Think Like A Scientist

Sunlight Science

NSTA eBooks+ Kids

TEACHER'S GUIDE

Overview

This teacher's guide is designed to provide ideas for how to use pages of the *Sunlight Science* e-book with students. It explains the concepts and suggests what to look for in students' learning, while also supplying information about how they are practicing science and using crosscutting concepts.

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The goals of this teacher's guide are as follows:

- engage students in grade-level appropriate, three-dimensional learning;
- use the e-book as a tool in class-wide, small group, or independent explorations of its content;
- provide additional ideas and activities that utilize the e-book content but are not included in the e-book;
- explore how STEM content can be effectively integrated into literacy (English language arts);
- facilitate investigations that utilize the e-book content and connect it with students' own classroom and community; and
- assess students on the second-grade content standards to which this e-book is aligned and additional *Common Core State Standards*, in English language arts and mathematics suggested throughout the e-book.

Book Description

The *Sunlight Science* e-book engages readers through an interactive story that features a family outing at the beach. Learners investigate along with the characters the phenomenon of sunlight heating sand, rocks, water, and other surfaces. Interactives and questions guide readers to explore the cause and effect of sunlight on different surfaces, as well as how blocking the sun creates shade and cooler areas.

In the first topic, "Hotter, Cooler," readers investigate the phenomenon of how sunlight warms different Earth surfaces. They make choices to determine what areas are hotter and cooler due to the effects of warming sunlight. These interactions also engage readers to apply the mathematical strategy of comparing two or more objects with a measurable attribute and describe the difference.

In the second topic, "Shade Makers," readers interact with the characters to decide how shade blocks sunlight. By using umbrellas, hats, and coverings, learners will explore the phenomenon of how objects can block sunlight to keep areas and objects cooler.

The final activity offers a way for students to apply their learning and to help design a playground space to block sunlight and keep an area cooler on a hot, sunny day.

The Driving Question

A driving question is one that drives the teaching and learning for a given unit, or even an entire school year. It provides context for the purpose of student exploration and understanding of a phenomenon. This e-book is written around the driving question:

Why are objects warmer on sunny days?

Three-Dimensional Learning and the *Sunlight Science* E-book

You will notice throughout the document that certain words and phrases are highlighted in different colors: blue, green, and orange. These colors correspond to the science and engineering practices (blue), crosscutting concepts (green), and disciplinary core ideas (orange). The book also incorporates engineering design (purple). This will help you quickly notice how each of the three dimensions and engineering design are used on a page. Refer back to this section for the full descriptions.

This e-book does not use all of the grade-level elements for the practices and crosscutting concepts, but that does not mean that you should not be aware of the other practices and concepts your students need to know. For a full list of all grade-level elements for the science and engineering practices and crosscutting concepts, refer to Appendix A.

For engaging in literacy ideas, refer to Appendix B.

Disciplinary Core Ideas (DCIs)

This e-book examines an anchor phenomenon related to the following disciplinary core ideas:

K-PS3.B: Conservation of Energy and Energy Transfer Sunlight warms Earth's surface.

Science and Engineering Practices

> Engaging in the practices of science helps students understand how scientific knowledge develops; such direct involvement gives them an appreciation of the wide range of approaches that are used to investigate, model, and explain the world. The actual doing of science or engineering can also pique students' curiosity, capture their interest, and motivate their continued study.

(NRC Framework for K-12 Science Education, 2012)

Through classroom experiences supported by this e-book, students should be capable of performing the following practices:

The specific science and engineering practices addressed include:

Asking Questions and Defining Problems

- Ask questions based on observations to find more information about the natural and/or designed world.
- Ask and/or identify questions that can be answered by an investigation.
- Define a simple problem that can be solved through the development of a new or improved object or tool.

Developing and Using Models

- Distinguish between a model and the actual object, process, and/or events the model represents.
- Compare models to identify common features and differences.
- Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
- Develop a simple model based on evidence to represent a proposed object or tool.

Planning and Carrying Out Investigations

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question.
- Make observations (firsthand or from media) to collect data that can be used to make comparisons.
- Make predictions based on prior experiences.

