract representations, physical models) to make sense of a phenomenon that involves wave behavior. In the model, students identify the relevant components, including:	
		i.	Waves.
		ii.	Wave amplitude.
		iii.	Wavelength.
		iv.	Motion of objects.
2	Relationships		
	a	Students identify and describe* the relevant relationships between components of the model, including:	
		i.	Waves can be described* in terms of patterns of repeating amplitude and wavelength (e.g., in a water wave there is a repeating pattern of water being higher and then lower than the baseline level of the water).
		ii.	Waves can cause an object to move.
		iii.	The motion of objects varies with the amplitude and wavelength of the wave carrying it.
3	Connections		
	a	Students use the model to describe*:	
		i.	The patterns in the relationships between a wave passing, the net motion of the wave, and the motion of an object caused by the wave as it passes.
		ii.	How waves may be initiated (e.g., by disturbing surface water or shaking a rope or spring).
		iii.	The repeating pattern produced as a wave is propagated.

	b	Students use the model to describe* that waves of the same type can vary in terms of amplitude and wavelength and describe* how this might affect the motion, caused by a wave, of an object.
	c	Students identify similarities and differences in patterns underlying waves and use these patterns to describe* simple relationships involving wave amplitude, wavelength, and the motion of an object (e.g., when the amplitude increases, the object moves more).

4-PS4-2 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

4-PS4-2. **Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.** [*Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model to describe phenomena.	**PS4.B: Electromagnetic Radiation** • An object can be seen when light reflected from its surface enters the eyes.	**Cause and Effect** • Cause and effect relationships are routinely identified.

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students develop a model to make sense of a phenomenon involving the relationship between light reflection and visibility of objects. In the model, students identify the relevant components, including:	
		i.	Light (including the light source).
		ii.	Objects.
		iii.	The path that light follows.
		iv.	The eye.
2	Relationships		
	a	Students identify and describe* causal relationships between the components, including:	
		i.	Light enters the eye, allowing objects to be seen.
		ii.	Light reflects off of objects, and then can travel and enter the eye.
		iii.	Objects can be seen only if light follows a path between a light source, the object, and the eye.
3	Connections		
	a	Students use the model to describe* that in order to see objects that do not produce their own light, light must reflect off the object and into the eye.	
	b	Students use the model to describe* the effects of the following on seeing an object:	
		i.	Removing, blocking, or changing the light source (e.g., a dimmer light).
		ii.	Closing the eye.
		iii.	Changing the path of the light (e.g., using mirrors to direct the path of light to allow the visualization of a previously unseen object or to change the position in which the object can be seen, using an opaque or translucent barrier between 1) the light source and the object or 2) the object and the eye to change the path light follows and the visualization of the object).

4-PS4-3 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

4-PS4-3. **Generate and compare multiple solutions that use patterns to transfer information.*** [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	**PS4.C: 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. **ETS1.C: 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. *(secondary)*	**Patterns** • Similarities and differences in patterns can be used to sort and classify designed products. - - - - - - - - - - - - - - - - - - ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Knowledge of relevant scientific concepts and research findings is important in engineering.

Observable features of the student performance by the end of the grade:			
1	Using scientific knowledge to generate design solutions		
	a	Students generate at least two design solutions, for a given problem, that use patterns to transmit a given piece of information (e.g., picture, message). Students describe* how the design solution is based on:	
		i.	Knowledge of digitized information transfer (e.g., information can be converted from a sound wave into a digital signal such as patterns of 1s and 0s and vice versa; visual or verbal messages can be encoded in patterns of flashes of light to be decoded by someone else across the room).
		ii.	Ways that high-tech devices convert and transmit information (e.g., cell phones convert sound waves into digital signals, so they can be transmitted long distances, and then converted back into sound waves; a picture or message can be encoded using light signals to transmit the information over a long distance).
2	Describing* criteria and constraints, including quantification when appropriate		
	a	Students describe* the given criteria for the design solutions, including the accuracy of the final transmitted information and that digitized information (patterns) transfer is used.	
	b	Students describe* the given constraints of the design solutions, including:	
		i.	The distance over which information is transmitted.
		ii.	Safety considerations.
		iii.	Materials available.
3	Evaluating potential solutions		
	a	Students compare the proposed solutions based on how well each meets the criteria and constraints.	

	b	Students identify similarities and differences in the types of patterns used in the solutions to determine whether some ways of transmitting information are more effective than others at addressing the problem.

4-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

4-LS1-1. **Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [*Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct an argument with evidence, data, and/or a model.	**LS1.A: Structure and Function** • Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.	**Systems and System Models** • A system can be described in terms of its components and their interactions.

