

Lesson 1.1 - Light and Shadows

Overview

During this lesson, students will gain understanding of how and why shadows are formed and the effects of light and shadow. Students will experiment with brightness and colour. Students will integrate and exhibit learning by measuring different types of lights and shadows they create.

Key Information

Level 1: (Ages 8-9) US Grades 2 or 3

Time: 45/90 minutes

Warm-Up	5 minutes
Mini-lesson	10 minutes
Worked Example	7 minutes
Challenge 1	7 minutes
Challenge 1 - Debug it	5 minutes
Challenge 2	7 minutes
Tidy Up / Exit Ticket	4 minutes

Lesson Topics

- **Earth Science**
 - Shadows are formed when the light from a light source is blocked by an object
- **Scientific Thinking**
 - Asking relevant questions and using different types of scientific enquiries to answer them setting up simple practical enquiries
- **Art and Design**
 - Explore and use mechanisms, devices and materials for imaginative activity that leads to original and creative outcomes
- **Design and Technology**
 - Generate, develop, model and communicate ideas through talking, drawing and mock-ups
- **Computing**
 - Inputs, outputs, abstraction, debugging
- **English Language Arts**
 - Use information gained from illustrations and the words in a text to demonstrate understanding of the text
 - Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area

Learning Objectives

- **As a result of this lesson, students will be able to**
 - Approximate the time of day from the position of light and shadows
 - Explain how light sources and an object form shadows
 - Make predictions and conduct experiments about the length of shadows
 - Create a SAM system to generate a shadow on an object experimenting with brightness and position

Lesson 1.1 - Light and Shadows

Materials

- Spherical globe (which can be rotated)
- Large flashlight
- Time zone chart or <https://www.worldtimezone.com/>
- 8 ping pong balls or equivalent, one per small group
- 1 sheet of wax paper
- SAM Labs Kit
- SAM Labs Student Workbook

Warm Up – Scientific Investigation

5 minutes

What time of day is it in different cities of the world?

Objective: Students investigate the time of day and night in different cities of the world, gathering observations and developing predictions.

Procedures: The teacher says, “Today, we are going to learn about light and shadows and the role they play in our everyday lives.” Students start by identifying the time of day or night in different cities of the world describing the amount of light or darkness in those places. The teacher leads students through the example below. The teacher should adjust the light in the classroom so subtleties between light and shadow is apparent to students.

The teacher says, “We’re going to use our globe and a flashlight to illustrate the different times of day and night in different cities of the world.”

Observation	Prediction	Result
<i>Eg</i> - It is dark on the other side of the Earth where China is located <hr/> - It is darker in China than it is in Europe	<i>Eg</i> - It is nighttime in China <hr/> - It's later in the evening/night in China than it is in Europe.	<i>Eg</i> - It is <u>X</u> time in China <hr/> - It is <u>X</u> many hours later in China than England.

Link forward: The teacher introduces the idea that light and shadows help us in many ways: our health (eg. sleep, vitamin D), farming, solar energy.

Mini-lesson

10 minutes

How do light and shadows affect our everyday lives?

Objective: Students investigate the role of light and shadows in our everyday lives, specifically solar energy.

Procedures: The teacher explains that solar power is produced from the Sun's rays that hit the Earth. The Sun's light is converted by a solar panel into energy we use everyday. Solar energy is a beneficial source of energy because its generation does not affect the environment negatively. Solar energy can be difficult because the amount of sunlight an area receives varies. Shadows and light are important to solar power. If a solar panel is covered by shadows it may not work properly. Sometimes 'shadows' can be caused by pollution.

Lesson 1.1 - Light and Shadows

The teacher demonstrates this difference to students by holding a piece of wax paper (mock pollution) between the flashlight and the globe. Students are asked to talk with a partner about the difference between the light and shadows produced with and without “pollution”. (8 minutes)

At the end of the mini-lesson, students can match or define keywords in their workbooks.
(2 minutes)

Key Words

- Shadow
- Light
- Solar power
- Opaque
- Clear
- Pollution

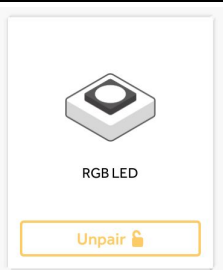


Let's Discuss: *How do shadows appear? In your workbook or with a partner, record, discuss, or share an example of how the sun's movement creates shadows.*

Link forward: Link to creating a system to test how the movement of a light can affect the shadow generated.

