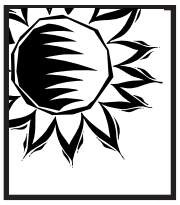
Classroom Adventures

TEACHER ENRICHMENT RESOURCE PACKET



Explorations in Energy

A *Classroom Adventure* for Grades 3–6

Learn about energy use and conservation through hands-on exploration. Experiment with different energy sources and how they can be converted into heat, light and motion.

what's inside

Think it.
Try it.
Explorit.

Sponsored by:

WELLS FARGO

Welcome

Thank you for choosing Explorit Science Center's *Classroom Adventures* to supplement your ongoing science curriculum. Whether you use the program to kick off a new unit, wrap up a nearly completed unit, or purely to excite and interest your students in the wonderful world of science, advance preparation and follow up with your students are critical to achieving the greatest educational benefit from this unique science experience.

Explorit provides two resources to help prepare you and your students for *Classroom Adventures*. First, simple logistics of the program are detailed in the confirmation letter. Second, this **Teacher Enrichment Resource Packet** outlines appropriate science content and processes to help you:

- successfully prepare your students prior to Explorit's visit;
- participate fully in *Classroom Adventure* yourself; and
- follow-up with your students after Explorit staff leave.

Learning Objectives

Learning objectives provide a broad overall guide to what students will begin to experience and understand through participation in Explorit's **Explorations in Energy** *Classroom Adventure* designed for Grades 3-6. During this program, students will:

- understand that energy can change forms and can be stored and moved, but cannot be created or destroyed.
- become familiar with many different forms of energy and know the difference between renewable and nonrenewable sources of energy.
- know some ways energy can be conserved in their homes and classrooms.
- be familiar with some new technologies and sources of energy.

Science Standards

Explorit's *Classroom Adventures* will help you help your students learn and enjoy science through a fun-filled experience that aligns closely with the requirements of the California Science Content Standards and the National Science Education Standards. For more information, please see page 8.

Our Mission:

To involve people in science experiences that touch our lives.

Background Information

WHAT IS ENERGY?

We use energy to power our homes, classrooms, computers, and cars. At the same time, energy fuels our bodies. We might even encourage our students to run around after lunch in order to burn off their excess energy. How is the energy that heats our homes and the energy that makes students fidget in their seats related?

Energy is the ability to do work. Work happens when an object is moved. Work also happens when grass grows, volcanoes erupt, donkeys bray, airplanes fly, and dynamite explodes. Thus, energy makes possible everything that happens.

Energy takes a number of different forms:

- mechanical energy, like water rushing through a dam;
- radiant energy, like sunlight;
- sound energy, which causes air molecules to vibrate;
- chemical energy, like that stored in a battery or in fossil fuels;
- thermal or heat energy, like the hot steam that escapes from a boiling pot;
- electrical energy, like the static that makes your hair stand on end on a dry autumn day; and
- nuclear energy, as used in some power plants and weapons.

Energy Trivia:
Many televisions continue to draw power even if they are turned off. Unplug TVs that you do not use frequently.

There is a finite amount of energy in the universe. It cannot be created or destroyed. It may seem that we are creating the electrical power that travels through transformers and over power lines to our homes, but really that electrical energy began as another form of energy, such as chemical energy in coal, or mechanical energy, such as the falling water used by hydropowered dams. This electrical power can in turn be transformed into radiant energy in a light bulb, some of whose energy is lost as heat, or thermal energy. Thus, although it cannot be created or destroyed, energy can be stored and change forms.

WHAT ARE THE SOURCES OF ENERGY?

There are many sources of energy, but the most common are:

- fossil fuels, which include coal, oil, and natural gas;
- biomass, which includes compostable materials, such as firewood or garden clippings, which can produce methane gas;
- geothermal energy, which comes through vents from the interior of the earth;
- hydropower, which is generated by moving water;
- wind, whose kinetic (moving) energy can be transformed into mechanical and then electrical energy when it spins the blades of a windmill;
- nuclear energy, which is produced when the nuclei of atoms split (fission) or fuse (fusion); and
- solar energy, the radiant energy of the sun, which is the source of much of the energy on Earth.