Analyzing and Interpreting Data

- Record information (observations, thoughts, and ideas). Use and share pictures, drawings, and/or writings of observations.
- 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.
- Analyze data from tests of an object or tool to determine if it works as intended.

Using Mathematics and Computational Thinking

- Use counting and numbers to identify and describe patterns in the natural and designed world(s).
- Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.
- Use quantitative data to compare two alternative solutions to a problem.

Constructing Explanations and Designing Solutions

- Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.

Engaging in Argument from Evidence

- Identify arguments that are supported by evidence.
- Distinguish between explanations that account for all gathered evidence and those that do not.
- Construct an argument with evidence to support a claim.
- Distinguish between opinions and evidence in one’s own explanations.
- Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument.
- Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.

Obtaining, Evaluating, and Communicating Information

- Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).
- Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea.
- Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim.
- Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Crosscutting Concepts

The crosscutting concepts are the lenses through which scientists think about the natural world. They are the big ideas that connect the sciences and help to understand nature and how science and engineering work. Students who understand the crosscutting concepts will have a deep framework for integrating and understanding science ideas across disciplines.

Through classroom experiences supported by this e-book, students should be able to use the crosscutting concepts in the following ways appropriate for students in grades K–2:

The specific crosscutting concepts elements addressed include:

Patterns

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Cause and Effect

- Simple tests can be designed to gather evidence to support or refute student ideas about causes.

Scale, Proportion, and Quantity

- Relative scales allow objects and events to be compared and described (e.g., bigger and smaller, hotter and colder, faster and slower).
- Standard units are used to measure length.

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s).

A Note About Safety

Throughout this e-book teacher's guide are hands-on activities and demonstrations that help to foster the learning and understanding of science. The reader will find safety notes and safety statements that help to make it a safer learning experience for students and teachers. In most cases, personal protection equipment (PPE) like glasses/goggles, non-latex gloves and aprons are required. Sanitized safety glasses and/or indirectly vented safety goggles noted must meet the ANSI/ISEA Z87.1 D3 safety standard. When dealing with hazardous chemicals, consult with the Safety Data Sheets prior to doing the activity. Make sure there are appropriate engineering controls; e.g., eyewash, shower, etc. The safety procedures and use of PPE must be followed based on legal safety standards and better professional safety practices.

For additional safety information, check out the NSTA Safety Portal at http://www.nsta.org/safety/. A safety acknowledgement form ("Safety in the Science Classroom, Laboratory, and Field Sites"), which is designed to review safety-operating procedures for students, needs to be used to address safety and teacher liability. A sample form is available at http://static.nsta.org/pdfs/SafetyAcknowledgmentForm-ElementarySchool.pdf.

Be aware that conditions of actual use of activities and demonstrations may vary and the safety procedures and practices described in this e-book teacher's guide are intended to serve only as a guide. Additional precautionary measures may be required. NSTA and the authors/reviewers do not warrant or represent that the procedures and practices in this e-book meet any safety code or standard of federal, state, or local regulations. NSTA and the authors/reviewers disclaim any liability for personal injury or damage to property arising out of or relating to the use of this e-book, including any of the recommendations, instructions, or materials contained therein. Selection of alternative materials or procedures for these activities may jeopardize the level of safety and therefore is at the user's own risk.

Safety Note: Remind students the importance of never looking directly at the Sun.

Consider using this e-book in the classroom as a digital Big Book. Project this onto a screen then decide when you want the class to break into groups to discuss an item in the e-book or to collaborate on an idea. This can help students with independent reading and language development, as well as model how children can participate in science.

Topic 1

Hotter, Cooler

This topic introduces children to the warming effect of sunlight. They will make comparisons between how warm or cool a surface is depending on whether it is in sunlight or shade.