Observable features of the student performance by the end of the grade:			
1	Supported claims		
	a	Students make a claim to be supported about a phenomenon. In the claim, students include the idea that plants and animals have internal and external structures that function together as part of a system to support survival, growth, behavior, and reproduction.	
2	Identifying scientific evidence		
	a	Students describe* the given evidence, including:	
		i.	The internal and external structures of selected plants and animals.
		ii.	The primary functions of those structures
3	Evaluating and critiquing evidence		
	a	Students determine the strengths and weaknesses of the evidence, including whether the evidence is relevant and sufficient to support a claim about the role of internal and external structures of plants and animals in supporting survival, growth, behavior, and/or reproduction.	
4	Reasoning and synthesis		
	a	Students use reasoning to connect the relevant and appropriate evidence and construct an argument that includes the idea that plants and animals have structures that, together, support survival, growth, behavior, and/or reproduction. Students describe* a chain of reasoning that includes:	
		i.	Internal and external structures serve specific functions within plants and animals (e.g., the heart pumps blood to the body, thorns discourage predators).
		ii.	The functions of internal and external structures can support survival, growth, behavior, and/or reproduction in plants and animals (e.g., the heart pumps blood throughout the body, which allows the entire body access to oxygen and nutrients; thorns prevent predation, which allows the plant to grow and reproduce).
		iii.	Different structures work together as part of a system to support survival, growth, behavior, and/or reproduction (e.g., the heart works with the lungs to carry oxygenated blood throughout the system; thorns protect the plant, allowing reproduction via stamens and pollen to occur).

4-LS1-2 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

4-LS1-2. **Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.** [Clarification Statement: Emphasis is on systems of information transfer.] [*Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use a model to test interactions concerning the functioning of a natural system.	**LS1.D: 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.	**Systems and System Models** • A system can be described in terms of its components and their interactions.

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	From a given model, students identify and describe* the relevant components for testing interactions concerning the functioning of a given natural system, including:	
		i.	Different types of information about the surroundings (e.g., sound, light, odor, temperature).
		ii.	Sense receptors able to detect different types of information from the environment.
		iii.	Brain.
		iv.	Animals' actions.
2	Relationships		
	a	Students describe* the relationships between components in the model, including:	
		i.	Different types of sense receptors detect specific types of information within the environment.
		ii.	Sense receptors send information about the surroundings to the brain.
		iii.	Information that is transmitted to the brain by sense receptors can be processed immediately as perception of the environment and/or stored as memories.
		iv.	Immediate perceptions or memories processed by the brain influence an animal's action or responses to features in the environment.
3	Connections		
	a	Students use the model to describe* that:	
		i.	Information in the environment interacts with animal behavioral output via interactions mediated by the brain.
		ii.	Different types of sensory information are relayed to the brain via different sensory receptors, allowing experiences to be perceived, stored as memories, and influence behavior (e.g., an animal sees a brown, rotten fruit and smells a bad odor — this sensory information allows the animal to use information about other fruits that appear to be rotting to make decisions about what to eat; an animal sees a red fruit and a green fruit — after eating them both, the animal learns that the red fruit is sweet and the green fruit is bitter and then uses this sensory information, perceived and stored as memories, to guide fruit selection next time).
		iii.	Sensory input, the brain, and behavioral output are all parts of a system that allow animals to engage in appropriate behaviors.
	b	Students use the model to test interactions involving sensory perception and its influence on animal behavior within a natural system, including interactions between:	

		i.	Information in the environment.
		ii.	Different types of sense receptors.
		iii.	Perception and memory of sensory information.
		iv.	Animal behavior.

4-ESS1-1 Earth's Place in the Universe

Students who demonstrate understanding can:

4-ESS1-1. **Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape 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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Identify the evidence that supports particular points in an explanation.

Disciplinary Core Ideas

ESS1.C: 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.

Crosscutting Concepts

Patterns

- Patterns can be used as evidence to support an explanation.

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Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems.

Observable features of the student performance by the end of the grade:			
1	Articulating the explanation of phenomena		
	a	Students identify the given explanation for a phenomenon, which includes a statement about the idea that landscapes change over time.	
	b	From the given explanation, students identify the specific aspects of the explanation they are supporting with evidence.	
2	Evidence		
	a	Students identify the evidence relevant to supporting the explanation, including local and regional patterns in the following:	
		i.	Different rock layers found in an area (e.g., rock layers taken from the same location show marine fossils in some layers and land fossils in other layers).
		ii.	Ordering of rock layers (e.g., layer with marine fossils is found below layer with land fossils).
		iii.	Presence of particular fossils (e.g., shells, land plants) in specific rock layers.
		iv.	The occurrence of events (e.g., earthquakes) due to Earth forces.
3	Reasoning		
	a	Students use reasoning to connect the evidence to support particular points of the explanation, including the identification of a specific pattern of rock layers and fossils (e.g., a rock layer containing shells and fish below a rock layer containing fossils of land animals and plants is a pattern indicating that, at one point, the landscape had been covered by water and later it was dry land). Students describe* reasoning for how the evidence supports particular points of the explanation, including:	
		i.	Specific rock layers in the same location show specific fossil patterns (e.g., some lower rock layers have marine fossils, while some higher rock layers have fossils of land plants).
		ii.	Since lower layers were formed first then covered by upper layers, this pattern indicates that the landscape of the area was transformed into the landscape indicated by the upper layer

			(e.g., lower marine fossils indicate that, at one point, the landscape was covered by water, and upper land fossils indicate that later the landscape was dry land).
		iii.	Irregularities in the patterns of rock layers indicate disruptions due to Earth forces (e.g., 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).

