Grade 1 Science, Unit 5

Communicating with Light and Sound

Overview

Unit abstract

In this unit of study, students will continue to develop their understanding of the relationship between sound and vibrating materials as well as between the availability of light and the ability to see objects. Students will apply their knowledge of light and sound to engage in engineering design to solve a simple problem involving communication with light and sound.

The crosscutting concepts of structure and function and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for the disciplinary core ideas. In the first grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in constructing explanations and designing solutions, asking questions and defining problems, and developing and using models. Students are expected to use these practices to demonstrate understanding of the core ideas.

Essential questions

- What happens when there is no light?
- What happens when materials vibrate?

Written Curriculum

Next Generation Science Standards

1. Waves: Light and Sound

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions ▪ Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4)	**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)	***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.ETS1.B** (1-PS4-4); **4.PS4.C** (1-PS4-4); **4.ETS1.A** (1-PS4-4)

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-PS4-4)

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)*

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.

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	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. ▪ Ask questions based on observations to find more information about the natural and/or designed world. (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)	**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)	N/A

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); **3-5.ETS1.C** (K-2-ETS1-1)

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)*
W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1)
Mathematics –
MP.2 Reason abstractly and quantitatively. *(K-2-ETS1-1)*
MP.4 Model with mathematics. *(K-2-ETS1-1)*
MP.5 Use appropriate tools strategically. *(K-2-ETS1-1)*
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)*

<table>
<tr><td colspan="3">K-2.Engineering Design</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td colspan="3">The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:</td></tr>
<tr><td>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. (K-2-ETS1-2)</td><td>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. (K-2-ETS1-2)</td><td>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)</td></tr>
<tr><td colspan="3">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</td></tr>
<tr><td colspan="3">Articulation of DCIs across grade-bands: 3-5.ETS1.A (K-2-ETS1-2); 3-5.ETS1.B (K-2-ETS1-2); 3-5.ETS1.C (K-2-ETS1-2)</td></tr>
<tr><td colspan="3">Common Core State Standards Connections:
ELA/Literacy –
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)</td></tr>
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Clarifying the standards

Prior learning

The following disciplinary core ideas are prior learning for the concepts in this unit of study.

In kindergarten, students learned that:

- 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.

Progression of current learning

Driving question 1
How can light or sound be used to communicate over a distance?

Concepts	Practices
• The shape and stability of structures of natural and designed objects are related to their function(s). • People depend on various technologies in their lives; human life would be very different without technology. • People also use a variety of devices to communicate (send and receive information) over long distances. • 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. • 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.	• Describe how the shape and stability of structures are related to their function. • Ask questions based on observations to find more information about the natural and/or designed world. • Define a simple problem that can be solved through the development of a new or improved object or tool. • Ask questions, make observations, and gather information about a situation people want to change in order to define a simple problem that can be solved through the development of a new or improved object or tool. • Develop a simple model based on evidence to represent a proposed object or tool. • 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. • Use tools and materials provided to design a device that solves a specific problem. • Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. Examples of devices could include: – A light source to send signals – Paper cup and string telephones – A pattern of drum beats

Integration of content, practices, and crosscutting concepts

In this unit of study, students will continue to develop their understanding of the relationship between sound and vibrating materials as well as between the availability of light and the ability to see objects. Students will apply their knowledge of light and sound to solve a simple problem involving communication with light and sound.

During this unit, students learn that people depend on various technologies in their lives, and that life would be very different without technology. Technology plays an important role in the development of devices that allow us to communicate (send and receive information) over long distances. Engineers design and build many kinds of devices, such as those used for communication. Like engineers, students engage in the **engineering design process** in order to design and build a device that uses light or sound to communicate over a distance. This process should include the following steps:

- Students brainstorm a list of ways that people communicate over a distance. Some examples include telephones, cellular phones, email, and video conferencing (by computer).
- Ask students, "How would we communicate over a distance without the use of any of the devices that people currently use?"
- Use that question to guide the class to define the problem: Design and build a device that allows us to communicate over a distance.
- As a class, determine the criteria that will be used to evaluate the design solutions. One criterion MUST be that the device uses either light or sound.
- Also as a class, determine possible constraints, such as available materials and amount of time allotted for designing and building the device.
- Small groups conduct research, looking for examples of devices that use light or sound to communicate over a distance.
- Small groups can then use tools and materials to design and build their devices. Examples could include a light source that sends a signal, paper cup and string telephones, or a pattern of drumbeats.
- Groups should prepare a sketch or drawing of their device. They should label the components and describe, in writing, how each component relates to the function of the device.
- Groups should present their devices to the class, demonstrating how they work.
- Students then determine which devices work as intended based on the criteria, using data as evidence to support their thinking.

Students should ask questions, make observations, gather information, and communicate with peers throughout the design process. Guidance and support from the teacher is also a critical part of the design process.

Integration of engineering

Engineering design is an integral part of this unit of study. Students are expected to define a simple problem, use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance, and develop a simple sketch, drawing, or physical model to illustrate how the structure of the device helps it function as needed to solve the problem. This processed is outlined in greater detail in the previous section.

Integration of DCI from prior units within this grade level

In Unit 4, Light and Sound, students planned and conducted investigations to understand the relationship between vibrating materials and sound. They learned that vibrating materials can make sound and that sound can make materials vibrate. Students observed that light is necessary for objects to be seen and that light travels from place to place. They also investigated the effect of placing objects made with different materials in the path of a beam of light. This learning is foundational for the content and practices in this unit of study.

In Unit 3, Mimicking Organisms to Solve Problems, students engaged in engineering design in order 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. Students learned that 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.

Integration of English language arts and mathematics

English language arts

To integrate the CCSS for English language arts into this unit, students will participate in shared research and writing projects as they engage in engineering design. Students can use text and media resources to first gather information about devices that use light or sound to communicate over a distance. They can demonstrate understanding of key details in a text by asking and answering questions during class and small-group discussions. In addition, students recall information from experiences or gather information from provided sources to support their thinking as they design and build their device. As students complete their devices, they prepare a sketch or drawing of their device, label the components, and describe, in writing, how each component relates to the function of the device and how their communication device works. Students can also write a "how-to" book describing how to use tools and materials to build their design. Students can also use drawings or other visual displays to accompany their writing in order to describe their thought process and clarify their ideas. Adult support should be provided throughout the process.

To integrate the CCSS for mathematics into this unit, students need opportunities to use tools to for a variety of purposes as they design and build devices for communicating with light or sound. They can use objects such as interlocking cubes or paper clips to measure length in nonstandard units, expressing their measurements as whole numbers. Students can also use indirect measurement (i.e., compare the lengths of two objects indirectly by using a third object) to order three objects by length. For example, they might compare the lengths of string used for paper-cup telephones and observe and describe the relative effectiveness of each length of string. Students can also use graphs to organize data, such as the number of drumbeats, and then analyze the data to find a pattern. Students will reason abstractly and quantitatively as they organize data into graphs, analyze the data, and use it to solve simple put-together, take-apart, and compare problems.

Future learning

The following disciplinary core ideas are future learning for the concepts in this unit of study.

By the end of the K–2 grade span, students know that:

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

By the end of Grade 4, students know that:

- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—that is, convert it from digitized form to voice and vice versa.

By the end of the 3–5 Grade span, students know that:

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of a design that need to be improved.
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Number of Instructional Days

Recommended number of instructional days: 25 (1 day = approximately 30–45 minutes)

Note—The recommended number of days is an estimate based on the information available at this time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.