

Think Like  
A Scientist

# The Amazing Light Show



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NSTA eBooks+ Kids



TEACHER'S  
GUIDE

# Overview

This teacher's guide is designed to provide ideas for how to use pages of *The Amazing Light Show* 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.



Lexile® Measure: 510L

- 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 itself;
- 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 NGSS performance expectations 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 Amazing Light Show* e-book encourages learners to take an active role assisting Liz, Sam, and their cat as they explore the anchor phenomenon: What happens when light encounters different objects and surfaces?

In Act 1, the characters put on a show that invites the reader to question, observe, and investigate the phenomenon that some objects block light completely, creating shadows. Students will analyze and interpret how the size and shape of shadows can change depending on direction and distance from a light source. This requires mathematical reasoning as they explore scale and proportion.

Readers also investigate how some things do

not block the light but let light pass through, creating different effects such as outlines and colored shadows. They will see how looking through different transparent objects can change the way things appear.

In Act 2, readers investigate the phenomenon of reflection as they investigate the effects of light bouncing from smooth, shiny surfaces. Likely, students will be familiar with mirrors and have experiences where they saw their reflection on things that aren't mirrors but are shiny and smooth, like car doors, spoons, etc. They will construct explanations and design solutions as they assist the story characters to solve reflection puzzles using mirrors to change the direction of a beam of light. This reasoning leads students to construct an explanation about why the Moon is visible and appears to change shape throughout its cycle. A system model of the Moon assists students as they analyze and interpret data to engage in an argument from evidence about how the Moon reflects light from the Sun.



## 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:

***What is the effect of placing different materials in the path of a beam of light?***

## Three-Dimensional Learning and *The Amazing Light Show* 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 [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 the grade-level elements for the science and engineering practices and crosscutting concepts, refer to [Appendix A](#).

For ideas for engaging in literacy, refer to [Appendix B](#).



# Topic 1

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## Act 1: Light and Shadows

This chapter introduces children to the world of light and shadows. They will investigate how shadows are made, how they change, and the difference in how objects block light.

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

- obtain and communicate information about the cause-and-effect of light being blocked to create shadows;
- plan and carry out investigations about how light interacts with objects of different opacity;
- use mathematics and computational thinking when investigating the patterns associated with scale and proportion of the distance and angle of light on the size and length of shadows;
- construct an explanation with evidence about the effects of light as it passes through, or is blocked, by different objects; and
- identify the phenomenon by answering a question about what happens when objects made of different materials (that allow materials to pass through them in different ways) are placed in the path of a beam of light. (Benchmark 1.a.i from the Evidence Statements for 1-PS4-3. See full document at [https://www.nextgenscience.org/sites/default/files/evidence\\_statement/black\\_white/1-PS4-3%20Evidence%20Statements%20June%202015%20asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/1-PS4-3%20Evidence%20Statements%20June%202015%20asterisks.pdf)).



## Page 1



The book opens with the two characters, Liz and Sam, on stage introducing the Amazing Light Show. One of the characters is in a spotlight and the other is in shadow.

Invite students to [share observations](#) about what they notice on this page. Observations should include that one of the characters is visible and one is not. They may notice that there are several different beams of light. Guide students to [share and make predictions from their own prior experiences and observations](#) about light. This particular piece is associated with an earlier core idea (1-PS4-2), that light illuminates objects, but it is important to recall as students explore [shadows, translucence, and reflection](#).

- Why can we see Liz?
- How would we be able to see Sam?
- What would happen if all the lights were off?

## Page 2



Students interact with the page to explore how different **objects block light to create a shadow on the white cloth**. The drag and drop interactive allows students to **investigate where the object needs to be placed for its shadow to appear**.

