

# Light and Sound Teacher Resources

## Related Documents

See “Files” section in the LMS.

## Preface

All products created by designers and engineers were created to meet a human need or want. One of the most basic of human needs is to communicate over a distance. In this module students will investigate light and sound, including vibration from sound waves and the effect of different materials on the path of a beam of light. The students will use a design process to sketch, build, test, and reflect on a device that uses light or sound to communicate over a distance.

A similar design problem is faced by three fictional characters the students read about. Mylo, Suzie, and Angelina are lost and need to use only the materials in their backpack to communicate using light or sound.

## Transfer

*Students will be able to independently use their learning to ...*

1. Evaluate a problem in a novel situation.
2. Apply a step by step design process to solve a problem.
3. Communicate over a distance using light or sound.

## Understandings

*Students will understand that:*

1. The design process is a step by step method used to guide people in developing solutions to problems.
2. Engineers and designers create new products or improve existing products and technology to meet human needs and wants.
3. Engineers ask questions, make observations, and gather information about a situation people want to change.
4. The shape of an object can help it perform as needed to solve a given problem.
5. Products may be analyzed by comparing objects designed to solve the same problem.
6. Engineers keep and organize all of their work in an engineering notebook.
7. Engineers share their work and get feedback from others during the design process.
8. Light and sound travel over distances.
9. Vibrating materials can make sound, and sound can make materials vibrate.
10. Objects can be seen only if they reflect available light or if they give off their own light.
11. Placing different materials in the path of a beam of light may cause the light to spread out, separate into colors, bounce back, or magnify.

12. Light and sound can be used to communicate over distances.

## Knowledge

*It is expected that students will:*

- List products created by engineers and designers that meet a human need or want.
- State questions that engineers may ask when gathering information about a situation people want to change.
- Identify the differences between a new object and an improved object.
- Recognize that light and sound travel over distances.
- Describe how we hear sound.
- Describe how we see objects.
- Describe what can happen when different materials are placed in the path of a beam of light.

## Skills

*It is expected that students will:*

- Follow a step by step method to solve a problem.
- Examine how other people have tried to solve a design problem.
- Gather information about a situation that people want to change.
- Describe how the shape of a structure helps it function as needed to meet a human need or want.
- Brainstorm possible solutions and select one solution to develop, taking into account strengths and weaknesses of each design.
- Build and test a physical model of an improved object or tool designed to meet a human need or want.
- Collect and analyze data from two models and compare the strengths and weaknesses of how each performed.
- Organize and maintain an engineering notebook to document work.
- Share findings and conclusions with others.
- Discover the relationship between sound and vibration.
- Experiment and document results of placing a variety of objects in the path of a beam of light.

## Essential Questions

*Students will keep considering:*

1. What are unique properties of light?
2. What are unique properties of sound?
3. How can people communicate over a distance?

## Day-by-Day Plans

*Time: 10 instructional hours*

**NOTE:** In preparation for teaching this module, it is strongly recommended that the teacher read the *Light and Sound Teacher Resources* document, including the *Understandings, Knowledge, and Skills* addressed in the module. The day-by-day plans call for students to access the curriculum using the Canvas app on a tablet. The activity, project, and problem documents may also be accessed through files in the course on the LMS.

## **Part 1: Introduction to Communicating with Light and Sound**

**40 minutes**

- Detailed instructions may be found in the document entitled Activity 1.1 Introduction to Communicating with Light and Sound Teacher Notes.
- As part of the activity, the teacher reads the Light and Sound Introduction, which is a fictional story that introduces the problem.
- The teacher distributes a Light and Sound Launch Log to each student. All written student work for the module will be completed in this log.
- In this activity students learn about the design process and are introduced to the design problem they will face at the conclusion of the module.
- As part of this activity, the teacher presents the design process slide show entitled Design Process. Students fill in the steps of the design process in their Launch Logs during the presentation.

## **Part 2: Sound**

**120 minutes**

- Detailed instructions may be found in the document entitled Activity 1.2 Sound Teacher Notes.
- The teacher introduces students to the PLTW Learning Management System (LMS) and assists students with the login process. For the remainder of the module, students will access Activity 1.2 Sound in the LMS and record their work in the Light and Sound Launch Log.
- In this activity students learn how sound travels over distances and is heard by humans. Students also discover the relationship between sound and vibration by exploring a variety of ways to generate sound.
- In pairs or small groups, students access the Exploring Sound link on the Light and Sound Activity 1.2 page.

## **Part 3: Light**

**120 minutes**

- Detailed instructions may be found in the document entitled Activity 1.3 Light Teacher Notes.
- In this activity students learn how light travels over distances and how objects are seen by humans. Students also investigate how objects can be seen only if they reflect available light or if they give off their own light.
- The students access Activity 1.3 Light in the LMS and document their work as they follow the steps of the design process in the Light and Sound Launch Log.

- As part of the activity, the students view a presentation entitled Exploring Light. This presentation may be viewed as a large group, in small groups, or as individuals as the teacher determines.
- (Optional) The teacher may wish to lead students through an app entitled Bobo Explores Light to reinforce key concepts related to light.
- At the conclusion of the activity, students create a digital presentation to explain how we see objects.

#### **Part 4: Light Investigation**

**120 minutes**

- Detailed instructions may be found in the document entitled Project 1.4 Light Investigation Teacher Notes.
- This project is an inquiry experience. The teacher will guide the students to an understanding of the effect that different materials have on a beam of light, including reflection, refraction, the creation of shadows, and color.
- Throughout the project students describe the effect that different materials have on a beam of light and predict the effect of novel objects on a beam of light.
- The students access Project 1.4 Light Investigation assignment in the LMS and document their work as they follow the steps of the design process in their Light and Sound Launch Log.

#### **Part 5: Communicating with Light and Sound Design Problem**

**200 minutes**

- Detailed instructions may be found in the document entitled Problem 1.5 Communicating with Light and Sound Design Problem Teacher Notes.
- In this design problem, students will create a device to communicate over a distance using light or sound with available materials.
- The students access the Problem 1.5 Communicating with Light and Sound Design Problem assignment on the LMS and document their work as they follow the steps of the design process in their Light and Sound Launch Log.
- At the conclusion of the module, the students complete the Light and Sound Check for Understanding.

### **National and State Standards Alignment**

#### Next Generation Science Standards

- 1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
- 1-PS4-2. Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.
- 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.
- 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.

- 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.

### Common Core ELA

- 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.
- 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.
  - SL.1.1a Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion).
  - SL.1.1b Build on others' talk in conversations by responding to the comments of others through multiple exchanges.
  - SL.1.1c Ask questions to clear up any confusion about the topics and texts under discussion.
- SL.1.5 Add drawings or other visual displays to descriptions when appropriate to clarify ideas, thoughts, and feelings.
- SL.1.6 Produce complete sentences when appropriate to task and situation.

### Common Core Math

- 1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object.
- 1.MD.A.2 Express the length of an object as a whole number of length units, by laying 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.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.