Background Information
continued

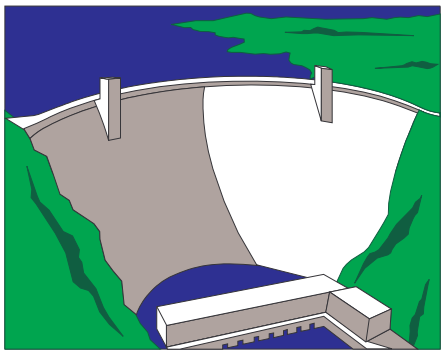
Energy Trivia:
Hydropower is the leading renewable power source used by electric utilities.

Energy Trivia:
In 2001, U.S. consumers used 19.6 million barrels of petroleum per day, which represents one-quarter of the world's petroleum consumption.

HOW CAN WE MAKE WISE DECISIONS ABOUT ENERGY USE?

Although it is not possible to destroy energy, it is possible to waste it, transforming it into new forms of energy that cannot be easily harvested and into byproducts that harm the environment. For example, when our cars burn gasoline, the chemical energy of the gas is transformed into the mechanical energy of the engine, which moves the car forward. However, this transformation of energy also produces waste gases, which pollute our air. Further energy is lost as heat as it escapes from beneath the hoods of our vehicles.

When we are making decisions about energy use, we need to consider the efficiency of an energy source. Gas, for example, is much more efficient in powering cars than is, say, wind. The way in which we use energy is also important. For example, putting a gallon of gas into a hybrid gas-electric car is going to allow us to travel farther than putting the same amount of gas into a traditional vehicle.



In addition, we also need to identify whether the energy source is sustainable or nonrenewable. Sustainable energy sources can be renewed or restored. Solar, wind, geothermal, and hydroelectric energy are all sustainable. Nonrenewable energy sources can be depleted. Fossil fuels, which can take millions of years to form, are a nonrenewable energy source.

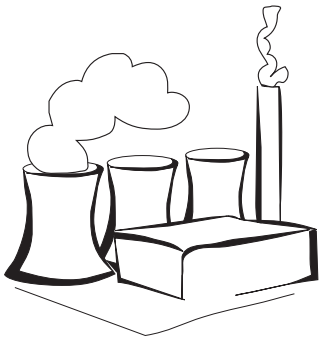
We need to consider whether an energy source is clean or polluting. Burning fossil fuels pollutes the air, for example. This is one area where your students can take direct responsibility for their role in wasting energy. Students need to understand that they and their parents are polluting the air when they drive to school. Short trips in cars—especially on cold days—are the most polluting. Walking to school, carpooling, bicycling, or taking the bus saves energy and keeps the air clean.

However, even clean and renewable energy sources, such as wind or solar power, can have environmental repercussions. A field of windmills can limit the activities of birds. Installing solar panels in a desert can harm the fragile desert ecosystem. There are different economic, environmental, and opportunity costs associated with each energy source.

Vocabulary

This list includes words that may be used during *Classroom Adventures*. Specific vocabulary used depends on students' grade level and prior knowledge.

chemical energy - energy stored in chemical form, such as a battery
clean energy - energy that does not pollute the environment
conserve - to use carefully, to avoid waste
electrical energy - energy produced by static electricity or electrical current
energy - the ability to do work
fossil fuels - materials that are extracted from the earth, such as coal, oil, or natural gas, that are deposited and created over extremely long periods of time. We use chemical energy from these fuels for a variety of purposes.
geothermal energy - thermal energy (heat) from the center of the earth
hydropower - energy generated by water
kinetic energy - the energy of movement. Water flowing over a dam is kinetic energy.
mechanical energy - energy produced through movement
nonrenewable - something that can be depleted, such as fossil fuels
nuclear energy - energy produced by the splitting (fission) or joining (fusion) of atomic nuclei
pollution - contamination of the natural environmant with harmful substances as a consequence of human activities; a byproduct of many energy sources, most notably fossil fuels
potential energy - stored energy, such as the still water behind a dam. An object stored high on a shelf also has potential energy because it could fall. The higher the shelf, the greater the potential energy.
radiant energy - light energy
sound energy - the vibrations of air molecules as sound waves travel
sustainable - something that can be sustained or renewed, such as wind or solar energy
thermal energy - energy from heat



