Lesson 3.3
Sunlight and Showers
Lesson Overview

At the beginning of this lesson, students complete a Critical Juncture writing task in which they apply their understanding of energy sources and conversion. They spend the remainder of the lesson focused on engineering practices through reading *Sunlight and Showers*, comparing their own experiences to those of professional engineers. The teacher introduces the book, which follows a team of engineering students as they design a solution to a problem. As they read, students identify engineering practices and synthesize what they are reading with their own experiences in the role of systems engineers. This lesson offers students the opportunity to reflect on the engineering practices they have employed throughout the unit.

**Anchor Phenomenon:** Ergstown has frequent blackouts.

**Investigative Phenomenon:** A team of engineers designs a system that uses solar energy to heat water.

**Students learn:**

- Engineers go through a multi-step design process in order to design solutions to problems.
- Students engage in many of the same engineering practices as those employed by engineers.
- Men and women from all cultures and backgrounds choose careers as scientists and engineers.
- Most scientists and engineers work in teams.
- Science affects everyday life.
- Creativity and imagination are important to science.
Thinking About Engineering Practices

The teacher introduces *Sunlight and Showers* and guides the class in thinking about what engineers do.

**Instructional Guide**

1. **Hold up *Sunlight and Showers***. Inform students that they are going to read about a group of college students who are learning to be engineers. They will read about the problem that this group of engineers worked to solve—designing a water heater that met certain criteria.

2. **Prepare students to synthesize**. Remind students that they have been working as systems engineers to try to solve Ergstown’s blackout problem. Explain that as students read you’d like them to make connections between what they’ve been doing and what they are reading about.

   As you read, you will probably notice that many of the things that the engineers in the book do are very similar to what you have been doing as you have tried to help solve Ergstown’s blackout problem.

3. **Review ways students have been like engineers**.

   What are some of the things you’ve done as systems engineers?

   [We’ve worked to solve Ergstown’s blackout problem; we’ve made design arguments; we’ve built simple electrical systems.]

4. **Assign student pairs**. Distribute one copy of *Sunlight and Showers* to each pair.

5. **Discuss engineering practices using the text**. Read pages 3–6 aloud and have students follow along in their books. Ask students to connect what they have done with the information you are reading about what engineers do. Guide students to think about how what they have done in during this unit.
6. **Project the notebook.** Have students turn to page 51, Engineering Practices, and follow along as you review the instructions.

   Remember, engineering practices are things that engineers do. As systems engineers working for the city of Ergstown, you have had many opportunities to engage in engineering practices.

   You’ve just named a few of the things that you do that are like what we just read about in *Sunlight and Showers*. Let’s record one of those ideas.

7. **Model synthesizing and recording ideas on page 51 of the notebook.** Reread the last sentence on page 4 of *Sunlight and Showers*.

   On page 4, I read that Ashok Gadgil “believes in using science to solve problems.” This is something engineers do—they use science to solve problems. In fact, knowing about current scientific research and science concepts is an important part of engineering.

   • Ask the students what they have done as systems engineers that is similar.
   • Draw on their input and the text from the book to model completing the first row of the table on page 51.

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**Teacher Support**

**Background**

**Literacy Note: About the Book**

*Sunlight and Showers* introduces readers to Dr. Ashok Gadgil, an engineer who uses his scientific knowledge to address real-world problems. Dr. Gadgil’s students work together as a team to design a solar water heater for use in Guatemala. The book describes various ways the young engineers solve the design problem—working as a team, investigating the issues and gathering data, and designing and testing a solution. The book demonstrates that solar energy is useful as an alternative source of energy and models the practices of engineering by providing a compelling example of engineers solving real problems for real people. The book allows students to reflect on how they have been like engineers and to anticipate more behaviors as they continue being engineers throughout the unit.
Students read the book and record engineering practices in their notebooks.

Instructional Guide

1. **Pairs read the book and complete the table.** Have partners read, discuss, and record the connections they are making on page 51 of the notebook. Remind students that although they are working in pairs, each partner should record information in the notebook independently.

