

Photo Description



This image shows a large rock casting a dark shadow on the ground on a sunny day. The shadow's shape matches the rock's outline, and you can see how the sun's position creates a sharp, distinct shadow on the grass and moss-covered ground nearby.

Scientific Phenomena

Anchoring Phenomenon: Shadow formation caused by light being blocked by an opaque object.

When sunlight hits an opaque object (something light cannot pass through, like this rock), the light rays are blocked. The area behind the object where light cannot reach appears darker—this is the shadow. The shadow's shape and size depend on the position of the light source (the sun) and the object blocking it. This is a direct application of how light travels in straight lines and what happens when that path is interrupted.

Core Science Concepts

- * Light travels in straight lines: Sunlight moves from the sun in straight paths until it hits an object or is absorbed.
- * Opaque objects block light: Materials that do not allow light to pass through (like rocks, wood, or metal) create shadows because they stop light from reaching the area behind them.
- * Shadow size and position change with light source position: As the sun moves across the sky during the day, shadows change in length, direction, and shape.
- * Shadows require three elements: a light source, an object, and a surface to cast the shadow upon. Without any one of these, no shadow forms.

Pedagogical Tip:

When teaching about shadows, have students observe their own shadows throughout the day (morning, midday, afternoon). This kinesthetic experience helps them understand that shadows are not static—they change constantly as the sun moves. Record observations with sketches to build evidence for the concept.

UDL Suggestions:

Provide multiple means of representation by using both visual observations (photos, real shadows) and tactile exploration (tracing shadows with chalk on pavement, using flashlights indoors). Allow students to document shadows through drawings, photographs, or written descriptions based on their preference. Consider pairing visual learners with kinesthetic learners during shadow-tracing activities.

Zoom In / Zoom Out

Zoom In — Atomic Level:

At the atomic level, light is made of particles called photons. When photons from sunlight strike the rock, they are absorbed by the rock's atoms or scattered in different directions. The photons never reach the surface behind the rock, which is why that area appears dark. The rock's atoms interact with light energy through absorption and reflection.

Zoom Out — Planetary System:

On a larger scale, shadows across Earth are created by the planet's relationship to the sun. As Earth rotates on its axis, different locations experience changing shadow patterns throughout the day. The tilt of Earth's axis is why shadows are longer in winter and shorter in summer at any given location. This phenomenon is fundamental to how we measure time (sundials), navigation, and understanding Earth's seasons.

Discussion Questions

- * Why does the shadow have the same shape as the rock? (Bloom's: Understand | DOK: 1)
- * If we observed this rock's shadow at different times of the day, how do you think it would change and why? (Bloom's: Predict | DOK: 2)
- * What would happen to the shadow if we covered the rock with a clear plastic bag instead of leaving it exposed? (Bloom's: Analyze | DOK: 2)
- * Can you think of a way humans use shadows to help us in daily life? (Bloom's: Create | DOK: 3)

Potential Student Misconceptions

- * Misconception: "Shadows are things that can move on their own or follow you."
 - Clarification: Shadows don't move independently; they move because the light source (the sun or a flashlight) is moving, or you are moving relative to the light. The shadow always stays on the opposite side of the object from the light source.
- * Misconception: "Shadows are made of darkness."
 - Clarification: Shadows aren't made of something called "darkness." A shadow is simply an area where light is not reaching because an object is blocking it. It's the absence of light, not a substance.
- * Misconception: "All shadows are the same darkness/blackness."
 - Clarification: Shadows have varying shades depending on how completely the light is blocked and what surface they fall on. A shadow on grass might look different than a shadow on concrete because the surfaces reflect light differently.

Extension Activities

- * Shadow Tracing Walk: Take students outside on a sunny day. Have them use chalk to trace shadows of objects (trees, flagpoles, their own bodies) on pavement. Return to the same location 2-3 hours later and trace the same objects' shadows again. Compare the tracings to see how shadows changed with the sun's movement. Create a poster showing the "journey" of one shadow throughout the day.
- * Flashlight Shadow Exploration: In a darkened classroom or gymnasium, provide students with flashlights and various opaque and transparent objects (blocks, bottles, fabric, plastic wrap). Have them experiment with how the distance between the flashlight and object affects shadow size, and how transparent vs. opaque materials create different shadow effects. Encourage them to hypothesize before testing.

* Shadow Puppet Theater: Students create shadow puppets using cardboard cutouts or their hands and a light source. This activity reinforces that you need light, an object, and a surface for shadows to form. Allow them to create and perform a short story using only shadows, demonstrating their understanding of how light and objects interact.

Cross-Curricular Ideas

- * Mathematics: Measure shadows at different times of day and create a line graph showing how shadow length changes hourly. Students can calculate the ratio of object height to shadow length and explore the geometric angles created by light rays.
- * ELA — Descriptive Writing: Have students write vivid descriptive paragraphs about shadows they observe, using sensory language. They could also read and discuss shadow-themed poetry or create their own shadow haikus.
- * Social Studies — Timekeeping: Research how ancient civilizations used shadows and sundials to measure time. Create a classroom sundial and use it to tell time over several weeks, connecting shadows to human history and navigation.
- * Art: Create mixed-media shadow art by arranging objects on paper, placing them in sunlight, and tracing or painting the shadows. Students can layer shadows of different objects to create abstract or representational artwork.

STEM Career Connection

- * Light Physicist: A physicist who studies how light behaves and interacts with materials. They might design better lighting systems, create new optical instruments, or improve solar panels. Understanding shadows helps them predict how light will behave in different situations. Average Salary: \$120,000 USD
- * Geologist/Earth Scientist: Geologists study rocks and Earth's structure. They use shadows and light angles to examine rock surfaces and understand mineral composition. This rock in the photo could be studied by a geologist to learn about Earth's history. Average Salary: \$95,000 USD
- * Landscape Architect: These professionals design outdoor spaces like parks and gardens. They use their knowledge of shadows and sunlight to plan where to place trees, buildings, and pathways so spaces are comfortable and beautiful throughout the day. Average Salary: \$72,000 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

Crosscutting Concepts:

- * Cause and Effect — The position of the light source causes changes in shadow size and direction.
- * 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 a surface.
- * Opaque: A material that does not let light pass through it; you cannot see through it.

- * Light source: Something that produces or gives off light, such as the sun, a flashlight, or a lamp.
- * Block: To stop something from passing through or moving forward.
- * Transparent: A material that allows light to pass through it so you can see clearly through it.

External Resources

Bear Shadow* by Frank Asch

Shadow* by Blanca Gómez

The Shadow Book* by Beatrice Schenk de Regniers