Lead a class discussion to **obtain and evaluate information** by **communicating** what students **observed as they carried out this investigation**. Have them **construct an explanation** about what **caused** each shadow. Then ask students to **give reasons from evidence to support their explanation**. Support students with the following prompts:

- Where does the mug need to go to make a shadow?
- Where does the plant need to go to make a shadow?
- Where does the pile of books need to go to make a shadow?
- What does this tell you about how shadows are made?
- Will an object put in another object's shadow have a shadow?

### Investigation

Reinforce the concept that **shadows are made when an object is in the path of light** by **conducting an investigation**. Have one student aim a flashlight, a second student position an object, and a third student hold up a white poster board to use as a screen. Ask them to arrange themselves so that a shadow of the object is seen on the screen.

#### Safety Notes



1. Students should never look directly into the beam of the flashlight or shine it into other students' eyes.

Have the class **make observations** about how the three students need to place themselves in order **to create the shadow**. Give all students a chance to try **this investigation** themselves by providing groups of three with a flashlight, a white poster board, and a variety of objects to choose from. Some examples of objects to use include a cup, pencil, book, block, toy car, or other items easily collected in the classroom. Caution students to use the items safely.

Students **review what they have observed from the investigation** and **describe in their own words how shadows are created using a flashlight**. They should identify that a shadow is going to appear on the **opposite side** of an object from the light source (**cause/effect**).

### Possible Preconceptions

Common student preconceptions related to light and shadows are detailed in *Helping Students Construct Understanding About Shadows* by Lloyd H. Barrow. Two preconceptions to watch for while working with students on this investigation include:

- A shadow is caused by something blocking the light rather than light travelling until it hits something.
- A shadow is made of black stuff or of a substance rather than being the absence of light.

See the full article at <http://files.eric.ed.gov/fulltext/EJ1081344.pdf>

## Page 11



Students **use evidence from the illustrations** to consider why the first shadows are long and the second shadows are short. They will see that **light coming from the side creates a long shadow, but when light comes from overhead, the shadow is short (cause/effect, scale, patterns)**. The pop-up answers guide students who might not be making this connection.

