Renew Our Future

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Teachers' Guide 2002

Dear Teacher,

Most students (and adults) do not know where their energy comes from – or how fundamental it is to everything we do. The energy that powers our lights or heats our homes may come from coal, natural gas, nuclear energy, water, the wind, or the sun. Several types of energy were used to prepare and deliver this publication.

Our energy use harms the environment and human health. The extraction, conversion and use of energy is the largest cause of air pollution. In addition, it is the source of most of the emissions that cause global warming.

This teachers' guide offers an overview of emerging energy solutions and suggests teaching activities to help bring energy issues alive for your students. Students will learn about how their energy choices affect the environment, and how clean, renewable energy is finding its place in the world today.

— Earth Day Network

Wind energy is the world's fastest growing energy source.

WHERE DO WE GET OUR ENERGY?

Nonrenewable energy sources either are unable to be replaced naturally, or would take millions of years for natural processes to replace.

FOSSIL FUELS provide most of the energy to power electricity, cars, and industry. Fossil fuels began as plants or animals. Over millions of years, their buried remains were transformed into coal, petroleum and natural gas. These fuels take millions of years to create, and they are becoming more difficult to find and extract. When these substances are burned to generate energy, they create pollution and release carbon dioxide, the most significant contributor to global warming, into the atmosphere.[1]

NUCLEAR ENERGY is produced by the splitting of radioactive uranium atoms. Although it is not a source of global warming pollution, using this type of energy has other environmental consequences. Along with the risk of accidents, radioactive wastes are dangerous to all life for tens of thousands of years. There is no safe way to dispose of them.

Renewable energy sources are replaced naturally. There is not a fixed supply that can eventually be used up.

SOLAR ENERGY is the most inexhaustible source of energy known to humankind, with an expected life span of at least 5 billion years.[2] Enough clean, renewable solar energy falls from the sky in a day to power the world for 27 years.[3] When the sun is shining, solar cells produce electricity. The energy from sunlight, which is intermittent, can be stored in batteries, as hydrogen, or in many other ways.

There are two main ways to harness solar energy:

- *Direct conversion to electricity*, known as photovoltaics, which most students have seen as solar cells on calculators, solar walkway lights, or pictures of the space station or space shuttle.
- *Thermal conversion to heat or electricity*. Sunlight can be used to heat water and buildings, create steam to turn electric generators, or power industrial processes.

Other technologies use the sun to provide natural lighting. Passive solar architecture uses building design and materials to keep buildings warmer in winter and cooler in summer.

WIND ENERGY produces electricity by turning blades on a wind turbine, similar to a windmill. It is particularly useful in places with strong, frequent winds. Wind energy can be stored in batteries for later use. It is an ecologically sound alternative because it doesn't produce waste. Although wind power facilities can be dangerous to raptors (such as hawks), careful siting away from flight pathways and improvements in wind turbine design have substantially reduced the impact on birds.

Panels of solar cells transform the sun's radiant energy into electricity.

GEOTHERMAL ENERGY comes from the heat inside the Earth that causes hot springs, geysers, and volcanoes. This natural heat can be captured and used to produce electricity. Geothermal energy is already used in places such as New Zealand, Iceland, and the United States to warm buildings and generate electricity.

BIOMASS ENERGY is produced from energy crops or from waste materials. Heat, electricity, and transportation fuels can be made from plant materials and wastes such as agricultural residues, forest underbrush, and organic human wastes. While wood is still the most widely used source of biomass fuel worldwide (especially in developing countries), other sustainable biomass sources are being developed. Methane gas from landfills produces electricity, corn is converted to alcohol fuels for cars, and certain vegetable oils can substitute for diesel fuel.

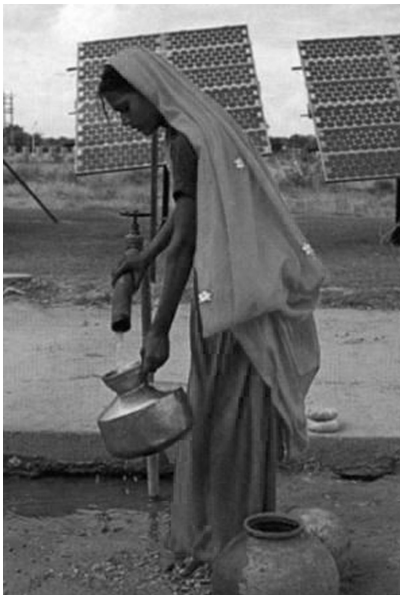
HYDROELECTRIC POWER harnesses the energy in flowing water to generate electricity. Hydropower production can cause environmental harm by flooding habitat and blocking fish spawning. Increasingly, efforts are being made to obtain hydroelectric power in ways that are less damaging to freshwater habitats and fish.

