Lesson 1.1
Pre-Unit Assessment
Lesson Overview

Students' Initial Explanations

Students are introduced to the Light and Sound unit and the context and design problem that motivates this unit. Students learn that the puppet-theater company needs help to design a portable puppet-show scene, using light and sound. In pairs and then as a whole class, students view and discuss a photograph of a surface with bright and dark areas. Students’ contributions during the discussion serve as a pre-unit assessment for formative purposes and are designed to reveal students’ initial understanding of some of the unit’s core content, both unit-specific science concepts and the crosscutting concept of Cause and Effect, prior to instruction. As such, these three-dimensional assessments offer a baseline from which to measure growth of understanding over the course of the unit. These explanations can also provide the teacher with insight into students’ thinking as they begin the unit. This will allow the teacher to draw connections to students’ experiences and to watch for preconceptions that might get in the way of understanding. The teacher then models how to use the unit’s reference book, Engineering with Light and Sound. Pairs look through the reference book and learn that engineers make solutions to a variety of problems. The purpose of this lesson is to provide students with an overview of the unit context and their role as light and sound engineers in order to motivate their learning about light and sound throughout the unit.

Design Problem: Design a puppet-show scene, using light.
Everyday Phenomenon: Surfaces can be brighter or darker.

Students learn:

- An engineer is a person who makes something to solve a problem.
- Engineers use what they know about light and sound to create solutions that help meet people’s wants or needs.
Introducing Engineering

Partners browse the reference book to gather information about the kinds of problems and solutions addressed by light and sound engineers.

Instructional Guide

1. Introduce the word engineer and its connection to the puppet-theater company.
   In order to help the puppet-theater company solve its problem, we will work as light and sound engineers. Engineers are people who make things to solve problems.

2. Hold up Engineering with Light and Sound and show students the front cover. Let students know that reading this book about engineering will help them find out more about what engineers do.
   This book is different from many of the books you have read together. Instead of reading the book from beginning to end, you can read specific parts of the book to gather information.

3. Introduce the Contents page. Turn to the Contents page and talk through where you can find more about what engineers do. Point out the “What is an Engineer?” section on page 4 that is listed at the top of the Contents page.

4. Read aloud pages 4 and 5. Invite students to share what they learned from those pages and emphasize that engineers make things that solve problems.

5. Review the problem–solution structure of the reference book. Quickly flip through a few pages/entries, pointing out that each section has the same two headings: “The Problem” and “The Solution.”
   “The Problem” section describes something that people wanted or needed to do but could not.
   “The Solution” section describes what the engineers made to solve that problem and help people do what they wanted or needed to do.

6. Set the purpose for exploring the reference book. Explain that students will browse the reference book with a partner, looking at examples of solutions to get a better idea about what light and sound engineers do and make.
7. Model browsing an entry of interest. Point out that there are many interesting examples in the book.

With this kind of book, you do not have to read the sections in order. You can look for one section that is interesting to you.

Flip through the book slowly, stopping when you come to the “Emergency Signal Mirror” section on page 23.

This section looks interesting. This person is wearing a raincoat and a backpack, and there are trees behind him.

I wonder if he is hiking or camping. He is holding something shiny that is very bright. Maybe it is a light. The picture below is just a metal rectangle.

Light from the sun might be bouncing off the object he is holding. It could be reflecting the light from the sun because it is a shiny metal object. I wonder what problem this might solve.

Maybe he is flashing the light because he wants to tell his friends he is there because it is too far for him to shout. Or maybe he is lost and needs to call for help.

Let students know that as partners are browsing the book, they can do the same thing that you just did—look for a page they think is interesting and talk to their partners about the problem that needs to be solved for the person and the solution.

8. Distribute copies of Engineering with Light and Sound. Distribute one copy of the book to each pair of students and have partners begin browsing.

- Circulate and observe how partners select the entries to look at and how partners are or are not speculating about the nature of the problem and the solution.
- Take opportunities to ask partners to tell you about an entry they have chosen. Have them describe the problem that is depicted, the solution that engineers created to solve the problem, and how partners think the solution helps solve the problem.

Teacher Support

Background

About the Book: Engineering with Light and Sound

Engineering with Light and Sound is this unit’s reference book. The introduction explains what an engineer is and describes the process engineers go through to design a solution to a problem. The book is divided into sections about designing light sources, things that block light or let light through, things that reflect light, sound sources, things that block sound, and things that use both light and sound. Each section includes an introductory paragraph, and each entry presents the problem and the solution to repeatedly highlight the basics of the design process. This reference book is intended to be used predominantly as a Shared Reading throughout the unit, offering secondhand investigation opportunities and inspiring students as they design their own light and sound solutions in the unit.
Background

Literacy Note: About Reference Books
Reference books provide in-depth information about specific topics and are typically read for particular purposes. For this reason, students do not read every section in reference books, nor do they read reference books from beginning to end. Sometimes, they search for the information they need and then read the relevant sections carefully. At other times, they browse the book as a way of seeing multiple examples of something. In this lesson, students will be introduced to the table of contents and introduction and are given the opportunity to explore the book. This exploration will prepare students to use the reference book in later lessons in this unit, as a scientist might, and it encourages students to read complex text in varied but strategic ways.