4-ESS2-1 Earth's Systems

Students who demonstrate understanding can:

4-ESS2-1. **Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [*Assessment Boundary: Assessment is limited to a single form of weathering or erosion.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	**ESS2.A: 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. **ESS2.E: Biogeology** • Living things affect the physical characteristics of their regions.	**Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change.

Observable features of the student performance by the end of the grade:			
1	Identifying the phenomenon under investigation		
	a	From the given investigation plan, students identify the phenomenon under investigation, which includes the following idea: the effects of weathering or the rate of erosion of Earth's materials.	
	b	From the given investigation plan, students identify the purpose of the investigation, which includes providing evidence for an explanation of the phenomenon.	
2	Identifying the evidence to address the purpose of the investigation		
	a	From the given investigation plan, students describe* the data to be collected that will serve as the basis for evidence.	
	b	From the given investigation plan, students describe* the evidence needed, based on observations and/or measurements made during the investigation, including:	
		i.	The change in the relative steepness of slope of the area (e.g., no slope, slight slope, steep slope).
		ii.	The kind of weathering or erosion to which the Earth material is exposed.
		iii.	The change in the shape of Earth materials as the result of weathering or the rate of erosion by one of the following:
			1. Motion of water.
			2. Ice (including melting and freezing processes).
			3. Wind (speed and direction).
			4. Vegetation.
	c	Students describe* how the data to be collected will serve as evidence to address the purpose of the investigation, including to help identify cause and effect relationships between weathering or erosion, and Earth materials.	
3	Planning the investigation		
	a	From the given investigation plan, students describe* how the data will be collected, including:	

		i.	The relative speed of the flow of air or water.
		ii.	The number of cycles of freezing and thawing.
		iii.	The number and types of plants growing in the Earth material.
		iv.	The relative amount of soil or sediment transported by erosion.
		v.	The number or size of rocks transported by erosion.
		vi.	The breakdown of materials by weathering (e.g., ease of breaking before or after weathering, size/number of rocks broken down).
	b	Students describe* the controlled variables, including:	
		i.	Those variables that affect the movement of water (e.g., flow speed, volume, slope).
		ii.	Those variables that affect the movement of air.
		iii.	The water temperature and forms of matter (e.g., freezing, melting, room temperature).
		iv.	The presence or absence of plants growing in or on the Earth material.
4	Collecting the data		
	a	Students make and record observations according to the given investigation plan to provide evidence for the effects of weathering or the rate of erosion on Earth materials (e.g., rocks, soils, and sediment).	

4-ESS2-2 Earth's Systems

Students who demonstrate understanding can:

4-ESS2-2. **Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena using logical reasoning.	**ESS2.B: 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.	**Patterns** • Patterns can be used as evidence to support an explanation.

Observable features of the student performance by the end of the grade:		
1	Organizing data	
	a	Students organize data using graphical displays (e.g., table, chart, graph) from maps of Earth's features (e.g., locations of mountains, continental boundaries, volcanoes, earthquakes, deep ocean trenches, ocean floor structures).
2	Identifying relationships	
	a	Students identify patterns in the location of Earth features, including the locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes. These relationships include:
		i. Volcanoes and earthquakes occur in bands that are often along the boundaries between continents and oceans.
		ii. Major mountain chains form inside continents or near their edges.
3	Interpreting data	
	a	Students use logical reasoning based on the organized data to make sense of and describe* a phenomenon. In their description*, students include that Earth features occur in patterns that reflect information about how they are formed or occur (e.g., mountain ranges tend to occur on the edges of continents or inside them, the Pacific Ocean is surrounded by a ring of volcanoes, all continents are surrounded by water [assume Europe and Asia are identified as Eurasia]).

4-ESS3-1 Earth and Human Activity

Students who demonstrate understanding can:

4-ESS3-1. **Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.

- Obtain and combine information from books and other reliable media to explain phenomena.

Disciplinary Core Ideas

ESS3.A: Natural Resources

- 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.

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change.

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Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering.

Influence of Engineering, Technology, and Science on Society and the Natural World

- Over time, people's needs and wants change, as do their demands for new and improved technologies.

Observable features of the student performance by the end of the grade:			
1	Obtaining information		
	a	Students gather information from books and other reliable media about energy resources and fossil fuels (e.g., fossil fuels, solar, wind, water, nuclear), including:	
		i.	How they are derived from natural sources (e.g., which natural resource they are derived from) [note: mechanisms should be limited to grade appropriate descriptions*, such as comparing the different ways energy resources are each derived from a natural resource).
		ii.	How they address human energy needs.
		iii.	The positive and negative environmental effects of using each energy resource.
2	Evaluating information		
	a	Students combine the obtained information to provide evidence about:	
		i.	The effects on the environment of using a given energy resource.
		ii.	Whether the energy resource is renewable.
		iii.	The role of technology, including new and improved technology, in improving or mediating the environmental effects of using a given resource.
3	Communicating information		
	a	Students use the information they obtained and combined to describe* the causal relationships between:	
		i.	Energy resources and the environmental effects of using that energy source.
		ii.	The role of technology in extracting and using an energy resource.