2. **Circulate and provide support as necessary.** Check to be sure that students are identifying engineering practices and connecting them with their own experiences in class.

Teacher Support

**Instructional Suggestion**

**Diverse Learners: Previewing Sunlight and Showers in a Small Group**

*Sunlight and Showers* highlights a number of engineering practices as it describes the work of a group of engineering students. In order to track each of the important themes as they read, some students may benefit from previewing *Sunlight and Showers* before reading with a partner. You may wish to point out key features such as diagrams, bolded text, and photographs. You also may wish to provide these students some key words about engineering (such as *design*, *make*, or *test*) and examples of a few engineering practices described in the book so they can look for information on these topics as they read.

**Rationale**

**Literacy Note: Using Tables During Reading**

Recording information in a table during reading helps focus student attention and, in this lesson, the Engineering Practices table helps students connect what they are reading about the practices of engineers to their own personal experiences. The table provides clear visual support that helps students directly correlate the practices of engineers with their own experiences across each row. Recording the practices of other engineers right beside their own use of these same engineering practices helps students understand how designing a solution to help Ergstown is authentic to the way engineers solve problems.
Rationale

Pedagogical Goals: Engineering Practices
The purpose of this activity is to make explicit the ways students do, talk, read, and write like engineers. Providing students with the opportunity to reflect in a metacognitive way about this is essential if students are to understand the connection between what they are doing in class and the nature and practices of engineering and engineers.

Pedagogical Goals: Understanding the Nature of Science
One goal set forth by the Next Generation Science Standards (NGSS) is for students to understand the nature of science as a discipline and how scientific knowledge develops over time. The NGSS calls out eight understandings about the nature of science that are woven throughout the Amplify Science curriculum. This unit gives students an opportunity to experience the understanding that Science Is a Human Endeavor. Specifically, the book Sunlight and Showers illustrates the ideas that:

- Men and women from all cultures and backgrounds choose careers as scientists and engineers.
- Most scientists and engineers work in teams.
- Science affects everyday life.
- Creativity and imagination are important to science.

Possible Responses

Investigation Notebook
Engineering Practices (page 51)

What engineers do: They investigate a problem.
Page: 10
What we do: We are investigating Ergstown’s blackout problem.

What engineers do: They shared their data with the rest of the team.
Page: 11
What we do: We talk about what we find out in class.

What engineers do: They have criteria they work with.
Page: 11
What we do: Mayor Joules gives us criteria for solutions that we have to think about.
What engineers do: They synthesized what they learned about the materials.
Page: 12
What we do: We synthesize what we learn from reading and from our investigations.

What engineers do: They tested their design.
Page: 16
What we do: We tested the simple electrical systems we made.

What new understanding do you have about what engineers do?
Engineers do lots of things to solve problems in the world. They use science to design solutions.
How We Were Engineers

Students discuss the book and their new understandings about engineering practices.

Instructional Guide

1. **Focus on the word design.** Turn to page 4 and highlight the following sentence about something Professor Gadgil did:

   *He designed a small, simple machine to help people clean water so that it’s safe to drink.*

   • Ask students what they think design means in this context. [To create something new; to build something new; to come up with a new idea.]

   To design means to try to make something new that solves a problem. As you know, designing solutions to problems is what engineers do.

   • Post the *design* vocabulary card.

2. **Discuss synthesizing.** If students do not point out that the student engineers in the book synthesized what they had learned in order to make the best solar water heater, then highlight this. Direct students’ attention to page 12.

   *The last line on page 12 says that the engineers synthesized everything they learned, putting it all together to decide which material to use.*

   • Ask students to share their connections to this practice.

   • Explain that you would like partners to connect ideas from their Engineering Practices table in order to come to a new understanding about engineering practices.

