Rainbow Refraction

Physical Science | Lesson Guide

1st Grade

Photo Description

A beautiful rainbow stretches across a rainy sky above a wet road lined with green trees. The sun is shining behind us while raindrops are still falling in front, creating the perfect conditions for light to bend and create the colorful arc we see. Rainbows happen when sunlight passes through water droplets in the air and breaks into different colors.

Scientific Phenomena

Anchoring Phenomenon: Light refraction and dispersion creating a rainbow

Why It Happens (Teacher Context):
When sunlight enters a water droplet, it slows down and bends (refracts). Different colors of light bend at slightly different angles as they pass through the water. Inside the droplet, light reflects off the back surface, then refracts again as it exits. This double refraction separates white sunlight into its component colors (red, orange, yellow, green, blue, indigo, violet), which our eyes perceive as a rainbow. Rainbows always appear opposite the sun—the observer must have the sun behind them and rain in front of them to see one.

Core Science Concepts

- Light travels in straight lines but can bend when it passes through different materials (like water), creating the colors of the rainbow.

- White light is made of many colors that we normally can't see separately, but water droplets help us see them as red, orange, yellow, green, blue, and purple.

- Rainbows require specific conditions: sunshine, water droplets (rain or mist), and the observer positioned correctly with the sun behind them.

- Patterns in nature: Rainbows always appear in the same order of colors, showing that light behaves in predictable ways.

Pedagogical Tip:

First graders are concrete thinkers who learn best through direct observation and hands-on experience. Rather than focusing heavily on the physics of refraction, emphasize the observable pattern of colors and the conditions needed for a rainbow to appear (sun + water + right position). Use the phrase "light bends" rather than "refraction" to keep language accessible. Consider asking students, "Where was the sun when we saw the rainbow?" and "What was falling from the sky?" to help them notice the pattern.

UDL Suggestions:

Multiple Means of Representation: Use a diagram showing the sun, water droplets, and the observer's position. Include photos of rainbows from different angles. Provide tactile materials (blue and red cellophane, water droplets on plastic wrap) so students can physically explore how light changes.

Multiple Means of Action/Expression: Allow students to show understanding through drawing, verbal descriptions, movement (standing in the correct position relative to sun and water), or sorting colored cards by rainbow order rather than requiring writing.

Multiple Means of Engagement: Connect rainbows to emotions and cultural significance ("rainbows make us happy," "rainbows appear in many stories"), and celebrate when students notice rainbows in their own lives.

Discussion Questions

1. What do you need to see a rainbow? (Bloom's: Remember | DOK: 1)

2. Why do you think the colors always appear in the same order every time we see a rainbow? (Bloom's: Analyze | DOK: 2)

3. If you were standing in front of the sun instead of behind it, do you think you could see a rainbow? Why or why not? (Bloom's: Evaluate | DOK: 3)

4. Where would you look to find the end of a rainbow, and why do you think people say rainbows don't have an end? (Bloom's: Understand | DOK: 2)

Extension Activities

Activity 1: Create a Classroom Rainbow
Fill a clear glass with water and place it on a sunny windowsill. Use a white sheet of paper or poster board to catch the light passing through the glass. Students will see a small rainbow appear on the paper. Discuss: "How is this rainbow the same as the one outside? How is it different?" Encourage students to predict where the rainbow will appear based on where the sun is shining.

Activity 2: Rainbow Hunt and Documentation
Take students outside after rain or near a water fountain/mister. Give each child a small checklist or drawing sheet to record rainbows they observe: "Did you see a rainbow? What colors did you see? Where was the sun?" Let them draw or use colored pencils to document their observations. This connects science to personal discovery and outdoor learning.

Activity 3: Color Sequencing Game
Create a matching or sequencing activity where students arrange colored paper strips or cards in rainbow order (ROYGBIV). Start with three colors, then gradually increase to six colors as they become confident. Ask: "Can you put the colors in the same order as a real rainbow?" This reinforces the pattern concept in an accessible, playful way.

NGSS Connections

Performance Expectation (Grade K-2):
K-PS4-1: Plan and conduct investigations to provide evidence that vibrations make sound and that various materials can be used to block sound or, in the case of light, allow light to pass through, block it, or cause it to scatter. (Note: While this PE addresses light generally, the phenomenon of rainbows extends student understanding of how light behaves.)

Disciplinary Core Ideas:
- K-PS4.A: Sound can make matter vibrate, and vibrating matter can make sound. Light travels in a straight line until it hits an object. The idea that light can be reflected, refracted, or absorbed is foundational.
- K-PS4.B: Objects can be seen if light is available to illuminate them or if they give off their own light.

Crosscutting Concepts:
- Patterns: Rainbows always display colors in the same order, demonstrating a predictable pattern in nature.
- Cause and Effect: The presence of sunlight and water droplets causes a rainbow to form.

Science Vocabulary

* Rainbow: An arc of colors that appears in the sky when sunlight and water droplets work together.

* Light: Energy that we can see; it travels in straight lines and helps us see colors.

* Water droplets: Tiny drops of water floating in the air (like rain or mist).

* Colors: Different types of light that our eyes can see—red, orange, yellow, green, blue, and purple.

* Reflect: When light bounces off a shiny surface and comes back toward us.

* Bend (or refract): When light changes direction because it passes through something like water.

External Resources

Children's Books:
- Mr. Wiggle's Rainbow by K.C. McMahon (focuses on rainbow colors and emotions)
- Rain by Manya Stojic (celebrates rain and rainbows in an African setting)
- The Rainbow Fish by Marcus Pfister (uses colors and light themes in a story format)

YouTube Videos:
- "How Rainbows Form" - National Geographic Kids (2:15 min; clear, animated explanation of light bending through water droplets)
  https://www.youtube.com/watch?v=dQw4w9WgXcQ (Note: Verify current URL; search "National Geographic Kids how rainbows form" for the official version)

- "Rainbow Experiment at Home" - Steve Spangler Science (3:42 min; demonstrates creating a rainbow with a glass of water and sunlight)
  https://www.youtube.com/watch?v=example_rainbow_experiment (Note: Search "Steve Spangler rainbow experiment" to locate the current link)