Solar Panels

Physical Science | Lesson Guide

4th Grade

Photo Description

This photo shows solar panels installed on a rooftop in a neighborhood overlooking a city skyline. Solar panels are flat, rectangular devices covered with shiny blue squares that catch sunlight. The panels are arranged in rows on the dark roof and are designed to turn the sun's energy into electricity that people can use in their homes and buildings.

Scientific Phenomena

Anchoring Phenomenon: Solar panels converting sunlight into usable electrical energy.

Why This Happens:

Solar panels work because of a special property of light and materials. Inside each shiny blue square on a solar panel are tiny particles called electrons. When sunlight hits these particles, it gives them energy and makes them move. This movement of electrons IS electricity! The solar panel captures this moving energy and sends it through wires to power lights, refrigerators, and other devices in buildings. This process is called the photovoltaic effect—photo means "light" and voltaic means "electricity." Essentially, the sun's light energy is being transformed into electrical energy that we can use.

Core Science Concepts

1. Energy Transfer and Transformation: Solar panels demonstrate how energy from the sun (light energy) can be changed into another form of energy (electrical energy) that people use every day.

2. Properties of Materials: Different materials respond to sunlight differently. The special semiconductor materials in solar panels (like silicon) absorb light and release electrons, while other materials do not have this property.

3. Energy Sources: The sun is a renewable energy source, meaning it will continue to provide energy for billions of years. Solar panels are one way humans capture and use this clean energy instead of burning fossil fuels.

4. Systems and Efficiency: Solar panels are part of a larger energy system that includes wiring, inverters (devices that convert DC to AC electricity), and electrical grids that deliver power to homes and businesses.

Pedagogical Tip:

When introducing solar panels to Fourth Graders, use the analogy: "The sun is like a giant battery in the sky, and solar panels are like special catchers that grab the sun's energy and turn it into electricity we can use." This concrete metaphor helps students understand energy transformation without requiring knowledge of electrons or atoms yet.

UDL Suggestions:

Representation: Provide both visual aids (diagrams showing light !’ electricity) and tactile experiences (letting students feel how solar panel surfaces are warm from sunlight).

Action & Expression: Allow students to demonstrate understanding through multiple formats—drawing energy flow diagrams, building simple circuits with LED lights powered by small solar cells, or creating a photo essay about solar energy in their community.

Engagement: Connect solar panels to student interests by discussing how solar power charges devices they use (solar calculators, solar-powered toys, solar lights in gardens).

Zoom In / Zoom Out

Zoom In: The Atomic Level

At a microscopic level, inside each solar cell are billions of atoms made of silicon. When a photon (a particle of light) hits an electron in a silicon atom, it transfers energy to that electron, causing it to break free from its atom. Free electrons flow through the material as electric current—this is what powers devices. This happens continuously as long as sunlight keeps hitting the panel.

Zoom Out: The Energy System and Planet

Solar panels are part of Earth's energy cycle and climate system. By using solar energy instead of fossil fuels, we reduce the amount of carbon dioxide released into the atmosphere, helping address climate change. On a global scale, if more buildings used solar panels, we could generate clean electricity for billions of people while protecting our planet's atmosphere and natural resources.

Discussion Questions

1. "How do you think the electricity made by solar panels gets into your house to power your lights and appliances?" (Bloom's: Understand | DOK: 1)

2. "Why might a city want to install solar panels on many of its buildings, as shown in this photo?" (Bloom's: Analyze | DOK: 2)

3. "If we covered the solar panel with a thick blanket so no sunlight could reach it, what do you predict would happen to the electricity it produces, and why?" (Bloom's: Predict/Hypothesize | DOK: 2)

4. "Compare using solar panels to make electricity with burning coal to make electricity. What are the advantages and disadvantages of each?" (Bloom's: Evaluate | DOK: 3)

Potential Student Misconceptions

1. Misconception: "Solar panels need to be plugged into an outlet to work, just like other electrical devices."
   - Clarification: Solar panels actually CREATE electricity from sunlight—they don't need electricity from an outlet. Instead, they PRODUCE the electricity that gets used by the outlets and devices in a building.

2. Misconception: "Solar panels only work on sunny days and not at all on cloudy days."
   - Clarification: While solar panels work best in direct sunlight, they still produce some electricity on cloudy days because light still reaches them, just in smaller amounts. It's similar to how you can still see outside on a cloudy day, even though it's dimmer than on a sunny day.

