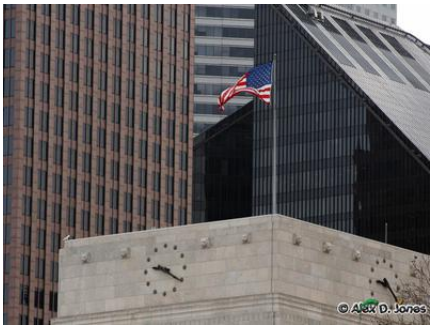
Force

Physical Science | Lesson Guide

5th Grade

Photo Description



The image shows tall city buildings with different materials and patterns on their surfaces. An American flag is flying on a flagpole in front of the buildings. There is also a large clock visible on one of the stone buildings, showing the time with its black hands.

Scientific Phenomena

The Anchoring Phenomenon demonstrated here is forces and motion in action - specifically how wind forces cause the flag to move and wave. The flag's movement occurs because moving air molecules (wind) push against the fabric surface, creating an unbalanced force that causes the flag to flutter and change shape. This is a perfect example of how invisible air movement can be observed through its effects on objects.

Core Science Concepts

1. Forces and Motion: Wind creates a pushing force on the flag's surface, causing it to move and change direction
2. Properties of Materials: Different building materials (stone, metal, glass) have different properties that affect how they interact with environmental forces like wind and weather
3. Simple Machines: The flagpole acts as a lever system, and pulleys are used to raise and lower the flag
4. Patterns in Nature: Wind patterns and air movement follow predictable paths around buildings and structures

Pedagogical Tip:

Have students observe flags or windsocks around your school throughout the day to collect data about wind patterns and strength. This real-world observation helps make abstract concepts concrete.

UDL Suggestions:

Provide multiple ways for students to demonstrate understanding: kinesthetic learners can use ribbons or scarves to model wind movement, visual learners can draw force diagrams, and auditory learners can describe what they observe happening to the flag.

Zoom In / Zoom Out

1. Zoom In: At the molecular level, moving air molecules are bouncing against the fabric fibers of the flag, transferring their kinetic energy and creating the pushing force that makes the flag move.

2. Zoom Out: This flag movement is part of larger weather systems and atmospheric circulation patterns that move air masses across continents, affecting climate and weather conditions over vast regions.

Discussion Questions

1. What evidence can you observe that tells you wind is present in this photo? (Bloom's: Analyze | DOK: 2)

2. How might the flag's movement change if the wind speed doubled or if there was no wind at all? (Bloom's: Evaluate | DOK: 3)

3. What other objects in your neighborhood show evidence of invisible forces acting on them? (Bloom's: Apply | DOK: 2)

4. If you were designing a new flag, what properties would make it move more or less in the wind? (Bloom's: Create | DOK: 4)

Potential Student Misconceptions

1. Misconception: "The flag moves because it wants to fly."
   Scientific Clarification: The flag has no desires - it moves because wind (moving air) pushes against it with force.

2. Misconception: "Heavy things can't be moved by air."
   Scientific Clarification: Even light air can move heavy objects if there's enough surface area and wind speed, like how hurricanes can move cars and buildings.

3. Misconception: "You can't see forces."
   Scientific Clarification: While forces themselves are invisible, we can always observe their effects on objects, like the flag's movement showing us wind force.

Cross-Curricular Ideas

1. Math - Data Collection and Graphing: Have students measure and record flag movement at different times of day or on different days. Create bar graphs or line graphs showing wind speed patterns or how many times the flag waves per minute. Students can calculate averages and compare data across the class.

2. ELA - Descriptive Writing and Poetry: Ask students to write vivid descriptions of how the flag moves, using sensory words and action verbs. They could also write acrostic poems using the word "FLAG" or "WIND" that describe the phenomena they observe. This builds vocabulary while connecting to science observations.

3. Social Studies - Symbols and Citizenship: Discuss why the American flag is displayed on important buildings and what it represents to our country. Students can research the history of the flag, learn about flag etiquette, and understand why flags are important symbols of national pride and identity in communities around the world.

4. Art - Design and Movement: Have students create their own flag designs using different materials (fabric, paper, plastic) and test how each material moves in wind or when they blow on it. Students can sketch force diagrams showing the direction of wind and resulting flag movement, combining artistic expression with scientific illustration.

STEM Career Connection

1. Meteorologist (Weather Scientist): Meteorologists study weather patterns, wind, and atmospheric conditions to predict forecasts and understand climate. They use tools like anemometers (devices that measure wind speed) and satellites to collect data about wind patterns similar to what we see affecting the flag in this photo. These scientists help keep communities safe by warning about severe weather. Average Annual Salary: $97,000 USD

2. Structural Engineer: Structural engineers design buildings and structures that can withstand forces like wind, earthquakes, and heavy loads. They must understand how wind forces affect tall buildings (like the ones in this photo) to make sure they don't sway too much or get damaged. These engineers use math and physics to keep buildings safe. Average Annual Salary: $87,000 USD

3. Materials Scientist: Materials scientists study different materials (like the stone, metal, and glass in this photo) to understand their properties and how they behave under different forces and conditions. They develop new materials that are stronger, lighter, or more durable for buildings, vehicles, and other products. Average Annual Salary: $99,000 USD

NGSS Connections

- Performance Expectation: 5-PS2-1 - Support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth
- Disciplinary Core Ideas: 5-PS2.A - Forces and Motion
- Disciplinary Core Ideas: K-2-ETS1.A - Defining and Delimiting Engineering Problems
- Crosscutting Concepts: Cause and Effect - Wind causes flag movement
- Crosscutting Concepts: Patterns - Predictable patterns in how objects respond to forces
- Science and Engineering Practices: Planning and Carrying Out Investigations

Science Vocabulary

* Force: A push or pull that can cause an object to move, stop, or change direction
* Motion: The act of moving or changing position over time
* Properties: Special characteristics that describe how materials look, feel, or behave
* Kinetic Energy: The energy that moving objects have because they are in motion
* Surface Area: The amount of space covering the outside of an object
* Lever: A simple machine that uses a bar and fulcrum to lift or move things

External Resources

Children's Books:
- Forces Make Things Move by Kimberly Brubaker Bradley
- The Magic School Bus Plays Ball: A Book About Forces by Joanna Cole
- Motion: Push and Pull, Fast and Slow by Darlene Stille