

## Photo Description



A large rock sitting on the ground has a dark shadow cast on the ground next to it. The shadow shows the shape of the rock, and you can see it because the sun is shining on the rock from one side. The grass and plants around the rock help us see how the shadow falls on the ground.

## Scientific Phenomena

Anchoring Phenomenon: Shadow Formation from a Light Source

This image shows a shadow—a dark area created when an object blocks light from reaching the ground. Here's what's happening scientifically: Light travels in straight lines from the sun. When the sun's light hits the rock, the light cannot pass through it. The rock blocks the light, creating a shadow on the ground behind it. The shape and direction of the shadow change throughout the day as the sun moves across the sky. This demonstrates that light travels in straight lines and that objects block light to create shadows.

## Core Science Concepts

- \* Light and Shadow Formation: Light travels in straight lines. When an object blocks light, it creates a shadow on the opposite side.
- \* Properties of Light: Light has direction and can be blocked by opaque (solid) objects. Transparent objects let light pass through, but shadows don't form the same way.
- \* Sun as a Light Source: The sun is Earth's primary light source during the day. Its position in the sky affects where and how long shadows appear.
- \* Relationship Between Objects and Shadows: The larger or more solid an object is, the darker and more defined its shadow becomes. Shadows always fall on the side away from the light source.

### Pedagogical Tip:

Help students understand shadows by having them observe their own shadows at different times of day. Start with a simple demonstration: darken the classroom slightly and use a flashlight as an artificial light source. Have students hold objects between the light and a wall to see how shadows form. This concrete, hands-on approach makes the abstract concept of light blocking tangible for eight-year-olds.

### UDL Suggestions:

Universal Design for Learning Strategy: To support diverse learners, provide multiple means of representation: (1) Use actual objects and shadows in the classroom rather than only discussing them; (2) Create shadow outlines students can trace; (3) Use a document camera to project shadows for the whole class to observe; (4) For students who struggle with spatial reasoning, use consistent language ("the shadow is opposite the light") and point to specific examples. Allow students to explore shadows through movement and play, which engages kinesthetic learners.

### Zoom In / Zoom Out

Zoom In (Microscopic/Atomic Level):

Light is made of tiny particles called photons that travel incredibly fast in straight lines from the sun. When these photons hit the rock's surface, they bounce back or are absorbed into the rock, but they cannot pass through the solid material. The atoms in the rock are packed so tightly that they block all the photons, creating the dark shadow. This is why shadows have such sharp, defined edges when sunlight is direct.

Zoom Out (Larger System/Ecosystem):

Shadows play an important role in Earth's ecosystems. Animals use shadows for shelter and protection from heat. Plants grow differently depending on how much shadow they receive throughout the day. The Earth itself creates a shadow in space—when the moon passes through Earth's shadow, we see a lunar eclipse. Shadow patterns also help determine seasons and daylight hours, which affect all life on our planet.

### Discussion Questions

1. "Why do you think the shadow has the same shape as the rock?" (Bloom's: Understand | DOK: 1)
  - This helps students recognize that shadows show the outline of objects blocking light.
2. "If we moved this rock to a different location, would the shadow look the same? Why or why not?" (Bloom's: Analyze | DOK: 2)
  - Students must think about how light direction and object placement affect shadows.
3. "What would happen to the shadow if we covered the sun with clouds? Can you explain why?" (Bloom's: Analyze | DOK: 2)
  - This connects to understanding light sources and how shadows form from direct light.
4. "How could we make the shadow bigger or smaller without moving the rock?" (Bloom's: Apply | DOK: 3)
  - Students must think creatively about changing the light source position or using artificial light.

### Potential Student Misconceptions

- \* Misconception: "Shadows are dark objects that follow us around and have their own existence."
  - Clarification: Shadows are not things—they are the absence of light. A shadow forms when light is blocked and doesn't reach a surface. Shadows disappear when the light source moves or is blocked differently.
- \* Misconception: "Shadows always look the same size and shape."
  - Clarification: Shadows change size, shape, and direction depending on where the light source is. When the sun is high in the sky, shadows are short. When the sun is low (early morning or late afternoon), shadows are long and stretched out.
- \* Misconception: "All shadows are black."
  - Clarification: Shadows are darkest where light is completely blocked, but they can appear in different shades of gray or blue depending on other light sources nearby (like reflected light from the sky). A shadow is not truly "black"—it's just darker than the surrounding area.

