

Photo Description



This image shows a beautiful rainbow stretching across a wet highway on a partly cloudy day. The rainbow appears as a curved arc of colors in the sky, visible because sunlight is shining from behind the camera toward the moisture and water droplets in the air ahead. Trees line both sides of the wet road, and you can see vehicles on the highway below the rainbow.

Scientific Phenomena

Anchoring Phenomenon: Light refraction and reflection creating a rainbow

When sunlight enters water droplets in the air (from rain or mist), the light bends, bounces inside the droplet, and bends again as it exits. This bending and bouncing separates white sunlight into its different colors—red, orange, yellow, green, blue, indigo, and violet—which is why we see a rainbow. The observer must have the sun behind them and water droplets in front of them for a rainbow to be visible. This is an excellent real-world example of how light behaves as it passes through different materials.

Core Science Concepts

- * Light travels in straight lines but can bend (refract) when passing through different materials. Water droplets have a different density than air, so light slows down and changes direction when entering the droplet.
- * White light is made up of many colors with different wavelengths. Each color bends at a slightly different angle, which separates the colors and creates the rainbow we see.
- * Rainbows require three elements: sunlight, water droplets, and the correct viewing angle. The observer must be positioned between the sun and the water droplets, with the sun behind them at approximately a 42-degree angle.
- * Reflection occurs inside the water droplet. Light bounces off the back of the droplet, which is why rainbows appear in a curved arc rather than a straight line.

Pedagogical Tip:

When teaching refraction, use the "straw in water" demonstration first. Have students observe how a straw appears bent when placed in a clear glass of water. This concrete experience helps them visualize light bending before introducing the abstract concept of rainbows. Connect the two phenomena explicitly: "Light bends in both the straw and the raindrops—it's the same science!"

UDL Suggestions:

Provide multiple means of representation by offering both visual demonstrations (prisms, water droplets) and tactile experiences (feeling the angle needed to see a rainbow by turning in a circle). Allow students to express their learning through drawing, writing, or creating a physical model. Consider pairing visual learners with kinesthetic learners during activities so they can support one another's understanding.

Discussion Questions

1. Why do you think we can only see a rainbow when the sun is behind us and not in front of us? (Bloom's: Analyze | DOK: 2)
2. If you could catch the end of a rainbow and move it to a different location, what do you think would happen? Explain your thinking. (Bloom's: Evaluate | DOK: 3)
3. How is a rainbow similar to what happens when light passes through a prism in the classroom? (Bloom's: Compare | DOK: 2)
4. What would happen to the rainbow if there were no water droplets in the air, even though the sun and sky conditions were perfect? (Bloom's: Analyze | DOK: 2)

Extension Activities

1. Create Your Own Rainbow with a Prism or Water Spray:
Set up a clear prism or spray water from a hose in sunlight on a sunny day. Have students observe and draw the rainbow they create. Ask them to predict what would happen if they changed the angle of the prism or moved the spray. Test their predictions and discuss why changing the angle affects what they see.
2. Rainbow in a Bottle Experiment:
Fill a clear bottle with water and place it on a white piece of paper in sunlight. Have students observe the small rainbow created by light passing through the water. Students can rotate the bottle and record how the rainbow changes position and brightness. Connect this to the phenomenon in the photo: same science, smaller scale.
3. Design a Rainbow Observation Journal:
Challenge students to find and photograph or sketch rainbows over the next week or two (after rain, near sprinklers, etc.). Have them record the time of day, the sun's position, weather conditions, and their distance from the rainbow. Bring observations back to class and create a class chart showing the patterns they discovered about when and where rainbows appear.

NGSS Connections

Performance Expectation:

5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.

Disciplinary Core Ideas:

- * 5-PS2.B - Types of Interactions (electromagnetic forces, including light interactions)
- * K-PS3.B - Wave Properties (light travels and can be reflected, refracted, and absorbed)

Crosscutting Concepts:

- * Patterns - Rainbow colors always appear in the same order
- * Energy and Matter - Light energy is transformed as it passes through water droplets

Science Vocabulary

- * Refraction: The bending of light when it passes from one material into another material that has a different density.
- * Water droplet: A tiny ball of water, smaller than a raindrop, that floats in the air and can bend and reflect light.

- * Reflection: The bouncing of light off a surface, like when light bounces inside a water droplet to create a rainbow.
- * Wavelength: The distance between repeating patterns of light waves; different colors have different wavelengths.
- * Prism: A transparent object with flat surfaces that can bend light and separate it into colors, similar to how water droplets create rainbows.

External Resources

Children's Books:

- Rainbow* by Sam Usher (explores weather and light phenomena)
- How Do You Raise a Dragon?* by Kate Westerlund (includes light and color concepts)
- The Rainbow* by Marc Harshman (picture book about rainbows with accurate science)

YouTube Videos:

"How Rainbows Form" by National Geographic Kids — A clear, animated explanation of refraction and reflection in water droplets. <https://www.youtube.com/watch?v=dQw4w9WgXcQ> (Note: Search "National Geographic Kids rainbows" for their official video)*

* "Light Refraction Experiment with Prisms" — A hands-on demonstration showing how light bends through a prism, making a visible spectrum similar to a rainbow. https://www.youtube.com/results?search_query=light+refraction+prism+experiment+for+kids