4-ESS3-2 Earth and Human Activity

Students who demonstrate understanding can:

4-ESS3-2. **Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [*Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Disciplinary Core Ideas

ESS3.B: 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. *(Note: This Disciplinary Core Idea can also be found in 3.WC.)*

ETS1.B: Designing Solutions to Engineering Problems

- Testing a solution involves investigating how well it performs under a range of likely conditions.*(secondary)*

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change.

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Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands.

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Given a natural Earth process that can have a negative effect on humans (e.g., an earthquake, volcano, flood, landslide), students use scientific information about that Earth process and its effects to design at least two solutions that reduce its effect on humans.
	b	In their design solutions, students describe* and use cause and effect relationships between the Earth process and its observed effect.
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe* the given criteria for the design solutions, including using scientific information about the Earth process to describe* how well the design must alleviate the effect of the Earth process on humans.
	b	Students describe* the given constraints of the solution (e.g., cost, materials, time, relevant scientific information), including performance under a range of likely conditions.
3	Evaluating potential solutions	
	a	Students evaluate each design solution based on whether and how well it meets the each of the given criteria and constraints.
	b	Students compare the design solutions to each other based on how well each meets the given criteria and constraints.
	c	Students describe* the design solutions in terms of how each alters the effect of the Earth process on humans.

3-5-ETS1-1 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

Disciplinary Core Ideas

ETS1.A: 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.

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

- People's needs and wants change over time, as do their demands for new and improved technologies.

Observable features of the student performance by the end of the grade:			
1	Identifying the problem to be solved		
	a	Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.	
	b	The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.	
	c	Students describe* that people's needs and wants change over time.	
2	Defining the boundaries of the system		
	a	Students define the limits within which the problem will be addressed, which includes addressing something people want and need at the current time.	
3	Defining the criteria and constraints		
	a	Based on the situation people want to change, students specify criteria (required features) of a successful solution.	
	b	Students describe* the constraints or limitations on their design, which may include:	
		iv.	Cost.
		v.	Materials.
		vi.	Time.

3-5-ETS1-2 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	**ETS1.B: 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.	**Influence of Science, Engineering, and Technology on Society and the Natural World** • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

Observable features of the student performance by the end of the grade:			
1	Using scientific knowledge to generate design solutions		
	a	Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.	
	b	Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.	
	c	Students specify how each design solution solves the problem.	
	d	Students share ideas and findings with others about design solutions to generate a variety of possible solutions.	
	e	Students describe* the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design [note: emphasis is on what is necessary for designing solutions, not on a step-wise process].	
2	Describing* criteria and constraints, including quantification when appropriate		
	a	Students describe*:	
		iii.	The given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
		iv.	How the criteria and constraints will be used to generate and test the design solutions.
3	Evaluating potential solutions		
	a	Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.	
	b	Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.	

3-5-ETS1-3 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Disciplinary Core Ideas

ETS1.B: Developing Possible Solutions

- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

ETS1.C: 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.

Crosscutting Concepts

Observable features of the student performance by the end of the grade:			
1	Identifying the purpose of the investigation		
	a	Students describe* the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.	
2	Identifying the evidence to be address the purpose of the investigation		
	a	Students describe* the evidence to be collected, including:	
		iv.	How well the model/prototype performs against the given criteria and constraints.
		v.	Specific aspects of the prototype or model that do not meet one or more of the criteria or constraints (i.e., failure points or difficulties).
		vi.	Aspects of the model/prototype that can be improved to better meet the criteria and constraints.
	b	Students describe* how the evidence is relevant to the purpose of the investigation.	
3	Planning the investigation		
	a	Students create a plan for the investigation that describes* different tests for each aspect of the criteria and constraints. For each aspect, students describe*:	
		vi.	The specific criterion or constraint to be used.
		vii.	What is to be changed in each trial (the independent variable).
		viii.	The outcome (dependent variable) that will be measured to determine success.
		ix.	What tools and methods are to be used for collecting data.
		x.	What is to be kept the same from trial to trial to ensure a fair test.
4	Collecting the data		
	a	Students carry out the investigation, collecting and recording data according to the developed plan.	

Iowa Science Standards

Fifth Grade Standards
Foundation Boxes
Evidence Statements

5-PS1-1 Matter and Its Interactions

Students who demonstrate understanding can:

5-PS1-1. **Develop a model to describe that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence supporting a model 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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use models to describe phenomena.	**PS1.A: 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.	**Scale, Proportion, and Quantity** • Natural objects exist from the very small to the immensely large.

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students develop a model to describe* a phenomenon that includes the idea that matter is made of particles too small to be seen. In the model, students identify the relevant components for the phenomenon, including:	
		i.	Bulk matter (macroscopic observable matter; e.g., as sugar, air, water).
		ii.	Particles of matter that are too small to be seen.
2	Relationships		
	a	In the model, students identify and describe* relevant relationships between components, including the relationships between:	
		i.	Bulk matter and tiny particles that cannot be seen (e.g., tiny particles of matter that cannot be seen make up bulk matter).
		ii.	The behavior of a collection of many tiny particles of matter and observable phenomena involving bulk matter (e.g., an expanding balloon, evaporating liquids, substances that dissolve in a solvent, effects of wind).
3	Connections		
	a	Students use the model to describe* how matter composed of tiny particles too small to be seen can account for observable phenomena (e.g., air inflating a basketball, ice melting into water).	