By the end of the topic, students will be able to:

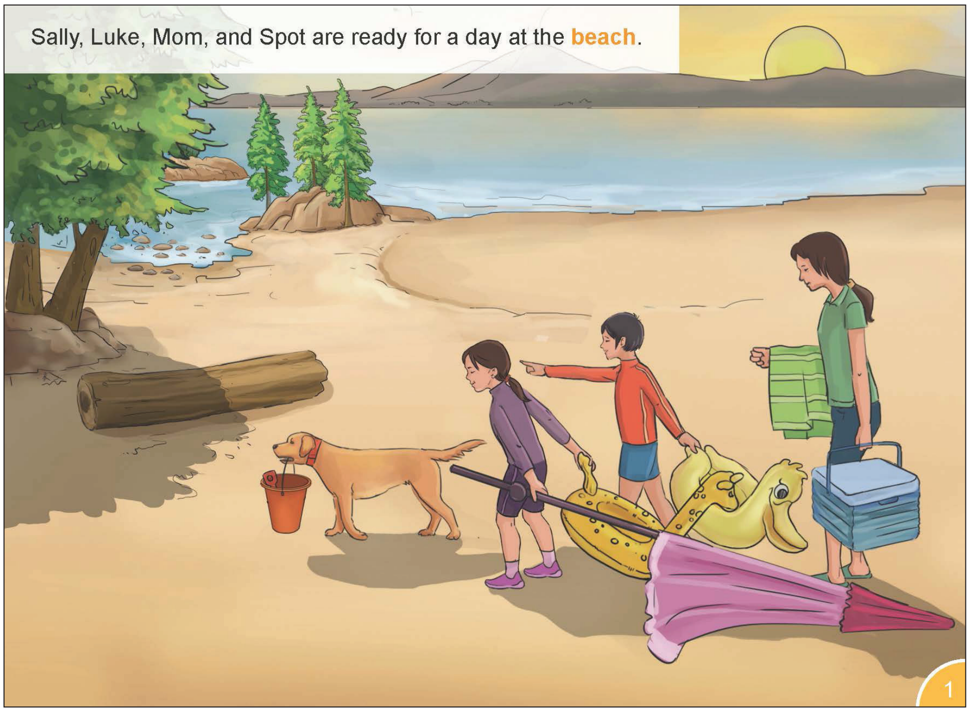
- carry out investigations to observe differences in how warm or cool objects feel (scale) depending on whether they are in the sunlight or shade;
- use mathematical reasoning to make observations of relative temperatures of Earth's surfaces as *hotter* or *cooler*;
- compare observations about how hot or cool objects or surfaces feel in direct sunlight compared to shade;
- construct an explanation of why some things feel warmer when in sunlight; and
- use evidence to describe the cause-and-effect of sunlight on different surfaces.

Pre-Assessment

Ask students the following questions as a pre-assessment:

- How does putting something in sunlight change how it feels?
- Where can you go to get cooler on a sunny day?
- Where can you go to get warm on a sunny day?

Page 1



The book opens with a family starting off for a day at the beach. They are carrying the things they will be using throughout the book to explore how surfaces heat up in sunlight and stay cooler in the shade. Encourage readers to look at the illustration and point out what they notice about the setting.

Set the Stage for Learning

Ask students to use observations to describe details they notice in the illustration. Engage students in a discussion to ask questions and communicate ideas about the different objects they see and what they might be used for (structure and function).

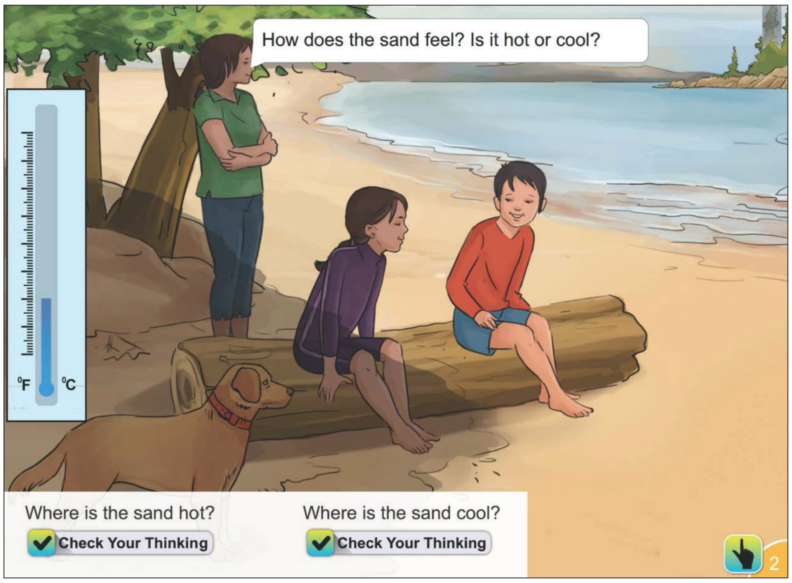
- What shows that the family is going to the beach?
- What places do you see the Sun shining on? (on the sand, half of the log, the water, etc.)
- What things are they taking with them?
- What might they do with these things?

