Shadow

Physical Science | Lesson Guide

5th Grade

Photo Description

This image shows a large rock sitting on ground covered with moss and short plants. On one side of the rock, you can see a dark shadow stretched across the ground. The shadow is created by sunlight hitting the rock and blocking the light from reaching the ground beneath it. The shadow's shape and direction tell us about where the sun is positioned in the sky.

Scientific Phenomena

Anchoring Phenomenon: Why does the rock create a shadow?

Shadows form when light from the sun travels in straight lines and hits an object. The rock blocks this light, preventing it from reaching the ground on one side. The area where light cannot reach appears dark—this is the shadow. The shadow's position, length, and direction change throughout the day as the sun moves across the sky. This demonstrates that light travels in straight lines and cannot pass through opaque (solid, non-see-through) objects.

Core Science Concepts

1. Light travels in straight lines: Light energy moves in predictable, straight paths until it hits something that stops or changes it.

2. Opaque objects block light: Materials that are solid and do not allow light to pass through them create shadows on the opposite side where light is blocked.

3. Shadow position and length depend on light source location: As the sun moves throughout the day, shadows change in length, direction, and position because the angle of light changes.

4. Shadows are evidence of light interaction: We cannot see light itself, but we can observe shadows as evidence that light exists and behaves in predictable ways.

Pedagogical Tip:

When teaching shadows to Fifth Graders, use the "hand flashlight" activity: have students hold a flashlight and move it around their hand to see how the shadow changes. This kinesthetic experience helps students understand that the shadow's appearance depends on where the light source is positioned. Ask students to predict how the shadow will look BEFORE they move the flashlight, then test their predictions.

UDL Suggestions:

Representation: Provide images of shadows at different times of day (sunrise, noon, sunset) so students can visualize how shadows change without needing to wait through an entire school day. Use labeled diagrams showing the light source, object, and shadow.

Action & Expression: Allow students to demonstrate shadow understanding through multiple modalities—some students might draw shadows, others might measure them with string, and others might create shadow puppets or use digital tools to model shadow movement.

Engagement: Connect shadows to student interests by examining shadows in sports (how shadows affect outdoor games), art (shadow puppets, silhouettes in drawings), or nature (animal camouflage using shadows).

Zoom In / Zoom Out

Zoom In: Atomic/Molecular Level
At the microscopic level, light is made of particles called photons that travel in waves. When photons hit the rock, they either bounce off the surface (which is why we can see the rock) or get absorbed into the material. The photons cannot pass through the solid rock because the atoms in the rock are tightly packed together, blocking the light's path. On the shadowed side, fewer photons reach the ground, making it darker.

Zoom Out: Daily and Seasonal Patterns
Shadows are part of Earth's larger system of how our planet moves relative to the sun. Throughout a single day, shadows change predictably because Earth rotates and the sun appears to move across the sky from east to west. Throughout the year, shadows change length and angle because Earth's tilt affects the sun's path. Ancient peoples used shadows to track time (sundials) and seasons, showing how shadows connect to Earth's cycles and our place in the solar system.

Discussion Questions

1. "If we moved this rock to a different location, would the shadow look the same or different? Why?"
   - Bloom's: Analyze | DOK: 2

2. "How could we use shadows to figure out what time of day it is without looking at a clock?"
   - Bloom's: Create | DOK: 3

3. "What would happen to this shadow if the sun were hidden behind clouds? Explain your thinking."
   - Bloom's: Evaluate | DOK: 2

4. "Compare the shadow of this rock to the shadow of a tall tree. Why might they be different shapes and sizes?"
   - Bloom's: Analyze | DOK: 2

Potential Student Misconceptions

1. Misconception: "Shadows are made of dark stuff, like darkness is a substance."
   - Clarification: Shadows are not made of anything—they are simply the absence of light. When light cannot reach an area, it appears dark. Darkness is the lack of light energy, not a material.

2. Misconception: "Shadows always point in the same direction."
   - Clarification: Shadows change direction and length throughout the day as the sun moves across the sky. In the morning, shadows point west; at noon, shadows are shortest; in the afternoon, shadows point east. Seasons also affect shadow direction.