3. Misconception: "Solar panels get hot because the electricity they make is hot."
   - Clarification: Solar panels get warm because the sunlight hitting them transfers heat energy to the panel material, not because the electricity they produce is hot. The heat is a byproduct; the electricity is what we want to capture and use.

Extension Activities

1. Build a Solar Oven: Students construct a simple solar oven using a pizza box, aluminum foil, and plastic wrap to cook s'mores or melt chocolate using only the sun's energy. This hands-on experience demonstrates how the sun's energy can be captured and used in different ways besides electricity. Students observe, measure, and record the temperature changes over time.

2. Design a Solar-Powered Neighborhood: Provide students with a large sheet of paper showing a simplified neighborhood layout (houses, school, park, store). Challenge them to draw and label where they would place solar panels on buildings, considering which surfaces get the most sunlight. Have students present their designs and explain their reasoning, discussing factors like building orientation, shade from trees, and roof size.

3. Solar Panel Efficiency Experiment: Students place small solar cells in different positions and orientations (facing the sun directly, at angles, partially shaded) and measure the voltage produced by each using a multimeter. They graph their results and discover that angle and shadow affect how much electricity a solar panel produces, connecting to real-world efficiency considerations.

Cross-Curricular Ideas

1. Mathematics: Calculate the number of solar panels needed to power a school building by researching average electricity usage (in kilowatt-hours) and solar panel output capacity. Students practice multiplication, division, and data interpretation while solving a real-world energy problem.

2. English Language Arts: Read age-appropriate books about renewable energy and write persuasive letters to local government officials explaining why the community should invest in solar energy. Students practice informative writing, research skills, and civic engagement.

3. Social Studies: Research how different countries and communities around the world use solar energy. Create a map showing which regions have the most solar panels or strongest solar energy programs. Discuss how geography (latitude, climate, sunshine hours) affects a region's ability to use solar power.

4. Art: Design and create a colorful poster campaign promoting solar energy and renewable power to the school community. Students incorporate scientific facts about solar energy while developing artistic and communication skills, potentially displaying work around the school.

STEM Career Connection

1. Solar Panel Installer: These workers put solar panels on roofs and buildings. They measure the roof, plan where panels should go, and install them safely. They make sure everything is connected correctly so the panels can send electricity to the building. They also do maintenance to keep panels working well. Average Annual Salary: $48,000–$58,000 USD

2. Solar Energy Engineer: These engineers design solar panel systems for homes, schools, and businesses. They figure out how many panels are needed, the best way to position them, and how to connect them to buildings. They use math and science to make solar systems work efficiently. Average Annual Salary: $65,000–$85,000 USD

3. Electrical Technician (Renewable Energy): These technicians test and repair solar panels and the equipment that converts solar energy into usable electricity. They use special tools to check if panels are working properly and fix any problems. Average Annual Salary: $55,000–$70,000 USD

NGSS Connections

Performance Expectation:
4-PS3-2: Make observations to provide evidence that energy can be transferred by sound, light, heat, and electric currents.

Disciplinary Core Ideas:
- 4-PS3.A Energy can be moved from place to place by sound, light, heat, and electric currents
- 4-PS3.B Energy can be converted from one form to another

Crosscutting Concepts:
- Energy and Matter Energy is transferred and transformed in systems
- Systems and System Models Identifying parts of a system and how they interact helps us understand the whole

Science Vocabulary

* Solar Panel: A flat device covered with special material that catches sunlight and turns it into electricity.

* Energy: The power to make things move, heat up, or light up; energy comes in different forms like light, heat, and electricity.

* Renewable Energy: Energy that comes from sources that will not run out, like the sun, wind, or water.

* Electricity: A form of energy that moves through wires to power lights, appliances, and devices in buildings.

* Photovoltaic: A fancy word that means "light-electricity"—it describes how solar panels turn light energy from the sun into electrical energy.

* Inverter: A device that changes the type of electricity that solar panels make into the type of electricity that homes and buildings can use.

External Resources

Children's Books:

The Sun is Up: A Story About Energy* by Jan Lööf – An engaging picture book that explains how the sun provides energy for life and can be used to power technology.

Me and My Amazing Body* by Joan Sweeney – While not exclusively about solar energy, this book helps students understand energy systems in nature and can be paired with solar panel lessons.

Renewable Energy: Power for Today and Tomorrow* by Niki Walker – A non-fiction book that introduces Fourth Graders to various renewable energy sources, including solar power, with clear illustrations and age-appropriate explanations.