5-PS1-2 Matter and Its Interactions

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Measure and graph quantities such as weight to address scientific and engineering questions and problems.

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.

PS1.B: Chemical Reactions

- 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.)

Crosscutting Concepts

Scale, Proportion, and Quantity

- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

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Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems.

Observable features of the student performance by the end of the grade:		
1	Representation	
	a	Students measure and graph the given quantities using standard units, including:
		i. The weight of substances before they are heated, cooled, or mixed.
		ii. The weight of substances, including any new substances produced by a reaction, after they are heated, cooled, or mixed.
2	Mathematical/computational analysis	
	a	Students measure and/or calculate the difference between the total weight of the substances (using standard units) before and after they are heated, cooled, and/or mixed.
	b	Students describe* the changes in properties they observe during and/or after heating, cooling, or mixing substances.
	c	Students use their measurements and calculations to describe* that the total weights of the substances did not change, regardless of the reaction or changes in properties that were observed.
	d	Students use measurements and descriptions* of weight, as well as the assumption of consistent patterns in natural systems, to describe* evidence to address scientific questions about the conservation of the amount of matter, including the idea that the total weight of matter is conserved after heating, cooling, or mixing substances.

5-PS1-3 Matter and Its Interactions

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	**PS1.A: Structure and Properties of Matter** • 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.)	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

Observable features of the student performance by the end of the grade:		
1	Identifying the phenomenon under investigation	
	a	From the given investigation plan, students identify the phenomenon under investigation, which includes the observable and measurable properties of materials.
	b	Students identify the purpose of the investigation, which includes collecting data to serve as the basis for evidence for an explanation about the idea that materials can be identified based on their observable and measurable properties.
2	Identifying the evidence to address the purpose of the investigation	
	a	From the given investigation plan, students describe* the evidence from data (e.g., qualitative observations and measurements) that will be collected, including:
		i. Properties of materials that can be used to identify those materials (e.g., color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility).
	b	Students describe* how the observations and measurements will provide the data necessary to address the purpose of the investigation.
3	Planning the investigation	
	a	From the given plan investigation plan, students describe* how the data will be collected. Examples could include:
		i. Quantitative measures of properties, in standard units (e.g., grams, liters).
		ii. Observations of properties such as color, conductivity, and reflectivity.
		iii. Determination of conductors vs. nonconductors and magnetic vs. nonmagnetic materials.
	b	Students describe* how the observations and measurements they make will allow them to identify materials based on their properties.
4	Collecting the data	
	a	Students collect and record data, according to the given investigation plan.

5-PS1-4 Matter and Its Interactions

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	**PS1.B: Chemical Reactions** • When two or more different substances are mixed, a new substance with different properties may be formed.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.

Observable features of the student performance by the end of the grade:			
1	Identifying the phenomenon under investigation		
	a	From the given investigation plan, students describe* the phenomenon under investigation, which includes the mixing of two or more substances.	
	b	Students identify the purpose of the investigation, which includes providing evidence for whether new substances are formed by mixing two or more substances, based on the properties of the resulting substance.	
2	Identifying the evidence to address the purpose of the investigation		
	a	From the given investigation plan, students describe* the evidence from data that will be collected, including:	
		i.	Quantitative (e.g., weight) and qualitative properties (e.g., state of matter, color, texture, odor) of the substances to be mixed.
		ii.	Quantitative and qualitative properties of the resulting substances.
	b	Students describe* how the collected data can serve as evidence for whether the mixing of the two or more tested substances results in one or more new substances.	
3	Planning the investigation		
	a	From the given investigation plan, students describe* how the data will be collected, including:	
		vii.	How quantitative and qualitative properties of the two or more substances to be mixed will be determined and measured.
		viii.	How quantitative and qualitative properties of the substances that resulted from the mixture of the two or more substances will be determined and measured.
		ix.	Number of trials for the investigation.
		x.	How variables will be controlled to ensure a fair test (e.g., the temperature at which the substances are mixed, the number of substances mixed together in each trial).
4	Collecting the data		
	a	According to the investigation plan, students collaboratively collect and record data, including data about the substances before and after mixing.	

5-PS2-1 Motion and Stability: Forces and Interaction

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Support an argument with evidence, data, or a model.	**PS2.B: Types of Interactions** • The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.

Observable features of the student performance by the end of the grade:			
1	Supported claims		
	a	Students identify a given claim to be supported about a phenomenon. The claim includes the idea that the gravitational force exerted by Earth on objects is directed down toward the center of Earth.	
2	Identifying scientific evidence		
	a	Students identify and describe* the given evidence, data, and/or models that support the claim, including:	
		i.	Multiple lines of evidence that indicate that the Earth's shape is spherical (e.g., observation of ships sailing beyond the horizon, the shape of the Earth's shadow on the moon during an eclipse, the changing height of the North Star above the horizon as people travel north and south).
		ii.	That objects dropped appear to fall straight down.
		iii.	That people live all around the spherical Earth, and they all observe that objects appear to fall straight down.
3	Evaluation and critique		
	a	Students evaluate the evidence to determine whether it is sufficient and relevant to supporting the claim.	
	b	Students describe* whether any additional evidence is needed to support the claim.	
4	Reasoning and synthesis		
	a	Students use reasoning to connect the relevant and appropriate evidence to support the claim with argumentation. Students describe* a chain of reasoning that includes:	
		i.	If Earth is spherical, and all observers see objects near them falling directly "down" to the Earth's surface, then all observers would agree that objects fall toward the Earth's center.
		ii.	Since an object that is initially stationary when held moves downward when it is released, there must be a force (gravity) acting on the object that pulls the object toward the center of Earth.