3. **Have students reflect on what they read.** Have students consider what they wrote in the Engineering Practices table on page 51. Ask students to think about what new understanding they now have about engineering. They can discuss this with their partners as needed before recording their ideas at the bottom of page 51.

4. Reflect on other connections between the engineers in *Sunlight and Showers* and students’ work.
5. **Conclude the lesson.** Let students know that in the next lesson they will get to do something that the engineers in *Sunlight and Showers* did—design a machine in order to help solve a problem!

### Teacher Support

**Rationale**

**Pedagogical Goals: Gradual Release of Responsibility to Synthesize Ideas**

Having partners synthesize their ideas from the reading and their own investigations gives students an opportunity to think deeply about important science and engineering ideas with the support of a partner. When students have to explain their ideas to each other and agree on the exact wording of the combined idea, they are engaged in a focused discussion of science ideas and have the opportunity to synthesize what they have learned from multiple sources.
School Backup Electrical Energy System

1. Imagine that your school is going to install a backup electrical system that can function during a blackout.

2. Decide what would be the best backup energy source to use. Be sure to consider things such as cost and whether the energy source is available in your area.

3. Then answer the questions below. Use evidence from the *It’s All Energy* reference book.

What is the best backup energy source for your school?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

How does the energy from the source become electrical energy?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Why is this the best backup energy source for your school? Use evidence from the Energy Sources section (pages 26–41) of *It’s All Energy* to help support your argument.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
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**Engineering Practices**

1. Read *Sunlight and Showers*. As you read, complete the table below.
2. In the first column, record some of the engineering practices in the book.
3. In the second column, make connections between what engineers in the book do and your work as a systems engineer.
4. Then answer the question below the table.

<table>
<thead>
<tr>
<th>What engineers do</th>
<th>What we do</th>
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<tbody>
<tr>
<td>Page:</td>
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</table>

What new understanding do you have about what engineers do?

___________________________________________________________________

___________________________________________________________________

© 2018 The Regents of the University of California. All rights reserved. Permission granted to photocopy for classroom use.
The teacher introduces *Sunlight and Showers* and guides the class in thinking about what engineers do.

**Instructional Guide**

1. **Hold up *Sunlight and Showers***. Inform students that they are going to read about a group of college students who are learning to be engineers. They will read about the problem that this group of engineers worked to solve—designing a water heater that met certain criteria.

2. **Prepare students to synthesize**. Remind students that they have been working as systems engineers to try to solve Ergstown’s blackout problem. Explain that as students read you’d like them to make connections between what they’ve been doing and what they are reading about.

Mientras leen, probablemente notarán que muchas de las cosas que hacen los ingenieros en el libro son muy similares a lo que han estado haciendo ustedes mientras han intentado ayudar a resolver el problema de apagones de Ergstown.

3. **Review ways students have been like engineers**.

¿Cuáles son algunas de las cosas que han hecho como ingenieros e ingenieras en sistemas?

[Hemos trabajado para resolver el problema del apagón en Ergstown; hemos hecho argumentos de diseño; hemos construido sistemas eléctricos simples.]

4. **Assign student pairs**. Distribute one copy of *Sunlight and Showers* to each pair.

5. **Discuss engineering practices using the text**. Read pages 3–6 aloud and have students follow along in their books. Ask students to connect what they have done with the information you are reading about what engineers do. Guide students to think about how what they have done in during this unit.
6. **Project the notebook.** Have students turn to page 51, Engineering Practices, and follow along as you review the instructions.

    Recuerden, las prácticas de ingeniería son cosas que hacen los ingenieros. Como ingenieros e ingenieras en sistemas que trabajan para la ciudad de Ergstown, han tenido muchas oportunidades de participar en prácticas de ingeniería.

    Acaban de mencionar unas cuantas de las cosas que hacen que son como lo que acabamos de leer en *Luz solar y duchas*. Apúntemos una de esas ideas.

7. **Model synthesizing and recording ideas on page 51 of the notebook.** Reread the last sentence on page 4 of *Sunlight and Showers*.