Instructional Suggestion

Providing More Experience: Characteristics of Reference Books
To give students additional examples of the common features of reference books, gather a variety of informational texts from your classroom library. Ask students to work in small groups to look through the books and make observations about how they are organized, what kind of information they contain, and what text features are present. Make a class chart of these characteristics and reflect on the usefulness of the various text features to organize and highlight information.

Background

Nature of Engineering: Problems and Solutions in Engineering
The use of the words problem and solution in engineering is different from their everyday meanings. We often think of problems as negative. Or, we think of problems and their corresponding solutions as well specified, with a single correct solution (e.g., a math problem). In engineering, a problem is an unmet want or need. Sometimes, unmet needs do have negative repercussions (e.g., a need for clean drinking water). Other times, a problem is a desire that is unsatisfied, and its absence is less dire (e.g., wanting a more exciting roller coaster). A problem is an engineering problem if knowledge of how the world works can be applied to create something that will address a need or desire that people have. Once a problem is initially defined, engineers work to design a solution. Creating a solution is a process of design because it involves both intentionally applying scientific knowledge to create something functional as well as considering the needs and expectations of the target users to make something useful. There is seldom a single correct solution to an engineering problem; rather, there are usually multiple possibilities that could address the design goals in different ways.

Instructional Suggestion

Going Further: Additional Activities Focusing on Light Reflection
If you would like to include some additional instructional activities focused on light reflecting off various materials, you will find a more detailed educative note in Lesson 2.3, Activity 2 (Going Further: Additional Reflection Activities).

Instructional Suggestion

Providing More Experience: Reading Images in Science Text
The books in this unit are designed to provide information both visually and through text. At this point in the unit, students are exploring the idea that engineers work to create solutions to problems. Point out how students can use the images in Engineering with Light and Sound to think about what kind of problem is being highlighted and how the
photograph gives clues about the solution that engineers designed to solve that problem. Students may not identify the problem and solution as described in the text. What is important in this lesson is that students are thinking about how the solutions in the book come from the work of engineers who addressed the problems.
Introducing Engineering

Partners browse the reference book to gather information about the kinds of problems and solutions addressed by light and sound engineers.

Instructional Guide

1. Introduce the word *engineer* and its connection to the puppet-theater company.

Para ayudar a la compañía de teatro de marionetas a resolver su problema, trabajaremos como ingenieros de la luz y el sonido. Los ingenieros son personas que hacen cosas para resolver problemas.

2. Hold up *Engineering with Light and Sound* and show students the front cover. Let students know that reading this book about engineering will help them find out more about what engineers do.

Este libro es diferente a muchos de los libros que han leído juntos. En vez de leer el libro de principio a fin, pueden leer partes específicas del libro para reunir información.

3. Introduce the Contents page. Turn to the Contents page and talk through where you can find more about what engineers do. Point out the “What is an Engineer?” section on page 4 that is listed at the top of the Contents page.

4. Read aloud pages 4 and 5. Invite students to share what they learned from those pages and emphasize that engineers make things that solve problems.

5. Review the problem–solution structure of the reference book. Quickly flip through a few pages/entries, pointing out that each section has the same two headings: “The Problem” and “The Solution.”

La sección "El problema” describe algo que la gente quería o necesitaba hacer pero no podía.

La sección "La solución” describe lo que crearon los ingenieros para resolver ese problema y ayudar a la gente a hacer lo que querían o necesitaban hacer.

6. Set the purpose for exploring the reference book. Explain that students will browse the reference book with a partner, looking at examples of solutions to get a better idea about what light and sound engineers do and make.
7. Model browsing an entry of interest. Point out that there are many interesting examples in the book.

Con este tipo de libro, ustedes no tienen que leer las secciones en orden. Pueden buscar una sección que les sea interesante.

Flip through the book slowly, stopping when you come to the “Emergency Signal Mirror” section on page 23.

Esta sección parece interesante. Esta persona lleva puesto un impermeable y una mochila, y hay árboles detrás de él.

Me pregunto si anda de excursión o si está acampando. Sostiene algo lustroso que es muy brillante. Tal vez es una luz. La imagen debajo es solo un rectángulo metálico.

La luz del sol podría estar rebotando del objeto que está sosteniendo. Podría estar reflejando la luz del sol, porque es un objeto metálico lustroso. Me pregunto qué problema podría resolver esto.

Tal vez está haciendo señales con la luz porque quiere decirle a sus amigos que está ahí, porque está muy lejos como para gritar. O tal vez está perdido y necesita llamar para pedir ayuda.

Let students know that as partners are browsing the book, they can do the same thing that you just did—look for a page they think is interesting and talk to their partners about the problem that needs to be solved for the person and the solution.

8. Distribute copies of Engineering with Light and Sound. Distribute one copy of the book to each pair of students and have partners begin browsing.

- Circulate and observe how partners select the entries to look at and how partners are or are not speculating about the nature of the problem and the solution.
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