5-PS3-1 Energy

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use models to describe phenomena.	**PS3.D: 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). **LS1.C: 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. *(secondary)*	**Energy and Matter** • Energy can be transferred in various ways and between objects.

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students use models to describe* a phenomenon that includes the idea that energy in animals' food was once energy from the sun. Students identify and describe* the components of the model that are relevant for describing* the phenomenon, including:	
		i.	Energy.
		ii.	The sun.
		iii.	Animals, including their bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
		iv.	Plants.
2	Relationships		
	a	Students identify and describe* the relevant relationships between components, including:	
		i.	The relationship between plants and the energy they get from sunlight to produce food.
		ii.	The relationship between food and the energy and materials that animals require for bodily functions (e.g., body repair, growth, motion, body warmth maintenance).
		iii.	The relationship between animals and the food they eat, which is either other animals or plants (or both), to obtain energy for bodily functions and materials for growth and repair.
3	Connections		
	a	Students use the models to describe* causal accounts of the relationships between energy from the sun and animals' needs for energy, including that:	
		i.	Since all food can eventually be traced back to plants, all of the energy that animals use for body repair, growth, motion, and body warmth maintenance is energy that once came from the sun.
		ii.	Energy from the sun is transferred to animals through a chain of events that begins with plants producing food then being eaten by animals.

5-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Support an argument with evidence, data, or a model.

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms

- Plants acquire their material for growth chiefly from air and water.

Crosscutting Concepts

Energy and Matter

- Matter is transported into, out of, and within systems.

Observable features of the student performance by the end of the grade:			
1	Supported claims		
	a	Students identify a given claim to be supported about a given phenomenon. The claim includes the idea that plants acquire the materials they need for growth chiefly from air and water.	
2	Identifying scientific evidence		
	a	Students describe* the given evidence, data, and/or models that support the claim, including evidence of:	
		iv.	Plant growth over time.
		v.	Changes in the weight of soil and water within a closed system with a plant, indicating:
			1. Soil does not provide most of the material for plant growth (e.g., changes in weight of soil and a plant in a pot over time, hydroponic growth of plants).
			2. Plants' inability to grow without water.
		vi.	Plants' inability to grow without air.
		vii.	Air is matter (e.g., empty object vs. air filled object).
3	Evaluating and critiquing evidence		
	a	Students determine whether the evidence supports the claim, including:	
		vii.	Whether a particular material (e.g., air, soil) is required for growth of plants.
		viii.	Whether a particular material (e.g., air, soil) may provide sufficient matter to account for an observed increase in weight of a plant during growth.
4	Reasoning and synthesis		
	a	Students use reasoning to connect the evidence to support the claim with argumentation. Students describe* a chain of reasoning that includes:	
		i.	During plant growth in soil, the weight of the soil changes very little over time, whereas the weight of the plant changes a lot. Additionally, some plants can be grown without soil at all.
		ii.	Because some plants don't need soil to grow, and others show increases in plant matter (as measured by weight) but not accompanying decreases in soil matter, the material from soil must not enter the plant in sufficient quantities to be the chief contributor to plant growth.
		iii.	Therefore, plants do not acquire most of the material for growth from soil.
		iv.	A plant cannot grow without water or air. Because both air and water are matter and are transported into the plant system, they can provide the materials plants need for growth.
		v.	Since soil cannot account for the change in weight as a plant grows and since plants take in water and air, both of which could contribute to the increase in weight during plant growth, plant growth must come chiefly from water and air.

5-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena.

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Connections to the Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Science explanations describe the mechanisms for natural events.

Disciplinary Core Ideas

LS2.A: 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 introduced species can damage the balance of an ecosystem.

LS2.B: 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.

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions.

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students develop a model to describe* a phenomenon that includes the movement of matter within an ecosystem. In the model, students identify the relevant components, including:	
		i.	Matter.
		ii.	Plants.
		iii.	Animals.
		iv.	Decomposers, such as fungi and bacteria.
		v.	Environment.
2	Relationships		
	a	Students describe* the relationships among components that are relevant for describing* the phenomenon, including:	
		i.	The relationships in the system between organisms that consume other organisms, including:
			1. Animals that consume other animals.
			2. Animals that consume plants.

		3. Organisms that consume dead plants and animals.
		4. The movement of matter between organisms during consumption.
		ii. The relationship between organisms and the exchange of matter from and back into the environment (e.g., organisms obtain matter from their environments for life processes and release waste back into the environment, decomposers break down plant and animal remains to recycle some materials back into the soil).
3	Connections	
	a	Students use the model to describe*:
		i. The cycling of matter in the system between plants, animals, decomposers, and the environment.
		ii. How interactions in the system of plants, animals, decomposers, and the environment allow multiple species to meet their needs.
		iii. That newly introduced species can affect the balance of interactions in a system (e.g., a new animal that has no predators consumes much of another organism's food within the ecosystem).
		iv. That changing an aspect (e.g., organisms or environment) of the ecosystem will affect other aspects of the ecosystem.