English Language Arts Connection

Speaking and Listening

This activity reinforces the *Common Core State Standards*, English language arts standard CCSS.ELA-Literacy.SL.K.4 as students describe the people, places, and things seen in the illustration. The prompts support students to provide additional details about the setting.

Page 2



Making observations allows readers to analyze and interpret how warm the sand feels to each character. By clicking on each character students discover that the thermometer shows red (warm) when Luke and the mother are chosen and blue (cool) when Sally or Spot are selected. Readers can repeat this investigation to notice patterns and the cause and effect relationship between sunlight and higher temperature.

The "Check Your Thinking" question and pop-up answer guide independent readers to construct an explanation that the Sun makes the sand hotter and that the sand in the shade is cooler.

Possible Preconceptions

Some students may need guidance to make the connection between the thermometer and how hot or cool something feels. In the e-book the thermometer is red to show when something feels warm and blue to show something cooler.

Differentiated Instruction

For students struggling with the concept of the thermometer colors and temperature, have them color in models of two thermometers, one blue and one red. Practice using the models by having students hold up the red one when talking about warm objects and the blue for cool. These thermometer models can be used when making decisions during discussions or investigations.

Investigation

Conduct an investigation where students use their sense of touch to obtain evidence that sunlight affects the temperature of sand.

1. Working in small groups, have students smooth 1 cup of sand in the bottom of two pie pans.
2. Have students place one pie pan in direct sunlight. Place the other in shade and cover it so sunlight does not reach the surface of the sand.
3. Allow the sand in the sun to heat up (20 minutes or so depending on the intensity of the sunlight).
4. Children take turns feeling the sand in the pans in the sunlight and in the shade. Create a simple chart like the one below to record observations. In the first column students can use a picture or words to show if each pan of sand is in sunlight or shade. In the second column, students circle the warm or cool thermometer to show how each pan of sand feels.

Use the following prompts to discuss results and initiate student explanations.

- Which pans of sand are warmer? How do you know? (The pans in the sunlight are warmer. They will know by feeling with their hands and sensing with touch which is warmer.)
- What do you think made the sand warm? (The sunlight heated the sand and made it warmer.)
- What question do you have about what happens when sand is in sunlight? (Answers will vary.)
- What does this investigation tell you about sunlight? (patterns) (Objects are warmed by sunlight.)
- How does this investigation model what happens to sand at the beach? (The sand is a model of the beach. Pans in sunlight and shade are similar to the sand in sunlight and shade at the beach.)
- How does sunlight change (cause and effect) how the sand feels (scale)? (explain using evidence) (The sunlight causes the sand to become warm. We know this by feeling the sand with our hands and comparing sand in sunlight and in shade. The sand in the sunlight feels warmer.)

Example chart:

	Is the sand in sunlight or shade?	**Is the sand warm or cool?**
Pan 1		Cool or Warm
Pan 2		Cool or Warm

Students review what they have observed from the investigation and describe in their own words how sunlight made the sand feel.

Mathematics Connection

Measurement and Data

This activity reinforces *Common Core State Standards*, Mathematics standard CCSS.Math.Content.K.MD.A.2 when students directly compare the two pans of sand for the common attribute of temperature. Prompt students to use comparison words, such as *warmer* and *cooler* to show they are able to use observations to describe the difference.

English Language Arts Connection

Language

This activity reinforces *CCSS ELA* standard CCSS.ELA-Literacy.L.K.5.c by having students identify real-life connections with the words *temperature*, *sunlight*, *shade*, *warmer*, *cooler*, and *thermometer*.