Conductor

Physical Science | Lesson Guide

5th Grade

Photo Description

A student is creating a simple electric circuit using a battery, wires, and a small light bulb. The light bulb is glowing, showing that electricity is flowing through the complete circuit path. This demonstrates how electrical energy can be converted into light energy when all parts of the circuit are properly connected.

Scientific Phenomena

The Anchoring Phenomenon is electrical conductivity and energy transfer in a complete circuit. When the circuit is closed (forming a complete loop), electrons flow from the negative terminal of the battery through the wires to the light bulb, then back to the positive terminal. This flow of electrons (electric current) provides energy that the light bulb converts into both light and heat energy. The phenomenon demonstrates energy transformation and the requirement for a complete pathway for electrical current to flow.

Core Science Concepts

1. Electric Circuits: A complete pathway that allows electric current to flow from a power source (battery) through conductors (wires) and back to the source.

2. Electrical Conductivity: Materials like copper wire allow electricity to flow through them easily, while materials like rubber or plastic resist electrical flow.

3. Energy Transformation: Electrical energy from the battery is converted into light energy and heat energy in the light bulb filament.

4. Complete vs. Incomplete Circuits: Electricity only flows when there is an unbroken path; any gap or break stops the current flow.

Pedagogical Tip:

Have students physically trace the path of electricity with their finger around the circuit to reinforce the concept that current needs a complete loop to flow.

UDL Suggestions:

Provide tactile circuit boards with raised wires and textured components for students with visual impairments, and use color-coded wires to help students with different learning preferences track the electrical pathway.

Zoom In / Zoom Out

1. Zoom In: At the atomic level, electrons are moving through the metal wire conductor. These tiny charged particles jump from atom to atom, creating the electrical current that powers the light bulb.

2. Zoom Out: This simple circuit represents the same principles used in our homes' electrical systems, power grids, and electronic devices. The electrical energy may originate from power plants that convert other forms of energy (coal, wind, solar) into electricity that travels through power lines to our communities.

Discussion Questions

1. What do you think would happen if we removed one of the wires from this circuit? (Bloom's: Predict | DOK: 2)

2. Why do you think the light bulb glows when connected to the battery but not when sitting by itself? (Bloom's: Analyze | DOK: 3)

3. How is this simple circuit similar to turning on a light switch in your house? (Bloom's: Compare | DOK: 2)

4. What other materials could we test to see if they conduct electricity like the copper wire does? (Bloom's: Apply | DOK: 2)

Potential Student Misconceptions

1. Misconception: "Electricity gets used up as it flows through the circuit."
   Clarification: Electric current flows in a complete loop. The same amount of current that leaves the battery returns to it; what gets "used up" is the battery's stored chemical energy.

2. Misconception: "Electricity only flows in one direction from the battery."
   Clarification: In this DC circuit, electrons actually flow from negative to positive terminal, but conventional current is described as flowing from positive to negative.

3. Misconception: "The light bulb creates electricity."
   Clarification: The light bulb converts electrical energy into light and heat energy; it doesn't generate electricity.

Cross-Curricular Ideas

1. Math - Measuring & Data: Students can measure the brightness of the light bulb using a light meter or by counting how many objects they can see illuminated by the bulb at different distances. They can create a graph showing how brightness changes with distance from the light source, practicing measurement and data visualization skills.

2. ELA - Procedural Writing: Have students write step-by-step instructions for building a simple circuit, using clear sequence words (first, next, then, finally). This reinforces both scientific understanding and technical writing skills while creating a resource other students can follow.

3. Social Studies - History of Innovation: Research the history of the light bulb and Thomas Edison's contributions to electrical technology. Students can create a timeline showing how electricity changed people's daily lives and communities, connecting scientific discovery to social and historical impact.

4. Art - Design & Engineering: Challenge students to design and decorate a "circuit board" using craft materials, or create artistic drawings that show the invisible flow of electricity through wires using colored pencils, glitter, or glow-in-the-dark materials to represent electrical energy.

STEM Career Connection

1. Electrical Engineer: Electrical engineers design, build, and test electrical equipment and systems. They might create circuits for everything from smartphones to power plants. They solve problems using electricity to make machines and devices work safely and efficiently. Average Salary: $104,000 USD/year

2. Electrician: Electricians install, maintain, and repair electrical wiring and equipment in homes, schools, and buildings. They make sure that circuits work safely and that electricity reaches every room where it's needed. Average Salary: $56,000 USD/year

3. Electronics Technician: Electronics technicians build and repair small electronic devices like computers, tablets, and gaming systems. They test circuits to find problems and fix them, making sure all the tiny electrical parts work together correctly. Average Salary: $61,000 USD/year

NGSS Connections

- Performance Expectation: 5-PS1-3 Make observations and measurements to identify materials based on their properties
- Disciplinary Core Ideas: 5-PS1.A - Structure and Properties of Matter, 4-PS3.A - Definitions of Energy, 4-PS3.B - Conservation of Energy and Energy Transfer
- Crosscutting Concepts: Energy and Matter, Cause and Effect

Science Vocabulary

* Circuit: A complete path that allows electricity to flow from a power source and back again
* Conductor: A material that allows electricity to flow through it easily, like copper wire
* Current: The flow of electric charge through a conductor
* Energy transformation: The process of changing one form of energy into another form
* Insulator: A material that does not allow electricity to flow through it easily
* Terminal: The positive or negative connection points on a battery

External Resources

Children's Books:
- Switch On, Switch Off by Melvin Berger
- The Magic School Bus and the Electric Field Trip by Joanna Cole
- Oscar and the Bird: A Book About Electricity by Geoff Waring