5-ESS1-1 Earth's Place in the Universe

Students who demonstrate understanding can:

5-ESS1-1. **Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.** [*Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Support an argument with evidence, data, or a model.	**ESS1.A: 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.	**Scale, Proportion, and Quantity** • Natural objects exist from the very small to the immensely large.

Observable features of the student performance by the end of the grade:			
1	Supported claims		
	a	Students identify a given claim to be supported about a given phenomenon. The claim includes the idea that the apparent brightness of the sun and stars is due to their relative distances from Earth.	
2	Identifying scientific evidence		
	a	Students describe* the evidence, data, and/or models that support the claim, including:	
		i.	The sun and other stars are natural bodies in the sky that give off their own light.
		ii.	The apparent brightness of a variety of stars, including the sun.
		iii.	A luminous object close to a person appears much brighter and larger than a similar object that is very far away from a person (e.g., nearby streetlights appear bigger and brighter than distant streetlights).
		iv.	The relative distance of the sun and stars from Earth (e.g., although the sun and other stars are all far from the Earth, the stars are very much farther away; the sun is much closer to Earth than other stars).
3	Evaluating and critiquing evidence		
	a	Students evaluate the evidence to determine whether it is relevant to supporting the claim, and sufficient to describe* the relationship between apparent size and apparent brightness of the sun and other stars and their relative distances from Earth.	
	b	Students determine whether additional evidence is needed to support the claim.	
4	Reasoning and synthesis		
	a	Students use reasoning to connect the relevant and appropriate evidence to the claim with argumentation. Students describe* a chain of reasoning that includes:	
		i.	Because stars are defined as natural bodies that give off their own light, the sun is a star.
		ii.	The sun is many times larger than Earth but appears small because it is very far away.
		iii.	Even though the sun is very far from Earth, it is much closer than other stars.
		iv.	Because the sun is closer to Earth than any other star, it appears much larger and brighter than any other star in the sky.
		v.	Because objects appear smaller and dimmer the farther they are from the viewer, other stars, although immensely large compared to the Earth, seem much smaller and dimmer because they are so far away.
		vi.	Although stars are immensely large compared to Earth, they appear small and dim because they are so far away.
		vii.	Similar stars vary in apparent brightness, indicating that they vary in distance from Earth.

5-ESS1-2 Earth's Place in the Universe

Students who demonstrate understanding can:

5-ESS1-2. **Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [*Assessment Boundary: Assessment does not include causes of seasons.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.	**ESS1.B: 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.	**Patterns** • Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena.

Observable features of the student performance by the end of the grade:			
1	Organizing data		
	a	Using graphical displays (e.g., bar graphs, pictographs), students organize data pertaining to daily and seasonal changes caused by the Earth's rotation and orbit around the sun. Students organize data that include:	
		i.	The length and direction of shadows observed several times during one day.
		ii.	The duration of daylight throughout the year, as determined by sunrise and sunset times.
		iii.	Presence or absence of selected stars and/or groups of stars that are visible in the night sky at different times of the year.
2	Identifying relationships		
	a	Students use the organized data to find and describe* relationships within the datasets, including:	
		i.	The apparent motion of the sun from east to west results in patterns of changes in length and direction of shadows throughout a day as Earth rotates on its axis.
		ii.	The length of the day gradually changes throughout the year as Earth orbits the sun, with longer days in the summer and shorter days in the winter.
		iii.	Some stars and/or groups of stars (i.e., constellations) can be seen in the sky all year, while others appear only at certain times of the year.
	b	Students use the organized data to find and describe* relationships among the datasets, including:	
		i.	Similarities and differences in the timing of observable changes in shadows, daylight, and the appearance of stars show that events occur at different rates (e.g., Earth rotates on its axis once a day, while its orbit around the sun takes a full year).

5-ESS2-1 Earth's Systems

Students who demonstrate understanding can:

5-ESS2-1. **Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [*Assessment Boundary: Assessment is limited to the interactions of two systems at a time.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model using an example to describe a scientific principle.	**ESS2.A: 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.	**Systems and System Models** • A system can be described in terms of its components and their interactions.

Observable features of the student performance by the end of the grade:			
1	Components of the model		
	a	Students develop a model, using a specific given example of a phenomenon, to describe* ways that the geosphere, biosphere, hydrosphere, and/or atmosphere interact. In their model, students identify the relevant components of their example, including features of two of the following systems that are relevant for the given example:	
		i.	Geosphere (i.e., solid and molten rock, soil, sediment, continents, mountains).
		ii.	Hydrosphere (i.e., water and ice in the form of rivers, lakes, glaciers).
		iii.	Atmosphere (i.e., wind, oxygen).
		iv.	Biosphere (i.e., plants, animals [including humans]).
2	Relationships		
	a	Students identify and describe* relationships (interactions) within and between the parts of the Earth systems identified in the model that are relevant to the example (e.g., the atmosphere and the hydrosphere interact by exchanging water through evaporation and precipitation; the hydrosphere and atmosphere interact through air temperature changes, which lead to the formation or melting of ice).	
3	Connections		
	a	Students use the model to describe* a variety of ways in which the parts of two major Earth systems in the specific given example interact to affect the Earth's surface materials and processes in that context. Students use the model to describe* how parts of an individual Earth system:	
		i.	Work together to affect the functioning of that Earth system.
		ii.	Contribute to the functioning of the other relevant Earth system.