3. Misconception: "If I move, my shadow moves because it's following me."
   - Clarification: Your shadow moves when YOU move because you are moving the object (your body) that blocks the light. The light source stays still, but the shadow changes position when the object blocking it changes position.

Extension Activities

1. Shadow Tracking Over Time: On a sunny day, place a stick or rock in a marked spot and trace its shadow with chalk every hour (or photograph it). Have students measure the shadow's length and direction, then create a chart showing how the shadow changed throughout the day. Discuss why the shadow moved and changed size. Students can predict where tomorrow's shadow will be at the same time.

2. Shadow Puppet Theater: Provide a light source (flashlight or lamp) and dark objects, and allow students to create shadow puppet stories behind a white sheet or screen. Challenge them to predict how moving the object closer to or farther from the light will change the shadow size, then test their predictions. This reinforces understanding that shadows depend on the position of the light source and object.

3. Sundial Construction: Have students create a simple sundial using a stick, paper plate, and markers. They mark where the shadow falls at different times of day and label the hours. This hands-on activity connects shadows to telling time and shows how ancient civilizations used shadows as a tool.

Cross-Curricular Ideas

1. Mathematics: Measure shadows at different times of day and create bar graphs or line graphs comparing shadow lengths. Calculate the ratio of object height to shadow length. Use shadows to explore angles and degrees (sun angle in the sky).

2. English Language Arts: Write descriptive paragraphs about shadows using sensory language ("the cool shadow felt refreshing"). Read and discuss books about shadows or darkness. Create shadow poems or haikus.

3. Social Studies: Investigate how ancient civilizations (Egyptians, Greeks, Chinese) used shadows and sundials to measure time. Research how sundials still appear on buildings today. Discuss how understanding shadows helped humans organize their day and calendar.

4. Art: Create silhouettes or shadow art by tracing shadows on paper and filling them in with dark colors or patterns. Design shadow puppet characters. Photograph shadows in nature or around school to create a shadow photography collection. Discuss how artists use shadows to create depth and mood in drawings and paintings.

STEM Career Connection

1. Astronomer: Astronomers study the sun, moon, stars, and planets. They use shadows and light to understand how objects move in space and how Earth's position affects what we see in the sky. By studying shadows and light, you learn skills astronomers use every day. Average Salary: $104,000 USD

2. Civil Engineer: Civil engineers design buildings, bridges, and outdoor spaces. They must think about how sunlight and shadows will affect these structures throughout the day and year. Understanding shadows helps engineers plan where to place windows, shade structures, and outdoor areas. Average Salary: $95,000 USD

3. Photographer or Cinematographer: Photographers and filmmakers use light and shadows to create beautiful or dramatic images. They position light sources to create shadows that make pictures more interesting or tell a story. Understanding how light creates shadows is a key skill in photography and filmmaking. Average Salary: $64,000 USD

NGSS Connections

Performance Expectation:
1-PS4-2: 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)
- 1-PS4.B (Electromagnetic Radiation)

Crosscutting Concepts:
- Cause and Effect (Light hitting an object causes a shadow to form on the opposite side)

- Patterns (Shadows follow predictable patterns based on light source location)
- Evidence (Shadows are observable evidence that light exists and travels in straight lines)

Science Vocabulary

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

* Opaque: Something you cannot see through because light cannot pass through it (like a rock, wood, or paper).

* Light source: Where light comes from, such as the sun, a flashlight, or a lamp.

* Block (or obstruct): To prevent something from passing through or moving forward; in this case, when an object stops light from traveling.

* Angle: The direction or slope at which something points; the position of light affects the angle of a shadow.

External Resources

Children's Books:

Shadows* by Roy Wandelmaier (Little, Brown Books for Young Readers) — Explores how shadows form and change throughout the day.

The Shadow* by Blanca Gómez (Elsewhere Editions) — A poetic exploration of a girl's relationship with her shadow, encouraging creative thinking about light and shadows.

Sun and Moon: A Story of Gravitational Harmony* by Christy Mihaly (Millbrook Press) — While focused on celestial objects, this book helps students understand how the sun's position creates different shadows throughout the year.