Classroom Activities

For your convenience, the following activities can be used as you deem most appropriate to integrate Explorit's **Explorations in Energy** into your ongoing curriculum. The activities are grade-level appropriate, but please note that this program is designed for a broad grade range (3-6) and thus all activities may not be appropriate for every group of children. Choose those activities that will work well for your students.

ACTIVITY #1: "BIOMASS BONANZA!"

Materials:
- leaves
- grass clippings (not too many)
- food waste (nondairy, non-meat)
- shredded newspaper
- some soil

Science Standards:
- Physical Science
- Third: 1 a, b, c
- Sixth: 3 b
- Life Science
- Third: 3 c
- Fourth: 2 a, b, c; 3 a
- Focus on Earth Sciences
- Sixth: 5 e

Objective: To illustrate the transfer and transformation of energy.

Procedure:

1. Build a large bin. Make it as deep as possible—at least three feet deep and three feet wide. You can construct it out of wood, chickenwire, or whatever materials are readily available. A lid is optional, it may trap heat and speed composting. You can also use a large (10 gallon) plastic bin with holes.
2. Place food and clean garden waste in the bin, alternating with layers of soil. Have your students place in the bin the remains of fruits, vegetables, and bread.
3. Add earthworms to your pile. Worms make compost decompose twice as fast.
4. If your pile becomes very damp, add newspaper strips to absorb the moisture.
5. Using a shovel, turn layers of compost every day to aerate the pile.
6. Have students examine the compost pile, and record their observations. When did they begin to note changes in the pile? What material decomposes fastest? Is anything in the pile not decomposing? How does the pile smell?
7. The pile should become warm. Students can feel this warmth by wearing arm-length plastic gloves and reaching into the bin. Or, you can insert a long thermometer into the pile. In healthy compost, temperatures may reach 100+° F.
8. Ask students to determine when the pile is done. Some clues: its temperature falls below 100°F, its volume reduces 50 to 75 percent, it smells earthy, and it's smooth or crumbly.
9. Have students illustrate the stages of the compost and their own experiments with energy—including growing plants with the compost.
10. Talk with students about the transfer and transformation of energy throughout this process of decay and growth. Have students trace their food waste to its origin (seed), and diagram the energy that went into the food, the chemical and mechanical energy they gained from eating the food, the thermal energy that the food waste generates in the pile, and, finally, how the chemical energy of the compost combines with solar energy to allow new seeds to germinate.

ACTIVITY #2: "CONSERVING ENERGY RESOURCES"

Materials:
- pipettes (eyedroppers)
- 2 bowls (1 clear, 1 opaque)
- water
- pencils
- paper

Science Standards:
- Focus on Earth Sciences
- Sixth: 6 b
- Investigation & Experimentation
- Third: 5
- Fourth/Fifth: 6

Objective: To get students thinking about their own energy use.

Procedure:

1. Have your students attempt to define "natural resource." A natural resource is anything that occurs naturally on earth that we can use to build or fuel things, i.e. wood and oil. Water is also a natural resource.
2. Pour a quart of water (4 cups, or more if you have a large class) into a bowl.

Classroom Activities
continued

Energy Trivia:
Sixty percent of the power used by a computer goes to the monitor. Turning off the monitor when you're not using it saves electricity and money!