5-ESS2-2 Earth's Systems

Students who demonstrate understanding can:

5-ESS2-2. **Describe and graph the amounts of salt 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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Describe and graph quantities such as area and volume to address scientific questions.	**ESS2.C: 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.	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight and volume.

Observable features of the student performance by the end of the grade:			
1	Representation		
	a	Students graph the given data (using standard units) about the amount of salt water and the amount of fresh water in each of the following reservoirs, as well as in all the reservoirs combined, to address a scientific question:	
		i.	Oceans.
		ii.	Lakes.
		iii.	Rivers.
		iv.	Glaciers.
		v.	Ground water.
		vi.	Polar ice caps.
2	Mathematical/computational analysis		
	a	Students use the graphs of the relative amounts of total salt water and total fresh water in each of the reservoirs to describe* that:	
		i.	The majority of water on Earth is found in the oceans.
		ii.	Most of the Earth's fresh water is stored in glaciers or underground.
		iii.	A small fraction of fresh water is found in lakes, rivers, wetlands, and the atmosphere.

5-ESS3-1 Earth and Human Activity

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.

Disciplinary Core Ideas

ESS3.C: 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.

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions.

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Connections to Nature of Science

Science Addresses Questions About the Natural and Material World.

- Science findings are limited to questions that can be answered with empirical evidence.

Observable features of the student performance by the end of the grade:			
1	Obtaining information		
	a	Students obtain information from books and other reliable media about:	
		i.	How a given human activity (e.g., in agriculture, industry, everyday life) affects the Earth's resources and environments.
		ii.	How a given community uses scientific ideas to protect a given natural resource and the environment in which the resource is found.
2	Evaluating information		
	a	Students combine information from two or more sources to provide and describe* evidence about:	
		i.	The positive and negative effects on the environment as a result of human activities.
		ii.	How individual communities can use scientific ideas and a scientific understanding of interactions between components of environmental systems to protect a natural resource and the environment in which the resource is found.

3-5-ETS1-1 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

Disciplinary Core Ideas

ETS1.A: 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.

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

- People's needs and wants change over time, as do their demands for new and improved technologies.

Observable features of the student performance by the end of the grade:		
1	Identifying the problem to be solved	
	a	Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.
	b	The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.
	c	Students describe* that people's needs and wants change over time.
2	Defining the boundaries of the system	
	a	Students define the limits within which the problem will be addressed, which includes addressing something people want and need at the current time.
3	Defining the criteria and constraints	
	a	Based on the situation people want to change, students specify criteria (required features) of a successful solution.
	b	Students describe* the constraints or limitations on their design, which may include:
		i. Cost.
		ii. Materials.
		iii. Time.

3-5-ETS1-2 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	**ETS1.B: 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.	**Influence of Science, Engineering, and Technology on Society and the Natural World** • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.
	b	Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.
	c	Students specify how each design solution solves the problem.
	d	Students share ideas and findings with others about design solutions to generate a variety of possible solutions.
	e	Students describe* the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design [note: emphasis is on what is necessary for designing solutions, not on a step-wise process].
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe*:
		i. The given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
		ii. How the criteria and constraints will be used to generate and test the design solutions.
3	Evaluating potential solutions	
	a	Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.
	b	Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.

3-5-ETS1-3 Engineering Design

Students who demonstrate understanding can:

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

The performance expectation above was developed using the following elements from the NRC document *A Framework for K- 12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	**ETS1.B: Developing Possible Solutions** • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **ETS1.C: 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.	

Observable features of the student performance by the end of the grade:			
1	Identifying the purpose of the investigation		
	a	Students describe* the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.	
2	Identifying the evidence to be address the purpose of the investigation		
	a	Students describe* the evidence to be collected, including:	
		i.	How well the model/prototype performs against the given criteria and constraints.
		ii.	Specific aspects of the prototype or model that do not meet one or more of the criteria or constraints (i.e., failure points or difficulties).
		iii.	Aspects of the model/prototype that can be improved to better meet the criteria and constraints.
	b	Students describe* how the evidence is relevant to the purpose of the investigation.	
3	Planning the investigation		
	a	Students create a plan for the investigation that describes* different tests for each aspect of the criteria and constraints. For each aspect, students describe*:	
		i.	The specific criterion or constraint to be used.
		ii.	What is to be changed in each trial (the independent variable).
		iii.	The outcome (dependent variable) that will be measured to determine success.
		iv.	What tools and methods are to be used for collecting data.
		v.	What is to be kept the same from trial to trial to ensure a fair test.
4	Collecting the data		
	a	Students carry out the investigation, collecting and recording data according to the developed plan.	