1st Grade - Thematic Model - Bundle 2
Sound and Light

This is the second bundle of the 1st Grade Thematic 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 "how can light or sound be used to send messages over a distance?"

Summary

The bundle organizes performance expectations around helping students understand the interaction of light with various materials, and how to apply ideas about light and sound to solve problems. 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

Since people use sound and light to communicate information, the idea that people use a variety of devices to communicate (send and receive information) over long distances (PS4.C as in 1-PS4-4) can connect to concepts about both sound—sound can make matter vibrate, and vibrating matter can make sound. (PS4.A as in 1-PS4-1) —and light, as some materials allow light to pass through them, others allow only some light through, and others block all the light (PS4.B as in 1-PS4-3). Concepts about light can also connect to the idea that seasonal patterns of sunrise and sunset can be observed, described, and predicted (ESS1.B as in 1-ESS1-2).

The engineering design idea that before beginning to design a solution, it is important to clearly understand the problem (ETS1.A as in K-2-ETS1-1), could be applied to several concepts such as people use a variety of devices to communicate (send and receive information) over long distances (PS4.C as in 1-PS4-4). These could connect through an engineering design task, such as one in which students could work to clearly understand a problem related to communicating over long distances before beginning to design a solution. For example, students can identify who has a need to communicate over a distance and why, they can determine the distance at which that their audience needs to communicate as well as the medium (e.g., sound, light). Alternately, students could learn more about a problem related to mirrors redirecting light beam (PS4.B as in 1-PS4-3) before beginning to design a solution.

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, 1-PS4-3, and 1-ESS1-2), and constructing explanations and designing solutions (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 concepts of Patterns (1-ESS1-2) and Cause and Effect (1-PS4-1 and 1-PS4-3). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations 1-ESS1-2 and K-2-ETS1-1 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-PS4-3 **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.*]** 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-ESS1-2 **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.**
Example Phenomena	Lighthouses are often found on rocky shores. I can't hear someone talk when they are at the other end of the school.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask and/or identify questions that can be answered by an investigation. Students could *ask and identify questions* [about which] ***materials allow light to pass through them,*** [which materials] ***allow only some light through and*** [which materials] ***block all the light*** *that can be answered by an investigation.* 1-PS4-3 **Developing and Using Models** ● Develop and/or use a model to represent patterns in the natural world. Students could *develop and/or use a model to represent* [their] ***observations, descriptions, and predictions*** [of] ***seasonal patterns of sunrise and sunset*** *in the natural world*. 1-ESS1-2 **Planning and Carrying Out Investigations** ● Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. Students could *make observations or measurements of a tool or solution* [intended to allow] ***people to communicate (send and receive information) over long distances*** *to determine if it meets* [the] *goal.* 1-PS4-4

Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** ● Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. Students could *use firsthand observations to describe relationships* [between] ***sound and vibrating matter***. 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] ***people using a variety of devices to communicate (send and receive information) over long distances***. 1-PS4-4 **Constructing Explanations and Designing Solutions** ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. Students could *make observations (firsthand or from media) to construct an evidence-based account* [that] ***sound can make matter vibrate, and vibrating matter can make sound***. 1-PS4-1 **Engaging in Argument from Evidence** ● Distinguish between explanations that account for all gathered evidence and those that do not. Students could *distinguish between explanations that account for all gathered evidence and those that do not* [about observations that] ***some materials allow light to pass through, others allow only some light through, and others block all the light***. 1-PS4-3 **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, numbers that provide detail about scientific ideas, practices, and/or design ideas. Students could *communicate information with others* [orally, providing] *detail about scientific ideas* [related to] ***seasonal patterns of sunrise and sunset*** [and the idea they] ***can be observed, described, and predicted***. 1-ESS1-2
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Students could describe how *patterns in the natural and human designed world*—[for example, patterns related to which types of] ***materials allow light to pass through them,*** [which types] ***allow only some light through, and*** [which types] ***block all the light***— *can be observed, used to describe phenomena, and used as evidence.* 1-PS4-3 **Systems and System Models** ● Objects and organisms can be described in terms of their parts. Students could explain that *objects can be described in terms of their parts* [through the example of] ***devices*** [that] ***people use to communicate (send and receive information) over long distances***. 1-PS4-4

Additional Crosscutting Concepts Building to the PEs (Continued)	**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 ***vibrating matter*** [that] ***makes sound*** [in which] *the shape and stability of structures of* [the] *objects are related to their function(s)*. 1-PS4-1
Additional Connections to Nature of Science	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Scientists search for cause and effect relationships to explain natural events. Students could describe how *scientists search for cause and effect relationships to explain natural events* [just as they searched for a cause and effect relationship when investigating that] ***sound can make matter vibrate and vibrating matter can make sound***. 1-PS4-1 **Science Addresses Questions About the Natural and Material World** ● Scientists study the natural and material world. Students could explain that *scientists study the natural and material world* [just as they did when investigating that] ***mirrors can be used to redirect a light beam***. 1-PS4-3

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-PS4-3 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-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.