BRING ENERGY INTO YOUR CLASSROOM

Try these investigative questions to help students understand more about energy and its role in their day-to-day lives. Several hands-on activities will help introduce your students to renewable energy and how it functions. For more information, or to locate free curriculum materials you can download from the web, see *Teacher Resources* on page 4.

Investigate

- What do you use energy for in your daily life?
- What was it like for earlier generations? How did they use energy to accomplish their daily activities?[4]
- What are the sources of energy used in our community?[5]
- What are some of the economic, social, and environmental issues involved in people's use of energy?
- What kinds of pollution arise from the use of what energy sources? How does this pollution affect people? How does it affect plants and animals?
- How does my country compare to the rest of the world in terms of energy consumed per person?[6]
- Where would wind or solar energy work well? Why?



solar panels near village well

Two billion people lack access to electricity. Solar energy can provide power to remote areas.

Classroom Activities

SOLAR

Box the Heat Up: Make a solar hot box to experiment with aspects of solar energy. Use different materials and colors to see how the temperature inside the box changes. Explore how solar energy functions and why it isn't always the best solution.
http://www.askeric.org/cgibin/printlessons.cgi/Virtual/Lessons/Science/Physical_Sciences/PHY0045.html

Baking in a Pizza Box: Make a solar oven from a pizza box—then cook up some s'mores or mini-pizzas! Measure how hot your oven can get from using the sun's energy.
http://www.solarnow.org/pizzabx.htm

WIND

Lifting Weights with Paper: It's amazing what wind energy can do. If you ask your students if paper can lift a weight, they'll all say NO. Prove them wrong, and show them how a windmill can convert kinetic energy into gravitational potential and lift the weight.
http://webpages.marshall.edu/~bady/RICK/wind.htm

HYDROPOWER

Hydro-What? Start with some paper cups and tinker toys, and end up with electricity. Okay, so you'll need some more materials, but by the end, students will have a small generator, and can see on their homemade galvanometer how water can generate electricity. Good for high school level.
http://www.ase.org/educators/lessons/hs/hydro.htm

Teacher Resources

These links will direct you to excellent information, resources, and curricula.

Alliance to Save Energy offers K-12 lesson plans on energy efficiency and renewable energy.
Contact: ASE, tel: (202) 857-0666, email: info@ase.org
http://ase.org/educators/lessons.htm

California Energy Commission's Energy Quest has kid-friendly information on renewable energy.
Contact: CEC, (916) 654-4058, email: renewable@energy.state.ca.us
http://www.energy.ca.gov/education/renewableroad/index.html*and* http://www.energy.ca.gov/education

Florida Solar Energy Center has free award-winning curricula for both middle school and high school students. Look for the solar energy slide show. *Contact:* FSEC, tel: (321) 638-1000, email: info@fsec.ucf.edu
http://www.fsec.ucf.edu/Ed/Teachers/index.htp

National Energy Education Development Project has a selection of informational books you can download, organized by age and subject. *Contact:* NEED, tel: (703) 257-1117, email: info@need.org
http://need.org/infobooks.htm *and* http://need.org/guides.htm

National Energy Foundation offers Energy Action and other resources. See especially the energy literature activity. *Contact:* NEF, tel: (801) 908-5800, email: info@nef1.org
http://www.nef1.org/ea/index.html

National Renewable Energy Laboratory offers a variety of grade-adaptable lessons and modules for K-12. *Contact:* NREL, tel: (303) 275-3000
http://www.nrel.gov/education/resource.html
http://www.nrel.gov/education

U.S. Department of Energy has several affiliate departments with helpful websites. At Energy Efficiency and Renewable Energy Network's website, you can request a free *Energy CD for Teachers* (or call 1-800-DOE-3732.)
Contact: DOE, tel: 1-800-342-5363, email: infoctr@eia.doe.gov
http://www.eren.doe.gov *and* http://www.eia.doe.gov/kids/renewable/renewable.html

Students prepare food using a solar cooker.

Sources

[1] For more information and statistics, see the U.S. Energy Information Agency's website, http://www.eia.doe.gov
[2] Melbourne Planetarium, "About the Sun," <http://www.museum.vic.gov.au/planetarium/solarsystem/sun.html>
[3] National Renewable Energy Laboratory, "Solar Energy," <http://www.nrel.gov/documents/solar_energy.html>
[4] See Solar Matters "Remember When?" Questionnaire, <http://www.fsec.ucf.edu/Ed/SM/CH6-SOLARME/REMEMBERWHENQUESTIONNAIRE_STUD.HTM>
[5] Environmental Defense, "Find out about YOUR electricity", <http://www.environmentaldefense.org/programs/Energy/green_power/x_calculator.html>
[6] See EcoWorld's "BTU per Capita" table: <http://www.ecoworld.com/People/Tables/BTU_Per_Cap_Rank_1995.cfm>

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