    En la página 4, leí que Ashok Gadgil “cree en el uso de la ciencia para resolver problemas”. Esto es algo que hacen los ingenieros: usan la ciencia para resolver problemas. De hecho, saber sobre la investigación científica actual y conceptos científicos es una parte importante de la ingeniería.

    • Ask the students what they have done as systems engineers that is similar.
    • Draw on their input and the text from the book to model completing the first row of the table on page 51.

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**Teacher Support**

**Background**

**Literacy Note: About the Book**

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Reading: Sunlight and Showers

Students read the book and record engineering practices in their notebooks.

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Instructional Suggestion

Diverse Learners: Previewing *Sunlight and Showers* in a Small Group

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Possible Responses

Investigation Notebook

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How We Were Engineers

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Instructional Guide

1. **Focus on the word design.** Turn to page 4 and highlight the following sentence about something Professor Gadgil did:

   > Él diseñó una máquina pequeña y sencilla que limpia el agua para que sea segura para beber.

   - Ask students what they think design means in this context. [To create something new; to build something new; to come up with a new idea.]

   Diseñar significa tratar de hacer algo nuevo que resuelve un problema. Como saben, diseñar soluciones a los problemas es lo que hacen los ingenieros.

   - Post the design vocabulary card.

2. **Discuss synthesizing.** If students do not point out that the student engineers in the book synthesized what they had learned in order to make the best solar water heater, then highlight this. Direct students’ attention to page 12.

   > La última línea en la página 12 dice que los ingenieros sintetizaron todo lo que habían aprendido, poniéndolo todo junto para decidir qué material usar.

   - Ask students to share their connections to this practice.
   - Explain that you would like partners to connect ideas from their Engineering Practices table in order to come to a new understanding about engineering practices.

3. **Have students reflect on what they read.** Have students consider what they wrote in the Engineering Practices table on page 51. Ask students to think about what new understanding they now have about engineering. They can discuss this with their partners as needed before recording their ideas at the bottom of page 51.

   4. Reflect on other connections between the engineers in *Sunlight and Showers* and students’ work.
5. Conclude the lesson. Let students know that in the next lesson they will get to do something that the engineers in *Sunlight and Showers* did—design a machine in order to help solve a problem!

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Sistema de respaldo de energía eléctrica de la escuela

1. Imagina que tu escuela va a instalar un sistema eléctrico de respaldo que pueda funcionar durante un apagón.

2. Decide cuál sería la mejor fuente de energía de respaldo para usar. Asegúrate de considerar cosas como el costo y si la fuente de energía está disponible en tu área.

3. Luego responde las siguientes preguntas. Usa evidencia del libro de referencia Todo es energía.

¿Cuál es la mejor fuente de energía de respaldo para tu escuela?

___________________________________________________________________

___________________________________________________________________

¿Cómo se convierte en energía eléctrica la energía de la fuente?

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

¿Por qué es la mejor fuente de energía de respaldo para tu escuela? Usa evidencia de la sección “Fuentes de energía” (páginas 26 a 41) de Todo es energía para ayudar a respaldar tu argumento.

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___________________________________________________________________
Nombre: __________________________________________ Fecha: __________________

**Prácticas de ingeniería**

1. Lee *Luz solar y duchas*. Mientras lees, completa la tabla siguiente.

2. En la primera columna, apunta algunas de las prácticas de ingeniería del libro.

3. Busca los enlaces entre lo que hacen los/as ingenieros/as del libro y tu trabajo como ingeniero/a de sistemas, y apúntalos en la segunda columna.

4. Luego responde la pregunta debajo de la tabla.

<table>
<thead>
<tr>
<th>Lo que hacen los/as ingenieros/as</th>
<th>Lo que hacemos nosotros</th>
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<tr>
<td>Página:</td>
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¿Qué es algo nuevo que comprendes acerca de lo que hacen los/las ingenieros/as?

Conversiones de energía—Lección 3.3

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