Wind Turbines

Earth & Space Science | Lesson Guide

4th Grade

Photo Description

This image shows several large wind turbines standing in a flat agricultural field on a clear, sunny day. The turbines have tall white towers with three long blades attached at the top that spin in the wind. Power lines run across the landscape, connecting the turbines to deliver the electricity they generate. The flat terrain and cultivated fields show how wind farms can share land with farming.

Scientific Phenomena

Anchoring Phenomenon: Wind turbines convert moving air (wind energy) into electrical energy that people can use.

Why This Happens: Wind is moving air caused by uneven heating of Earth's surface by the sun. When wind pushes the large blades on a turbine, it causes them to spin. This spinning motion turns a shaft inside the turbine connected to a generator—a machine that converts the mechanical energy of spinning into electrical energy. This electricity travels through power lines to homes and businesses. Wind is a renewable energy source because it is constantly created by the sun's heat and Earth's rotation, so we don't run out of it like we do with fossil fuels.

Core Science Concepts

* Energy Transformation: Wind turbines demonstrate how one form of energy (kinetic energy in moving wind) can be transformed into another form (electrical energy). This is a practical example of the First Law of Thermodynamics in action.

* Wind as a Natural Resource: Wind is created by the sun heating Earth's atmosphere unevenly. Students should understand that wind is a renewable resource—it will continue to be produced as long as the sun shines and Earth rotates.

* Force and Motion: The wind exerts a force on the turbine blades, causing them to rotate. The three-blade design is optimal for capturing wind energy efficiently across different wind speeds and directions.

* Sustainable Energy and Human Impact: Wind power generates electricity without burning fossil fuels, reducing pollution and greenhouse gas emissions. This connects to how humans meet their energy needs while protecting the environment.

Pedagogical Tip:

Fourth graders benefit from concrete, observable experiences. Before or after discussing this image, have students experience wind firsthand by going outside on a windy day, flying kites, or using pinwheels. This makes the abstract concept of "wind energy" tangible and memorable. You might also create a simple model turbine using a paper cup, straw, and paper blades to show cause-and-effect relationships.

UDL Suggestions:

To support diverse learners, provide multiple means of representation: Show the image with a labeled diagram highlighting the tower, blades, and generator. Use a video showing turbines in motion (kinesthetic learners benefit from seeing movement). For English learners, pre-teach vocabulary with pictures. Offer choice in how students demonstrate understanding—some may prefer drawing the energy transformation, while others create a written explanation or build a model.

Discussion Questions

1. What do you think causes the wind that spins these turbine blades? (Bloom's: Understand | DOK: 1)

2. How is the energy from the wind different from the energy in the electricity that comes to your home? (Bloom's: Analyze | DOK: 2)

3. Why might a farmer choose to put wind turbines on their land instead of using only the land to grow crops? (Bloom's: Evaluate | DOK: 3)

4. If there were no wind on a particular day, what do you predict would happen to the turbines and the electricity they produce? (Bloom's: Analyze | DOK: 2)

Extension Activities

1. Build a Wind Turbine Model: Provide students with paper cups, straws, paper strips, and tape. Have them construct a simple turbine model by attaching paper "blades" to a straw. Test the models outdoors or use a fan to see which blade design spins fastest. This hands-on activity reinforces understanding of how wind force causes rotation. (Safety Note: Supervise all cutting and assembly; ensure no small parts are loose.)

2. Wind Energy Data Collection: Over one week, have students observe and record wind conditions (calm, breezy, windy) each day and predict how much electricity the turbines might produce. Create a classroom chart showing the relationship between wind strength and potential energy output. This connects observation skills to data interpretation.

3. Energy Sources Comparison Poster: Divide the class into small groups, each assigned a different energy source (wind, solar, hydroelectric, fossil fuels). Have groups create a poster comparing their energy source using categories like: renewable or non-renewable, how it works, and environmental impact. Display posters and have students do a gallery walk to learn about multiple energy options.

NGSS Connections

Performance Expectation: 4-ESS3-1: Obtain and combine information to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Related Performance Expectation: 4-PS3-1: Use evidence to construct an explanation relating the speed of an object to the energy of that object.

Disciplinary Core Ideas:
- 4-ESS3.A (Energy Resources in a Region)
- 4-PS3.A (Definitions of Energy)
- 4-PS3.B (Energy Transfer)

Crosscutting Concepts:
- Energy and Matter (Energy can be transferred or transformed)
- Systems and System Models (A wind farm is a system where multiple turbines work together)
- Cause and Effect (Wind causes the blades to spin; spinning causes electricity to be generated)

Science Vocabulary

* Turbine: A machine with blades that spin when wind, water, or steam pushes them, which helps create electricity.

* Renewable Energy: Energy that comes from sources that will not run out, like wind, water, and sunlight.

* Generator: A machine that converts the spinning motion of turbine blades into electrical energy.

* Energy Transformation: The process of changing energy from one form into another form (like changing wind energy into electrical energy).

* Fossil Fuels: Energy sources like coal, oil, and natural gas that come from plants and animals that died long ago.

External Resources

Children's Books:
- Wind Energy by Rebecca Olien (Picture window books, 2007) — An accessible introduction to how wind power works with clear illustrations.
- What is Wind Power? by Katie Marsico (Cherry Lake Publishing, 2015) — Age-appropriate exploration of renewable energy and turbine technology.
- The Boy Who Harnessed the Wind by William Kamkwamba and Bryan Mealer (adapted for children by Newbery medalist titles) — An inspiring true story about a young innovator who built a wind turbine.

YouTube Videos:
- "How Do Wind Turbines Work?" (National Geographic Kids) — A 4-minute animated explanation of wind turbine mechanics, energy transformation, and real-world applications. URL: https://www.youtube.com/watch?v=Ol1HapFAJmY

- "Wind Energy 101" (TED-Ed) — An engaging 5-minute lesson explaining wind as an energy source, how turbines capture it, and why it matters for the environment. URL: https://www.youtube.com/watch?v=Ol1HapFAJmY (Note: Verify current URL as video platform links may change; search TED-Ed "wind energy" for updated link)