ENERGY ALTERNATIVES: THE COOL FUEL ROADTRIP
Water and Wind Power
Teacher's Guide

Grade Level: 6–12 **Curriculum Focus:** Science **Running Time:** 23 minutes

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Program Description

You don't need big rivers or massive waterfalls to create hydropower; energy can be generated from small streams. That's just what Shaun Murphy and the Cool Fuel Crew are looking for as they try to travel 250 miles through Colorado fueled by micro-hydropower. Then Shaun tries to catch the wind with turbine power for a journey along Route 66 in New Mexico.

Learning Objectives

After viewing the program and participating in discussion, students will be able to:

- Explain how water energy is converted into electricity;
- Consider how wind energy is a result of solar energy;
- Identify the economic benefits of alternative fuel production;
- Note the environmental advantages of using water and wind energy;
- Utilize energy-saving techniques in their everyday lives.

Classroom Connections

How can flowing water produce electricity? Is a large waterfall necessary to produce power?

What is the minimum wind speed needed to generate electricity?

Explain how wind energy is a result of solar energy. How else does the sun impact Earth's weather?

What is a thermal? How does this relate to the forces that create wind?

How many different vehicles does Shaun use while in New Mexico?

How do the owners of water and wind generators benefit economically from producing electricity?

Classroom Activities

Investigate Egypt's Aswan High Dam to uncover the benefits and drawbacks of damming a river for hydropower. Using the school library and trusted Internet sources, have students research the economic, environmental, and social impacts the dam has had on Egypt. Direct students to these Web sites as a starting point:
http://www-ocean.tamu.edu/Quarterdeck/QD3.1/Elsayed/elsayed.html
http://www.mbarron.net/Nile/envir_nf.html
http://sitemaker.umich.edu/sec004_gp5/home
Working in groups, students should write a brief report on their research and complete a poster illustrating before and after pictures of the area surrounding the dam.

Have students estimate their daily energy consumption to determine how much power they require. Ask students to list the electrical appliances they use, the number of hours per day they use the appliances (see chart on page five), and the rate at which the items use electricity in watts. To determine an appliance's energy use, multiply the appliance's wattage by the number of hours used per day and divide the product by 1,000. This figure is the item's estimated daily kilowatt-hour (kWh) consumption. Add up all of the results to find out how much power each student uses daily. After completing the activity, students should answer the following questions:
-Were you surprised by how much energy you use? Was the number higher or lower than you expected?
-Given that one photovoltaic module (panel) in Phoenix, Arizona, will produce an average of 0.8 kWh a day during the summer months, how many panels would you need to cover your energy use?
-How can you reduce your energy consumption? Are there any appliances you don't need to use on a daily basis?

Demonstrate how wind power turns kinetic energy into mechanical energy by having students build and test wind turbines. Working in groups of three or four, students will research turbine designs on the Internet and choose the best design that can be constructed out of simple materials (small DC motor, cardboard, push pins, wire, etc.). Groups will build their design with an accompanying written explanation of their design's prominent features. Provide groups with an electric fan and an anemometer to determine which turbine produces the fastest wind speed. After completing the activity, ask students the following questions:
-Could wind harvesting work in every community? Explain your answer.
-Based on what you learned from the program and in this exercise, do you think wind power could replace fossil fuels as the world's main source for electricity?

Target Vocabulary*

biodiesel - a fuel that is similar to diesel fuel and is derived from usually vegetable sources (as soybean oil)

combustion - an act or instance of burning

generator - a machine by which mechanical energy is changed into electrical energy

hydroelectric - of or relating to production of electricity by waterpower (constructed a *hydroelectric* power plant at the dam site)

organic - of, relating to, yielding, or involving the use of food produced with the use of feed or fertilizer of plant or animal origin without employment of chemically formulated fertilizers, growth stimulants, antibiotics, or pesticides (*organic* farming) (*organic* produce)

thermal - a rising body of warm air

turbine - a rotary engine actuated by the reaction or impulse or both of a current of fluid (as water, steam, or air) subject to pressure and usually made with a series of curved vanes on a central rotating spindle

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Academic Standards

National Academy of Sciences

The National Academy of Sciences provides guidelines for teaching science in grades K–12 to promote scientific literacy. To view the standards, visit this Web site: http://books.nap.edu/html/nses/html/overview.html#content.

This guide addresses the following standards:

- Physical Science: Chemical reactions
- Physical Science: Transfer of energy
- Science in Personal and Social Perspectives: Natural resources
- Science in Personal and Social Perspectives: Science and technology in local, national, and global challenges

AAAS Benchmarks

Benchmarks for science literacy, developed by the American Association for the Advancement of Science (AAAS), state what all students should know and be able to do in science, mathematics, and technology by the end of grades 2, 5, 8, and 12.

Appendix A: Typical Wattages of Various Appliances*

Aquarium = 50–1210 Watts
Clock radio = 10
Coffee maker = 900–1200

Clothes washer = 350–500
Clothes dryer = 1800–5000
Dishwasher = 1200–2400 (using the drying feature greatly increases energy consumption)
Dehumidifier = 785
Electric blanket- Single/Double = 60 / 100
Fans
    Ceiling = 65–175
    Window = 55–250
Furnace = 750
Whole house = 240–750
Hair dryer = 1200–1875
Heater (portable) = 750–1500
Clothes iron = 1000–1800
Microwave oven = 750–1100
Personal computer
    CPU - awake / asleep = 120 / 30 or less
    Monitor - awake / asleep = 150 / 30 or less
    Laptop = 50
Radio (stereo) = 70–400
Refrigerator (frost-free, 16 cubic feet) = 725
Televisions (color)
    19" = 65–110
    27" = 113
    36" = 133
    53"-61"
    Projection = 170
    Flat screen = 120
Toaster = 800–1400
Toaster oven = 1225
VCR/DVD = 17–21 / 20–25
Vacuum cleaner = 1000–1440
Water heater (40 gallon) = 4500–5500
Water pump (deep well) = 250–1100
Water bed (with heater, no cover) = 120–380

*Source: U.S. Department of Energy