Shadow

Physical Science | Lesson Guide

4th Grade

Photo Description

This image shows a large rock sitting on the ground with green plants and moss growing around it. The rock has a dark shadow cast on its surface and stretches across the ground beside it. The shadow is created by sunlight hitting the rock from one side, blocking the light and creating a dark shape that shows exactly where the rock is blocking the sun's rays.

Scientific Phenomena

Anchoring Phenomenon: Shadow Formation

This image demonstrates how light travels in straight lines and is blocked by objects. When sunlight hits an object like this rock, the light cannot pass through the solid material. The light rays traveling in straight paths from the sun are interrupted, creating a shadow—a dark area where light is blocked. The shadow's shape matches the object creating it because light travels in straight lines. If you move the light source (sun) or the object (rock), the shadow's size, shape, and position change predictably.

Core Science Concepts

* Light travels in straight lines. Sunlight moves in straight paths from the sun toward Earth. When these light rays hit an object, they cannot go through it, creating a shadow behind the object.

* Shadows are created when light is blocked. A shadow forms on the opposite side of an object from the light source. The shadow shows us exactly where light cannot reach because the object is in the way.

* Shadow size and position change with the light source. As the sun moves across the sky during the day, shadows change in length, direction, and position. Objects between the light and a surface cast shadows.

* Objects have properties that affect shadows. Transparent objects (like clear glass) let light pass through and create faint shadows, while opaque objects (like rocks) block all light and create dark shadows.

Pedagogical Tip:

Use this rock as a concrete anchor for your entire light and shadow unit. Return to this same photograph multiple times throughout your lessons to help students make connections between abstract concepts (light travels in straight lines) and observable phenomena they can see. Consider taking photos of this same rock at different times of day to show how shadows change with the sun's position.

UDL Suggestions:

Multiple Means of Representation: Provide both visual examples (like this photo) AND kinesthetic demonstrations where students physically stand in sunlight to create their own shadows. Some students learn better by seeing shadows in real time rather than in a static image.

Multiple Means of Action & Expression: Allow students to demonstrate understanding by drawing shadow diagrams, creating shadows with flashlights and objects, or verbally explaining what they observe—not just through written work.

Zoom In / Zoom Out

Zoom In (Microscopic/Unseen):
At the atomic level, light is made of tiny particles called photons that travel in waves. When photons hit the rock, they are absorbed (taken in) by the material rather than bouncing back to our eyes, which is why we see darkness. The rock's surface is made of minerals with atoms packed tightly together, creating an opaque material that photons cannot pass through.

Zoom Out (Larger System):
Shadows are essential to life on Earth and create patterns in ecosystems. The sun's daily movement creates changing shadows that help plants grow in different amounts of sunlight. Over seasons, shadow patterns shift dramatically—in summer, shadows are short at noon, but in winter, shadows are long all day. These shadow patterns create microclimates (small areas with unique conditions) where different plants and animals can thrive.

Discussion Questions

1. "Why do you think the shadow on this rock is darker in some places than others?" (Bloom's: Analyze | DOK: 2) Possible answer: Parts of the rock are taller and block more light, or the sunlight hits it at different angles.

2. "If we took a picture of this same rock at 3:00 PM instead of this morning, how would the shadow be different, and why?" (Bloom's: Predict | DOK: 3) Possible answer: The shadow would be on the other side because the sun moves across the sky, so the light comes from a different direction.

3. "Can you think of a time when YOU cast a shadow? Where was the sun in relation to you?" (Bloom's: Understand | DOK: 1) Possible answer: When I'm playing outside at noon, my shadow is very short and under my feet because the sun is directly overhead.

4. "If this rock were made of clear glass instead of solid stone, what would happen to its shadow?" (Bloom's: Evaluate | DOK: 3) Possible answer: The shadow would be much lighter or barely visible because light could pass through the glass instead of being blocked.

Potential Student Misconceptions

* Misconception: "Shadows are made of a dark substance or 'shadow material.'"

Clarification: Shadows are not things; they are the absence of light. A shadow is simply the area where light is blocked from reaching a surface. There is nothing dark there—light simply isn't present.

* Misconception: "Shadows always point down or stay in one place."

Clarification: Shadows move and change throughout the day because the sun moves across the sky. A shadow always points away from the light source. In the morning, shadows point west; at noon, they're short; and in the afternoon, they point east.

* Misconception: "All objects make shadows the same way."