### Investigation

#### Safety Notes

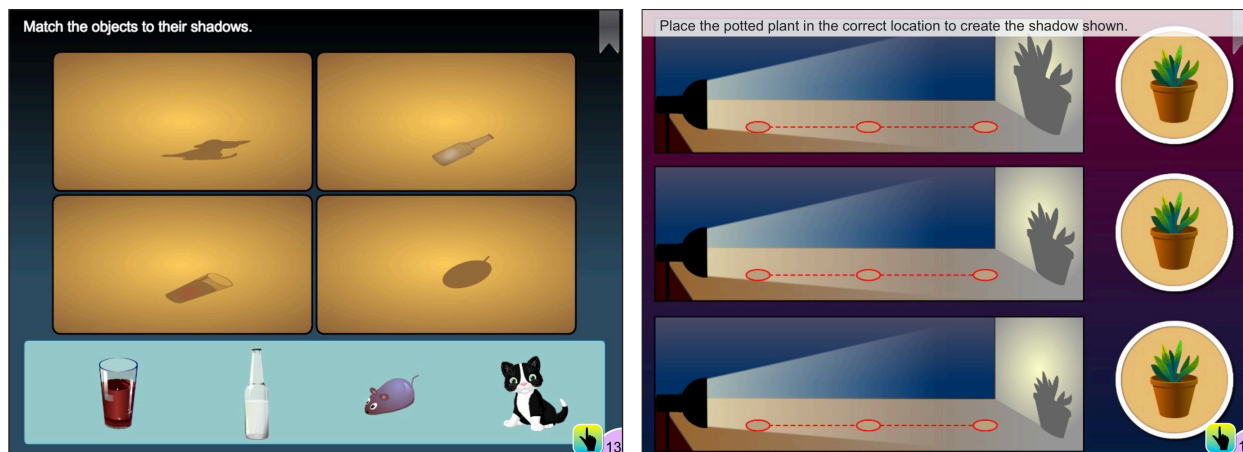


1. Students should never look directly into the beam of the flashlight.

Students **conduct an investigation** using a rectangular block, a flashlight, and a piece of white paper to observe the **cause and effect** of different angles of light to the shape and size of shadows. Have students place the block on the piece of paper so it stands on its shortest end. Have them work with a partner to trace the block's shadow with the flashlight in **three different positions**: to one side at the base of the block, at a higher angle, and a third time with the light pointing straight down at the block. Have students number these shadow drawings 1, 2, and 3. Next, have them **measure the length** of each shadow with a ruler and record this next to each tracing.



## Page 13



### Assessment

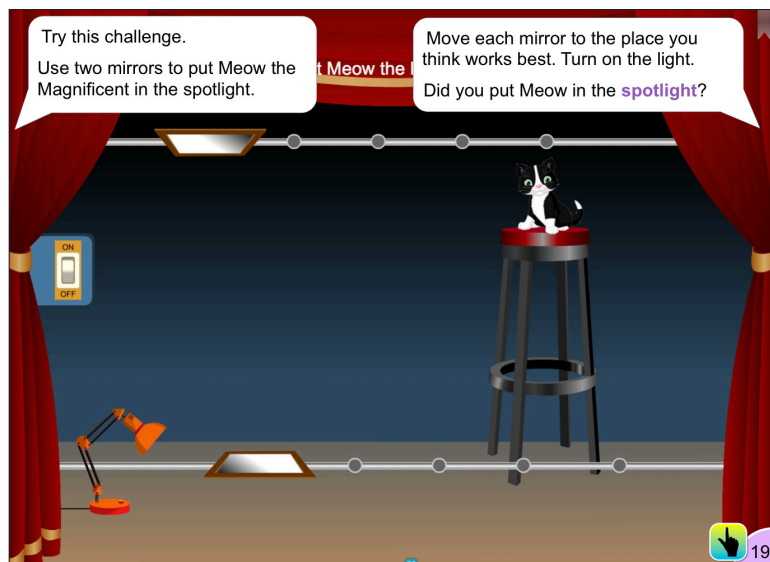
Use the assessment as a check-in with your students to make sure students are understanding the concepts about **how light travels**, **that when something blocks light a shadow is formed**, and **that some things allow light to pass through**.

The first section will help you to learn if students are grasping the concept that **light needs to be blocked by an object to create a shadow**. For students who are struggling or incorrectly matching the shadows, provide time for these students **to ask their own questions** or use follow-up questions to help them **clarify their thinking and reasoning**.

The second and third sections review the **relationship between the angle of the light and the length of the shadow (patterns, scale)**. For students who matched the shadows incorrectly, review the e-book pages and classroom investigations that demonstrate how **shadows change depending on the angle of the light (patterns, scale)**. Again, use follow-up questions to help students understand the differences and **construct explanations**. You may want to use the flashlight and block again as a refresher.

As a conclusion, create a class chart to record students' answers to the question: What do we know about shadows?

## Page 19



The reflection challenge is taken one more step with the use of two mirrors so that the **light takes a second bounce**. This takes thinking up a level in complexity as students apply what they have learned about **how mirrors reflect light (structure and function)**. They will observe through **this investigative interactive** how to place two mirrors so **light is reflected** to shine on Meow the Magnificent.

### Model

#### Safety Notes



1. Students should not look into the beam of the flashlight.
2. Mirrors can break and should be handled with caution. They also may have sharp edges that can cut skin.

Duplicate the placement of the light and the mirrors on this page by creating a **life-sized model**. Have one student hold a flashlight in one corner of the room. Two other students hold lightweight non-breakable mirrors. Place a stuffed animal cat on a stool to represent Meow the Magnificent in one corner of the room, opposite the light source. Have students volunteer to help direct where the students holding the mirrors should stand until the **light is reflected twice** and shines on the stuffed animal cat.