1st Grade - Topic Model - Bundle 2
Observing Objects with Sight and Hearing

This is the second bundle of the 1st Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart

Bundle 2 Question: This bundle is assembled to address the question "why can we see objects and hear sounds?"

Summary
The bundle organizes performance expectations with a focus on the theme of *observing objects with sight and hearing.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but recognize that instruction is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs
The idea that seasonal patterns of sunrise and sunset can be observed, described, and predicted (ESS1.B as in 1-ESS1-2) connects to the concept that the patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted (ESS1.A as in 1-ESS1-1). These ideas also connect to the concept that objects can be seen if light is available to illuminate them or if they give off their own light (1-PS4-2).

The concept of how objects can be seen can also connect to the idea that people also use a variety of devices to communicate (send and receive information) over long distances (PS4.C as in 1-PS4-4). Ideas about communication devices also connect to the concept that sound can make matter vibrate, and vibrating matter can make sound (PS4.A as in 1-PS4-1).

The engineering design idea that a situation that people want to change or create can be approached as a problem to be solved through engineering (ETS1.A as in K-2-ETS1-1) could be applied to different science concepts, such as to the concept that sound can make matter vibrate, and vibrating matter can make sound (PS4.A as in 1-PS4-1), and to the concept that people also use a variety of devices to communicate (send and receive information) over long distances (PS4.C as in 1-PS4-4). Connections can be made through engineering tasks such as a task in which students identify devices they, or their families, may use that have been created to solve the problem of communicating over long distances, through a task in which students are challenged to create an instrument that uses vibrations to make sound, or through a task in which students try to make something move with vibrations created by sound. Additionally, students could connect these science concepts to the idea that, because there is always more than one possible solution to a problem, it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3). For example, students could test the instruments they created or they can compare different devices for how well the device allows people to communicate over long distances.

Bundle Science and Engineering Practices
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of asking questions and defining problems (K-2-ETS1-1), planning and carrying out investigations (1-PS4-1 and 1-ESS1-2), analyzing and interpreting data (1-ESS1-1), and constructing explanations and designing solutions (1-PS4-2 and 1-PS4-4). Many other practice elements can be used in instruction.

Bundle Crosscutting Concepts
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Patterns (1-ESS1-1 and 1-ESS1-2) and Cause and Effect (1-PS4-1 and 1-PS4-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations 1-ESS1-2, K-2-ETS1-1, and K-2-ETS1-3 are partially assessable.	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 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.]** 1-PS4-4 **Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*** **[Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.]** **[*Assessment Boundary: Assessment does not include technological details for how communication devices work.*]** 1-ESS1-1 **Use observations of the sun, moon, and stars to describe patterns that can be predicted.** **[Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.]** **[*Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.*]** 1-ESS1-2 **Make observations at different times of year to relate the amount of daylight to the time of year.** **[Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.]** **[*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]** K-2-ETS1-1 **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-ETS1-3 **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**
Example Phenomena	A speaker vibrates when it plays music. I can't see stars during the daytime.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Define a simple problem that can be solved through the development of a new or improved object or tool. Students could *define a simple problem* [related to] ***people communicating (sending and receiving information) over long distances*** *that can be solved through the development of a new object*. 1-PS4-4 **Developing and Using Models** ● Develop and/or use a model to represent patterns in the natural world. Students could *develop a model to represent* ***patterns of the motion of the sun, moon, and stars in the sky*****.** 1-ESS1-1 **Planning and Carrying Out Investigations** ● Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. Students could evaluate different ways of observing [the] phenomenon [that] ***objects can be seen if light is available to illuminate them or if they give off their own light*** to determine which way can best answer a question. 1-PS4-2

Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** ● Record information (observations, thoughts, and ideas). Students could *record information* [from their] *observations* [that] ***sound can make matter vibrate, and vibrating matter can make sound***. 1-PS4-1 **Using Mathematical and Computational Thinking** ● Use quantitative data to compare two alternative solutions to a problem. Students could *use quantitative data to compare two alternative solutions to a problem* [related to] ***sound making matter vibrate***. 1-PS4-1 **Constructing Explanations and Designing Solutions** ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. Students could *make firsthand observations to construct an evidence-based account* [that] ***devices*** [can help] ***people communicate over long distances***. 1-PS4-4 **Engaging in Argument from Evidence** ● Distinguish between explanations that account for all gathered evidence and those that do not. Students could *distinguish between explanations* [of how] ***objects can be seen if light is available to illuminate them or if they give off their own light*** [for those] *explanations that account for all gathered evidence and those that do not*. 1-PS4-2 **Obtaining, Evaluating, and Communicating Information** ● Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. Students could *communicate with others using drawings* [showing their] *design ideas* [related to the problem that] ***people*** [want] ***to communicate (send and receive information) over long distances***. 1-PS4-4
Additional Crosscutting Concepts Building to the PEs	**Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; faster and slower). Students could use *relative scales to compare and describe* [variations of] ***vibrating matter*** [that] ***make*** [different] ***sounds***. 1-PS4-1 **Structure and Function** ● The shape and stability of structures of natural and designed objects are related to their function(s). Students could identify examples of ***communication devices*** [in which] *the shape of structures of designed objects are related to their function(s)*. 1-PS4-4

Additional Crosscutting Concepts Building to the PEs (Continued)	**Stability and Change** ● Some things stay the same while other things change. Students could describe how *some things stay the same—**the sun*** [keeps producing light each day]—*while other things change*—[like flashlights that eventually burn out and stop producing] ***light***. 1-PS4-2 and 1-ESS1-1
Additional Connections to Nature of Science	**Science is a Human Endeavor** ● People have practiced science for a long time. Students could obtain information about [people in the past who studied the] ***patterns of the motion of the sun, moon, and stars in the sky*** [(e.g., Galileo) in order to describe that] *people have practiced science for a long time.* 1-ESS1-1 **Science is a Human Endeavor** ● Men and women of diverse backgrounds are scientists and engineers. Students could obtain information about the *men and women of diverse backgrounds* [who are] *scientists and engineers* [and who have studied] ***patterns of the motion of the sun, moon, and stars in the sky*** [(e.g., Sergio Fajardo-Acosta, and Neil deGrasse Tyson)]. 1-ESS1-1

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-PS4-4 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-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-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-ETS1-3 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.