Clarification: Only opaque objects (ones light cannot pass through) make dark, clear shadows. Transparent objects like glass let light through and make very faint shadows. Translucent objects (partially see-through) make soft, fuzzy shadows.

Extension Activities

1. Shadow Tracking Activity: On a sunny day, place a stick upright in the ground or use the rock in the image. Mark the shadow's position with chalk every hour. Students observe and record how the shadow moves, changes length, and changes direction throughout the day. This demonstrates that the sun appears to move across the sky and shows the relationship between light source position and shadow direction.

2. Flashlight Exploration: In a darkened classroom, give students flashlights and various objects (blocks, balls, transparent bottles, translucent cups). Have them shine light on objects from different angles and distances to observe how shadow size, shape, and darkness change. Students can hypothesize before testing: "What happens to the shadow if I move the light closer? Further away? From the side?"

3. Shadow Shape Matching: Provide students with black silhouettes of different objects and challenge them to predict what the 3D object is based only on its shadow. Then show the actual objects. Discuss why some objects look very different as shadows than they do in real life, emphasizing that shadows only show the outline and height, not color or texture.

Cross-Curricular Ideas

* Mathematics – Measurement: Students measure and record shadow lengths at different times of day, then create a graph showing how shadow length changes with time. They can calculate the ratio of object height to shadow length.

* ELA – Descriptive Writing: Have students write vivid descriptions of shadows they observe, using sensory words. Create a class "Shadow Poetry" collection where students write poems about shadows they've noticed (e.g., tree shadows, their own shadow, building shadows).

* Social Studies – Ancient Civilizations: Explore how ancient peoples used shadows to tell time—sun dials use shadow movement to measure hours. Students can create simple sun dials and understand how people tracked time before clocks.

* Art – Light and Shadow Drawing: Teach students that artists use light and shadow to create depth in drawings. Students practice shading techniques to show how objects cast shadows in their own artwork, learning that darker shades suggest shadows and lighter shades suggest light.

STEM Career Connection

* Lighting Designer: A lighting designer plans where and how light should shine in theaters, buildings, or movie sets to create the right mood and show off spaces beautifully. They understand how light creates shadows and use this knowledge to make spaces look amazing. Many lighting designers work in theaters, concert halls, and film studios. Average salary: $51,000–$65,000 USD per year

* Astronomer: An astronomer studies the sun, planets, and stars. They use tools to observe how light from space reaches Earth and how objects in space (like the moon) cast shadows on planets during eclipses. Understanding light and shadows helps astronomers learn about the universe. Average salary: $65,000–$95,000 USD per year

* Architect: An architect designs buildings and needs to understand how sunlight and shadows will affect the building throughout the day and seasons. They use shadow patterns to plan windows, outdoor spaces, and how buildings will look at different times of day. Good use of light and shadow makes buildings beautiful and comfortable. Average salary: $68,000–$100,000 USD per year

NGSS Connections

Performance Expectation: 1-PS4-2 (or equivalent at your grade level, "Make observations to construct an evidence-based account that objects can be seen only when light is available to illuminate them")

Disciplinary Core Ideas:
1-PS4.A Wave Properties* – Light can be seen when it enters the eye; objects are visible only when light bounces off them or when they produce light.

Crosscutting Concepts:
Cause and Effect – The presence of an object between a light source and a surface causes* a shadow to form; moving the object or light source has predictable effects on the shadow.
* Patterns – Shadows follow predictable patterns based on the sun's position in the sky throughout the day and seasons.

Science Vocabulary

* Shadow: A dark area created when an object blocks light from reaching a surface.

* Light source: Something that gives off light, like the sun, a flashlight, a lamp, or a candle.

* Opaque: A material that light cannot pass through, so it blocks light completely and makes a dark shadow (like this rock).

* Transparent: A material that light can pass straight through, so you can see objects clearly on the other side (like clear glass or water).

* Block: To stop light from traveling in a straight line by putting an object in its way.

* Angle: The direction or slant of the sun's light rays as they hit an object and the ground.

External Resources

* Children's Books:
- Shadows by Tana Hoban (Greenwillow Books) – A photographic exploration of shadows in everyday life
- What Makes a Shadow? by Clyde Robert Bulla (HarperCollins) – A simple picture book explaining shadows for early elementary readers
- In and Out of the Shadow by Robert Louis Stevenson – A classic poem about shadows that can spark discussion