Worked Example

7 minutes

Create a system to test how shadows are formed


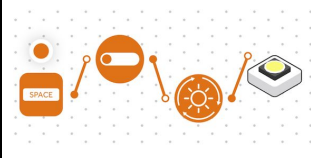
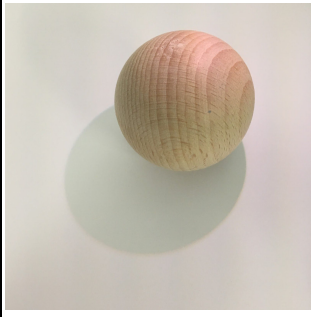
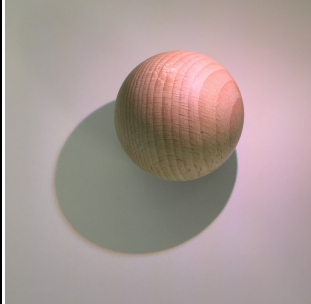
Instructions	Workspace	Notes for Teachers
Step 1. Turn on and pair: <ul style="list-style-type: none"> 1 RGB LED 		<i>Remind students they need to hold the on/off button down for a few seconds for it to turn on. A red light will appear once it is on</i>
Step 2. Drag the RGB LED onto the Workspace.		<i>The RGB LED will enable us to create shadows</i>
Step 3. Add a Key Press block and a Toggle block to the canvas. Place the Toggle between the Key Press and RGB LED.		<i>Teacher says, "What is the difference in how our system operates if we add or remove the Toggle block?" (Hint: The Toggle Block is an input/output which allows you to keep the light on or off without having to hold down the Key Press)</i>

Checks for understanding: *How did we turn on our light? Which block acts as our on/off 'switch'?*

Challenge 1

7 minutes

Create a system to test how the brightness affects the shadow created

Instructions	Workspace	Notes for Teachers
Step 1. Add a Cycle Brightness block to the Workspace.		Teacher says, "We are going to test how the brightness of a light can affect the shadow created. Let's add the Cycle Brightness block to the system, between the Toggle and RGB LED".
Step 2. Connect the Cycle Brightness between the Toggle and the RGB LED.		Support students to explore the Cycle Brightness block. Each time they press the Key Press the level of brightness will change from 0%, 50% and 100% respectively. Students can use their workbooks to record observations
Step 3. Place the ping-pong ball in the middle of the table. Place the RGB LED above the ball, slightly to the right.		Teacher says, "Shadows change shape and size depending on the brightness light. Set your RGB LED to 100% and hold it 6 inches from your ping pong ball, to the right. Record the size and shape of your shadow".
Step 4: Change the brightness of the RGB LED.		For the testing aspect, you may wish to position the light on a platform. This also enables the experiment to be fair. This is a good opportunity to discuss the importance of consistency in scientific experiments to generate a true finding. We have used a small box and blu tack for my RGB LED.

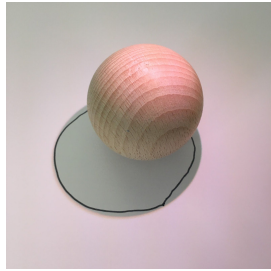
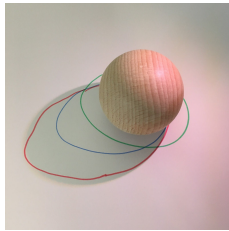
Checks for understanding: Does the brightness of the light affect the shadow generated? Does the position of the light affect the shadow generated?

