

Photo Description



This image shows a large rock sitting on the ground surrounded by grass and moss. The most striking feature is the dark shadow cast by the rock on the ground next to it. The shadow appears darker and longer than the rock itself, stretching across the grass in a shape that mirrors the rock's outline.

Scientific Phenomena

Anchoring Phenomenon: Why does a shadow appear on the ground when sunlight shines on an object?

Shadows form because light travels in straight lines. When an opaque object (something solid that light cannot pass through) is placed in the path of sunlight, the light cannot get around it. The area behind the object where light is blocked becomes darker—this darker area is the shadow. The shadow's size and direction depend on where the sun is positioned in the sky. When the sun is high overhead, shadows are short; when the sun is low on the horizon (morning or late afternoon), shadows are longer and stretch farther across the ground.

Core Science Concepts

- * Light travels in straight lines: Light from the sun moves in a direct path until it hits an object or is blocked. This is why shadows form directly behind objects blocking sunlight.
- * Opaque objects block light: Materials that are solid and not see-through (like rocks) completely block light and create dark shadows. Transparent or translucent materials allow light to pass through, creating little to no shadow.
- * Shadows change with the sun's position: As the sun moves across the sky throughout the day, shadows change in length and direction. Shadows are longer in the morning and evening when the sun is low, and shorter at midday when the sun is high.
- * Shadows are evidence of light: A shadow is not a physical object you can touch—it is the absence of light. We use shadows as proof that light is traveling and that objects are blocking it.

Pedagogical Tip:

Help students understand that shadows are not "things" but rather the absence of light. Use an analogy: "A shadow is like an empty parking space—you can see where something isn't, but the empty space isn't an object itself." This conceptual shift helps Fourth Graders move beyond thinking of shadows as dark substances.

UDL Suggestions:

Representation: Provide both visual demonstrations (observing shadows outdoors) and physical models (flashlight and objects in a darkened room). Some students may benefit from tracing shadows on paper to see the shape more clearly.
Action & Expression: Allow students to show understanding through drawing, measurement, or verbal explanation rather than requiring only written responses. **Engagement:** Connect shadows to things students care about—their own shadows, shadow puppets, or shadows of favorite objects—to increase relevance and motivation.

Zoom In / Zoom Out

Zoom In (Microscopic/Atomic Level):

Light is made of tiny particles called photons that travel outward from the sun in waves. When photons hit the surface of the rock, some bounce off (allowing us to see the rock's color and shape), but many are absorbed by the rock's material and converted to heat energy. The rock's atoms absorb the photons rather than letting them pass through, which is why the rock casts a shadow.

Zoom Out (Larger System/Earth Level):

Shadows are a key part of Earth's daily cycles and seasons. The length and direction of shadows change throughout the day as Earth rotates, and they change throughout the year as Earth's tilt changes our position relative to the sun. Shadows affect entire ecosystems—plants in forests live in patchy shadows cast by taller trees, and many animals depend on shadows for shelter and hunting. Shadows also help us track time (sundials) and understand the sun's position in our sky.

Discussion Questions

1. Why do you think the shadow in this photo looks darker than the grass around it? (Bloom's: Understand | DOK: 1)
2. If you moved this rock to a different location on Earth where it's morning time, how would the shadow look different? Explain your thinking. (Bloom's: Analyze | DOK: 2)
3. What would happen to this shadow if a thick cloud covered the sun? Why would that happen? (Bloom's: Apply | DOK: 2)
4. How could we use shadows to tell what time of day it is? What evidence would we look for? (Bloom's: Evaluate | DOK: 3)

Potential Student Misconceptions

- * Misconception: "Shadows are dark things that move around."
 - Clarification: Shadows are not objects or substances. They are areas where light is blocked. Shadows appear to "move" because the sun's position changes in the sky, which changes where light and darkness fall on the ground.
- * Misconception: "Shadows are always the same size as the object that makes them."
 - Clarification: Shadows change size depending on the sun's angle. When the sun is directly overhead, the shadow is small and directly under the object. When the sun is at an angle (morning or evening), the shadow stretches out and becomes much longer.
- * Misconception: "Everything has a shadow all the time."
 - Clarification: Shadows only form when light is blocked. In complete darkness, there are no shadows. On a cloudy, overcast day, shadows are very faint or invisible because clouds scatter the light in many directions.

Extension Activities

1. Shadow Length Investigation: Take students outside at three different times of day (morning, midday, and afternoon). Have them measure the same object's shadow using a meter stick or string at each time. Create a chart showing how the shadow length changes. Discuss why this happens based on the sun's position.
2. Shadow Puppet Theater: In a darkened classroom or hallway, set up a light source (flashlight or lamp) and a white sheet or screen. Have students create shadow puppets with their hands and simple objects. Experiment with moving the light source closer and farther away to see how shadow size changes. Connect this to the rock's shadow changing with the sun's position.

3. Sundial Creation: Have students create a simple sundial using a stick placed in the ground or a paper plate. Mark where the shadow falls at different times of day with chalk or pen. Discuss how ancient people used shadows to track time and why shadows are reliable timekeepers.

Cross-Curricular Ideas

- * Mathematics: Measure shadow lengths at different times of day and create a bar graph or line graph showing how shadow length changes. Calculate the ratio of object height to shadow length. Use geometry to identify the shapes created by shadows.
- * Language Arts: Write a narrative story from the perspective of a shadow—where does it go during the day? What does it "see"? Read picture books about shadows and discuss how authors describe light and darkness.
- * Social Studies: Research how different cultures have used shadows (sundials, shadow clocks, shadow puppetry in Asian cultures). Create a timeline showing how humans have tracked time using shadows throughout history.
- * Art: Create shadow art by painting or drawing the outline of shadows. Make a shadow collage using cut-out shapes. Explore light and shadow in famous artworks and discuss how artists use shadow to create mood and depth.

STEM Career Connection

- * Astronomer: Astronomers study the sun, moon, stars, and planets. They use knowledge of how light travels and how shadows form to understand movements in space. They might study how shadows on the moon help us learn about craters. Average Salary: \$104,000 per year.
- * Lighting Designer: Lighting designers work in theaters, movies, and museums to control where light and shadows fall to create mood and help audiences see what's important. They use their understanding of how light interacts with objects. Average Salary: \$48,000 per year.
- * Archaeologist: Archaeologists dig up old artifacts and buildings. They use the position of the sun and shadows to help them understand how ancient structures like pyramids and temples were built and used by people long ago. Average Salary: \$63,000 per year.

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 (Properties of sound and light)

Crosscutting Concepts:

- * Cause and Effect - The sun's position causes shadows to change in length and direction.
- * Evidence - Shadows are evidence that light is traveling and being blocked by objects.
- * Patterns - Shadows follow predictable patterns based on the sun's movement across the sky.

Science Vocabulary

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

- * Opaque: A material that is solid and does not let light pass through it (like rocks, wood, or metal).
- * Light source: Anything that produces light, such as the sun, a lamp, or a flashlight.
- * Block: To stop or prevent something from moving through; in this case, to stop light from traveling past an object.
- * Transparent: A material that you can see through clearly because light can pass through it (like glass or clear plastic).
- * Angle: The direction or tilt of something; the sun's angle in the sky changes throughout the day and year.

External Resources

Children's Books:

- * Me and My Amazing Body by Joan Sweeney (introduces light and shadows as part of understanding how our bodies interact with the world)
- * What Makes a Shadow? by Clyde Robert Bulla (a classic picture book specifically about shadows and how they form)
- * The Shadow Book by Beatrice Schenk de Regniers (poetic exploration of shadows throughout the day)