First Grade

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

1.Waves: Light and Sound

1.Waves: Light and Sound

Students who demonstrate understanding can:

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

1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated. [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]

1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]

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

The performance expectations above were 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 data to serve as the basis for evidence to answer a question. (1-PS4-1),(1-PS4-3)

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 (1-PS4-2)
- Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations begin with a question. (1-PS4-1)
- Scientists use different ways to study the world. (1-PS4-1)

Disciplinary Core Ideas

PS4.A: Wave Properties

- Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)

PS4.B: Electromagnetic Radiation

- Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2)
- 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.) (1-PS4-3)

PS4.C: Information Technologies and Instrumentation

- People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4)

Crosscutting Concepts

Cause and Effect

- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1),(1-PS4-2),(1-PS4-3)

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. (1-PS4-4)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-levels: **K.ETS1.A** (1-PS4-4); **2.PS1.A** (1-PS4-3); **2.ETS1.B** (1-PS4-4); **4.PS4.C** (1-PS4-4); **4.PS4.B** (1-PS4-2); **4.ETS1.A** (1-PS4-4)

Common Core State Standards Connections:

ELA/Literacy –

W.1.2	Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure. *(1-PS4-2)*
W.1.7	Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-PS4-1),(1-PS4-2),(1-PS4-3),(1-PS4-4)
W.1.8	With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-PS4-1),(1-PS4-2),(1-PS4-3)
SL.1.1	Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. *(1-PS4-1),(1-PS4-2),(1-PS4-3)*

Mathematics –

MP.5	Use appropriate tools strategically. *(1-PS4-4)*
1.MD.A.1	Order three objects by length; compare the lengths of two objects indirectly by using a third object. *(1-PS4-4)*
1.MD.A.2	Express the length of an object as a whole number of length units, by layering multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *(1-PS4-4)*

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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. Vibrating materials 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

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

PS4.B: Electromagnetic Radiation

- Objects can be seen if light is available to illuminate them or if they give off their own light.

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	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

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.

Disciplinary Core Ideas

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.)

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:
		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

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.Structure, Function, and Information Processing

1.Structure, Function, and Information Processing

Students who demonstrate understanding can:

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

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

1-LS3-1. 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 expectations above were 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. (1-LS3-1)
- Use materials to design a device that solves a specific problem or a solution to a specific problem. (1-LS1-1)

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. (1-LS1-2)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Scientists look for patterns and order when making observations about the world. (1-LS1-2)

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. (1-LS1-1)

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. (1-LS1-2)

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. (1-LS1-1)

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. (1-LS3-1)

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. (1-LS3-1)

Crosscutting Concepts

Patterns

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-LS1-2),(1-LS3-1)

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s). (1-LS1-1)

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 by built using materials derived from the natural world. (1-LS1-1)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-levels: **K.ETS1.A** (1-LS1-1); **3.LS2.D** (1-LS1-2) **3.LS3.A** (1-LS3-1); **3.LS3.B** (1-LS3-1); **4.LS1.A** (1-LS1-1); **4.LS1.D** (1-LS1-1); **4.ETS1.A** (1-LS1-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.1.1	Ask and answer questions about key details in a text. (1-LS1-2),(1-LS3-1)
RI.1.2	Identify the main topic and retell key details of a text. (1-LS1-2)
RI.1.10	With prompting and support, read informational texts appropriately complex for grade. (1-LS1-2)
W.1.7	Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-LS1-1),(1-LS3-1)
W.1.8	With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-LS3-1)

Mathematics –

MP.2	Reason abstractly and quantitatively. *(1-LS3-1)*
MP.5	Use appropriate tools strategically. *(1-LS3-1)*
1.NBT.B.3	Compare two two-digit numbers based on the meanings of the tens and one digits, recording the results of comparisons with the symbols >, =, and <. *(1-LS1-2)*
1.NBT.C.4	Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning uses. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten. *(1-LS1-2)*
1.NBT.C.5	Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used. *(1-LS1-2)*
1.NBT.C.6	Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. *(1-LS1-2)*
1.MD.A.1	Order three objects by length; compare the lengths of two objects indirectly by using a third object. *(1-LS3-1)*

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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.Space Systems: Patterns and Cycles

1.Space Systems: Patterns and Cycles

Students who demonstrate understanding can:

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

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

The performance expectations above were 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. (1-ESS1-2)

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. (1-ESS1-1)

Disciplinary Core Ideas

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. (1-ESS1-1)

ESS1.B: Earth and the Solar System

- Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)

Crosscutting Concepts

Patterns

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-ESS1-1),(1-ESS1-2)

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. (1-ESS1-1)
- Many events are repeated. (1-ESS1-1)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-levels: **3.PS2.A** (1-ESS1-1); **5.PS2.B** (1-ESS1-1),(1-ESS1-2) **5-ESS1.B** (1-ESS1-1),(1-ESS1-2)

Common Core State Standards Connections:

ELA/Literacy –

W.1.7 Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-ESS1-1),(1-ESS1-2)

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-ESS1-1),(1-ESS1-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(1-ESS1-2)*

MP.4 Model with mathematics. *(1-ESS1-2)*

MP.5 Use appropriate tools strategically. *(1-ESS1-2)*

1.OA.A.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations to represent the problem. *(1-ESS1-2)*

1.MD.C.4 Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. *(1-ESS1-2)*

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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

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.

Disciplinary Core Ideas

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.

Crosscutting Concepts

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.Engineering Design

K-2.Engineering Design

Students who demonstrate understanding can:

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

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

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

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

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. (K-2-ETS1-1)
- Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1)

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. (K-2-ETS1-2)

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. (K-2-ETS1-3)

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. (K-2-ETS1-1)
- Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1)
- Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)

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. (K-2-ETS1-2)

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. (K-2-ETS1-3)

Crosscutting Concepts

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)

Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2
Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include:
Kindergarten: K-ESS3-3, **First Grade:** 1-PS4-4, **Second Grade:** 2-LS2-2
Connections to K-2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1

Articulation of DCIs across grade-bands: **3-5.ETS1.A** (K-2-ETS1-1),(K-2-ETS1-2),(K-2 -ETS1-3); **3-5.ETS1.B** (K-2-ETS1-2),(K-2-ETS1-3); **3-5.ETS1.C** (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3)

Common Core State Standards Connections:

ELA/Literacy –

RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (K-2-ETS1-1)
W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. *(K-2-ETS1-1),(K-2-ETS1-3)*
W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1),*(K-2-ETS1-3)*
SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. *(K-2-ETS1-2)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(K-2-ETS1-1),(K-2-ETS1-3)*
MP.4 Model with mathematics. *(K-2-ETS1-1),(K-2-ETS1-3)*
MP.5 Use appropriate tools strategically. *(K-2-ETS1-1),(K-2-ETS1-3)*
2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. *(K-2-ETS1-1),(K-2-ETS1-3)*

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:
		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

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:
		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.