Lesson 1.1 - Light and Shadows

Challenge 1 - Debug it

5 minutes



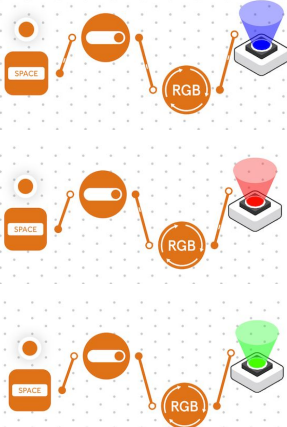
Why can't we see the shadows move?

Instructions	Workspace	Notes for Teachers
Step 1. Draw a line around the shadow		<i>If the lighting in the class is bright, the difference may not be observable. You may want to dim or switch off the lights or draw blinds. Remind students that the proximity and position of the RGB LED will also affect the visibility of the shadow.</i> <i>Keep the position of the light as it was for Challenge 1. Draw a line around the shadow.</i>
Step 2. Try placing the RGB LED at different distances from the object		<i>Draw a line around the shadow, now move the light, and notice the shadow change. Draw a line around the shadow again - ask students to record how the shadow has changed shape and size.</i>

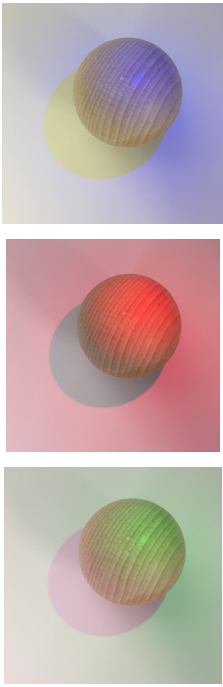

Challenge 2

7 minutes

Create a system to test how the colour of the light affects the shadow

Instructions	Workspace	Notes for Teachers
Step 1. Remove the Cycle Brightness block from the system and replace with the RGB Cycle Colors block		<i>Teacher says, "Let's now study the effects of color on shadows. Remove the Cycle Brightness block and add the RGB Cycle Colors block to the system. The Cycle Colors block allows the colour to change from Red, Green and Blue."</i>
Step 2. Place the RGB Cycle Colors block between the Toggle and the RGB LED blocks.		<i>Press the Key Press and experiment with the the light changing between the 3 colors.</i>
Step 3. Press the Key Space to change the color of the RGB LED from red, green to blue.		<i>Ask students to consider how color has an effect on how we feel, like traffic lights and temperature. In the case of temperature, red = hot, blue = cold.</i> <i>Ensure the system is working effectively before moving to the experiment.</i>

Lesson 1.1 - Light and Shadows

<p>Step 4: Place the ping-pong ball in the middle of the table. Place the RGB LED above the ball, slightly to the right.</p>		<p>Teacher says, "Remember to keep the light position the same in all tests to allow it to be a fair test".</p>
<p>Step 5. Photograph your results! Add the Camera block between the Key Press and the RGB LED.</p>		<p>Using the Camera block, students can be invited to photograph each light. (Photos are saved to the 'Photos' folder/desktop of your device).</p> <p>Students will notice that with the shadow stays the same but the strength of the shadows visibility is different. Teacher says, "How do these results compare to the first experiment?"</p> <p>Teacher says, "Based on these results, why do you think yellow is the common color for lights?"</p>
<p>Extension Ideas:</p> <ul style="list-style-type: none"> • Can you edit the system in any other way to test the effect brightness and colours on light and shadows created? • Geography: <ul style="list-style-type: none"> ◦ How else does the position of the sun in the world affect the shadows created? Zero shadow day on the equator. Lahaina noon in Hawaii • Science: <ul style="list-style-type: none"> ◦ Does the color of the Sun affect the shadow created? • English: <ul style="list-style-type: none"> ◦ Describe other effects the colour could have on an object. For example, what does the colour red make you think of (hot)? 		

Checks for understanding: What makes a shadow move and change shape? Based on our experiment, why do you think yellow is the common color for lights?

Tidy Up / Exit Ticket

4 minutes

Reinforcing the learning objectives of the lesson, students can reflect on key takeaways by completing and submitting an exit ticket