Materials:
several fresh lemons
coated copper wire with stripped ends
pennies
zinc washers
LED (available at electronic shops)

Science Standards:
Physical Science
Third:1 a, b, c, d; 2 a, b, c, d
Fourth: 1 a, c, f, g
Focus on Earth Sciences
Sixth: 3 a, d

Mark the water level on the outside of the bowl. Explain to students that the water in the bowl represents the water available to the city. Tell the students that this morning you washed your face and brushed your teeth. Remove one pipette of water for each activity and squirt it into the opaque bowl, explaining that we cannot reuse that water. Then tell them that you washed your clothes this morning. Remove several pipettes of water, explaining that washing clothes takes more water. Tell them you flushed the toilet, and remove two pipettes of water.

3. Invite students to come forward and share with the class an activity they did that used water, and have them remove that amount of water from the bowl.
4. When finished, ask them to look at the water level. It should be very depleted.
5. Explain that conserving a resource means using it wisely, and not wasting it. Ask students what they can do to conserve water.
6. Ask students what other natural resources they use. Discuss electricity, and that electricity comes from many sources—solar, wind, coal, hydropower. Ask students to list ways they can conserve natural resources Their list should include examples that may be applied in the classroom or at home.

ACTIVITY #3: "ELECTRICAL FRUIT!"

Objective: To introduce students to electrical circuits.

Background: By setting up a simple circuit, you can use lemons as a battery to light a low-current LED. A chemical reaction occurs between copper and zinc when they contact the acid of the lemon, and causing electrons to flow through the circuit—transforming chemical energy into electrical energy.

Procedure:

1. Discuss with students the idea of an electrical circuit. A circuit is anything that allows electrons to flow through it, making electricity.
2. Make two slits in the skin of each lemon.
3. Push a copper coin into one slit and a zinc washer into the other.
4. Slip paperclips onto each coin.
5. Slide wires between paperclips and pennies and washers, connecting coin to washer, coin to washer, coin to washer.
6. Attach the long lead of the LED to a penny.
7. When the circuit is complete, the LED should light. If not, add more lemons to your circuit.
8. Ask the class to hypothesize about and test their answers to these questions: What happens if you remove a washer or coin from a lemon? What happens if a wire gets loose? Why do there need to be connections between the metal pieces and the wires? Would this work with other foods as well? Which foods? Why? And finally, are there other ways to use energy from food?
9. Discuss with the class the transformation of chemical energy into radiant energy (light). Tell them electricity is made in many ways. Ask them to imagine, and draw, the process by which energy comes to their homes. Then talk with them about electricity generated by dams (through hydropower, or mechanical energy) or by burning fossil fuels (like coal, or chemical and thermal energy).

Supplemental Resources

BOOKS

Berger, Melvin. **Switch On, Switch Off**. HarperTrophy, 2001. *An easy-to-understand, informative, and accurate science concept book (grades K-3).*

Brubaker Bradley, Kimberly. **Energy Makes Things Happen**. HarperTrophy, 2002. *Uses familiar examples and has a clear focus to introduce basic scientific concepts (grades 1-3).*

Gibbons, Gail. **Recycle: A Handbook for Kids**. Little Brown & Co., 1996. *An easy-to-read and well-organized book introducing the importance of recycling. (grades 2-4)*

Graham, Ian S. **Water Power (Energy Forever Series)**. Raintree/Steck Vaughn, 1999. *Examines the historical uses of water as a source of energy, the advantages & disadvantages, and new advances in harnessing water power (grades 4-6).*

Hawkes, Nigel. **New Energy Sources (Saving Our World)**. Copper Beech Books, 2000. *Discusses energy technology and engineering.*

White, Larry. **Energy: Simple Experiments for Young Scientists**. Millbrook Paper Trade, 1996. *This series of books ask intriguing questions and provide clear, concise answers. Many simple projects using easy to find materials (grades 3-6).*

WEB SITES

California Governor's Energy Web Site
http://www.fypower.org
Information on energy efficiency & conservation; plus, CA government's strategies to conserve and re-new energy.

Energy Information Administration Kids Page
http://www.eia.doe.gov/kids/
Facts, games, history, class activities, links and glossary regarding energy.

National Energy Education Development Web Site
http://www.need.org/
Information guides and activities on energy for all grade levels.