### Extension Activities

1. **Shadow Tracing Activity:** Take students outside at different times of day (morning, noon, and afternoon). Have each student stand on a large piece of paper and a partner traces their shadow with chalk. Compare the three tracings and discuss why the shadows are different lengths and directions. Create a display showing how shadows change throughout the day.
2. **Shadow Puppet Theater:** In a darkened classroom, set up a light source (flashlight or lamp) and have students hold various objects or their hands between the light and a white sheet or wall. Ask them to predict what shadow shape will form, then test their predictions. Students can create simple shadow stories or scenes to perform for classmates.
3. **Shadow Hunt and Measurement:** Give students clipboards and ask them to find five different shadows outside. Have them use string or a measuring tape to measure the shadow length and estimate the object's height. Create a chart comparing object size to shadow size. Discuss why some shadows are longer or shorter than others based on sun position.

### Cross-Curricular Ideas

- \* **Mathematics:** Measure and compare shadow lengths at different times of day. Create a graph showing how shadow length changes from morning to afternoon. Use geometric shapes to estimate shadow area. Have students notice the different angles shadows create.
- \* **English Language Arts:** Write descriptive stories about "A Day in the Life of a Shadow." Create a shadow journal where students draw and describe shadows they notice. Read and discuss shadow-themed children's literature. Use shadow observations as inspiration for poetry or creative writing.
- \* **Social Studies:** Research how different cultures use shadows in celebrations, art, or storytelling (like shadow puppet theater in Asia). Discuss how shadows affect daily life in different parts of the world. Explore how shadows are used on maps and in geography.
- \* **Art:** Create shadow art by arranging objects and tracing their shadows. Make shadow silhouettes by cutting black paper into shape profiles. Paint or draw pictures showing objects and their shadows at different times of day. Create a collaborative mural showing a landscape with shadows at sunrise, noon, and sunset.

### STEM Career Connection

**Astronomer:** Astronomers study light, shadows, and how they appear in space. They use telescopes to look at stars and planets, and they study how shadows from planets and moons (like during eclipses) help us learn about space. Astronomers use knowledge of light and shadows to understand the universe. Average Annual Salary: \$119,000\*

**Photographer:** Photographers use light and shadows to create beautiful pictures. They know how to position light sources to make interesting shadows that make their photos more interesting and artistic. They understand how light direction affects the mood and quality of images. Average Annual Salary: \$68,000\*

**Lighting Designer:** Lighting designers use light and shadows to create special effects for theaters, movies, concerts, and events. They plan where lights should go to create shadows that tell a story or create a certain mood. They understand exactly how light travels and interacts with objects. Average Annual Salary: \$65,000\*

### NGSS Connections

Performance Expectation:

- 3-PS2-1: Plan and conduct an investigation to provide evidence that balanced and unbalanced forces on an object change its motion.

(Note: While this lesson focuses on light, observing how objects block light connects to understanding how forces and energy interact.)

Disciplinary Core Ideas:

- 3-PS2.A (Objects can move in different ways based on forces acting on them; light can be thought of as energy that travels)

Crosscutting Concepts:

- Cause and Effect: Light hitting a rock causes a shadow to form on the ground.
- Patterns: Shadow patterns change predictably based on the sun's position throughout the day.
- Energy and Matter: Light is a form of energy that travels and interacts with objects.

### Science Vocabulary

- \* Shadow: A dark area on the ground or a surface that forms when an object blocks light from reaching that spot.
- \* Light Source: Something that makes light and sends it outward, like the sun, a lamp, or a flashlight.
- \* Block (or Blocks): To stop light from passing through something; to get in the way of light traveling.
- \* Opaque: A material or object that light cannot pass through; it blocks light completely.
- \* Straight Line: The shortest path light takes as it travels from a light source; light doesn't curve or bend around objects.

### External Resources

Children's Books:

- My Shadow by Robert Louis Stevenson (Classic poetry about shadows; beautifully illustrated versions available)
- Bear Shadow by Frank Asch (A story about a bear discovering his shadow in spring)
- Shadows by Tana Hoban (Nonfiction photo book exploring shadows in the real world)