Plans for solar cookers
http://solarcooking.org/plans/
Construction plans for various types of solar cookers. Build your own!

Re-Energy Renewable Energy Education Kit
http://www.re-energy.ca/
Information regarding various types of energy; includes entire unit plan on energy.

Energy Trivia:
Automobile traffic in the United States costs $100 billion each year in wasted fuel, lost productivity, and health costs.

Science Standards Alignment

Below is the exact language of national and state science standards that Explorit's Explorations in Energy program addresses either during our visit to your classroom or through materials in this Teacher's Packet that you may use.

CALIFORNIA SCIENCE CONTENT STANDARDS

Physical Sciences

Grade 3: 1. Energy and other matter have multiple forms and can be changed from one form to another. As a basis for understanding this concept, students know: a. energy comes from the Sun to Earth in the form of light. b. sources of stored energy take many forms, such as food, fuel, and batteries. c. machines and living things convert stored energy to motion and heat. d. energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects. f. evaporation and melting are changes that occur when the objects are heated. 2. Light has a source and travels in a direction. As a basis for understanding this concept, students know: a. sunlight can be blocked to create shadows. b. light is reflected from mirrors and other surfaces. c. the color of light striking an object affects the way the object is seen. d. an object is seen when light traveling from the object enters the eye.

Grade 4: 1. Electricity and magnetism are related effects that have many useful applications in everyday life. As a basis for understanding this concept, students know: a. how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs. c. electric currents produce magnetic fields and know how to build a simple electromagnet. f. that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other. g. electrical energy can be converted to heat, light, and motion.

Grade 5: 1. Elements and their combinations account for all the varied types of matter in the world.

Life Sciences

Grade 4: 2. All organisms need energy and matter to live and grow. As a basis for understanding this concept, students know: a. plants are the primary source of matter and energy entering most food chains. b. producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem. c. decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals. 3. Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept, students know: a. ecosystems can be characterized by their living and nonliving components.

Focus on Earth Sciences

Grade 6: 3. Heat moves in a predictable flow from warmer objects to cooler objects until all the objects are at the same temperature. As a basis for understanding this concept, students know: a. energy can be carried from one place to another by heat flow or by waves, including water, light, sound waves, or by moving objects. b. that when fuel is consumed, most of the energy released becomes heat energy. c. heat flows in solids by conduction (which involves no flow of matter) and in fluids by conduction and by convection (which involves flow of matter). d. heat energy is also transferred between objects by radiation (radiation can travel through space). 4. Many phenomena on Earth's surface are affected by the transfer of energy through radiation and convection currents. 5. Organisms in ecosystems exchange energy and nutrients among themselves with the environment. As a basis for understanding this concept, students know: e. the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition. 6. Sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation. As a basis for understanding this concept, students know: a. the utility of energy sources is determined by factors that are involved in converting these sources to useful forms and the consequences of the conversion process. b. different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forests, and know how to classify them as renewavle or nonrenewable.

Investigation and Experimentation

Grade 3 Concept 5 / Grades 4-5 Concept 6 / Grade 6, Concept 7:
Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept...students should develop their own questions and perform investigations.

Explorit's Classroom Adventures *involve students' use of many science process skills. For specific skills, see California Science Content Standards at www.cde.ca.gov/board.*

Explorit Programs for Schools and Groups

At Explorit's Site

Discovery Lessons & Labs Visit one or more of the Changing Exhibitions throughout the year
Nature Safaris & Labs Visit Explorit's outdoor spaces at Mace Park Branch

Explorit in Your Classroom

Classroom Adventures Explorit educators visit your classroom for hour-long presentations
Young Scientist Series Science investigations through multiple visits

For the Whole School

Health in Your World Learn about keeping your body and the world healthy and safe
Science in Your World The ultimate family science night
Science Assembly A multimedia presentation for the whole school

Reservations required.
For information please call
530.756.0191

Think it.
Try it.
Explorit.

HOW TO CONTACT US

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