Discovery Lesson

TEACHER ENRICHMENT RESOURCE PACKET

The Energy Story

February 21, 2009 - May 24, 2009

Energy is all around us -- even within us. Often it's invisible. What is this weird force that can't be created or destroyed? Investigate the forms of energy and how we use them to help us get things done.

Learning Objectives:

- Understand that energy is the ability to do work
- Discover that energy can change forms, and be stored or moved, but cannot be created or destroyed
- Identify many resources from which energy comes, and be able to differentiate between those that are renewable and nonrenewable
- Recognize the importance of conserving energy, and be familiar with clean and efficient energy choices

Think it.
Try it.
Explorit.

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Welcome

Thank you for choosing Explorit Science Center's *Discovery Lesson* program to supplement your ongoing science curriculum. You might 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. Whichever way you incorporate it, advance preparation and follow-up with your students are critical to achieving the greatest educational benefit from this unique science experience.

Our Mission:

We engage people in science experiences that touch all our lives.

Explorit provides two resources to help prepare you and your students for the *Discovery Lesson*. 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 visiting Explorit;
- participate fully in the *Discovery Lesson* yourself; and
- follow-up with your students back in the classroom.

Background Information

WHAT IS ENERGY? WHAT ARE ITS FORMS?

We use energy to power our buildings, electronics, transportation systems, and even our own bodies. Energy is the ability to do work, which happens when things are moving. Every time we feel heat, see light, hear sound, or make something change or move, energy is responsible. Energy makes possible everything that happens.

Energy can take on many different forms that scientists group into categories:

form of energy	examples of form
mechanical	water rushing through a dam
radiant	sunlight
sound	your voice, which causes air molecules to vibrate
chemical	stored in batteries, fossil fuels, and food we eat
thermal or heat	hot steam that escapes from a boiling pot
electrical	static that makes your hair stand on end on a dry day
nuclear	used in some power plants and weapons

There is a finite amount of energy in the universe, meaning we can neither add to nor take away from the universe's energy supply. Thus, energy 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. Yet, this electrical energy began as another form of energy, such as chemical energy in coal, or mechanical energy, such as the falling water in a hydropowered dam. Electrical power can then be transformed into radiant energy in a light bulb, some of whose energy is lost as heat, or thermal, energy. Although it cannot be created or destroyed, energy can be stored for later, moved somewhere else, or changed into a different form.

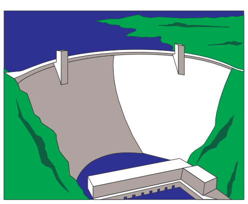
All forms of energy can be either potential (stored) energy, or kinetic (moving) energy. Potential energy is ready to do work, whereas kinetic energy is actually doing work. Potential energy is converted into kinetic energy during the process of work being done. This conversion from potential energy to kinetic energy can occur in a variety of ways, depending on the form of energy we are using. For example, it could happen as an object falls from a height, bonds between atoms are broken, or a compressed spring expands.

WHAT ARE THE SOURCES OF ENERGY?

Energy comes from many places. Commonly used energy resources include:

source of energy	description of source
fossil fuels	coal, oil (petroleum), natural gas, and propane
biomass	plant material that is burned for its energy
geothermal energy	comes from the heat within the earth
hydropower	generated by moving water
wind	wind turns rotating machines, called turbines, to change the wind's kinetic energy into electrical energy
nuclear energy	produced when the nuclei (center) of atoms split apart (fission) or fuse together (fusion)
solar energy	radiant energy of the Sun, often turned into electrical energy with the help of solar cells

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



We do not have an unlimited supply of all energy resources. Some are renewable, and others are nonrenewable. Renewable energy sources can be quickly replenished. Solar, wind, geothermal, and hydroelectric energy are renewable. Nonrenewable energy sources can be depleted; they can eventually run out. Fossil fuels, which can take millions of years to form, are a nonrenewable energy source. Nuclear energy is also nonrenewable. In the United States, we get most of our energy from nonrenewable sources, so it is essential to conserve them and find ways to use more renewable sources.

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

Background Information
continued

WHAT MIGHT WE CONSIDER WHEN MAKING CHOICES ABOUT ENERGY USE?

Even though it is not possible to destroy energy, it is possible to waste it. We waste energy when transforming it into other forms of energy that cannot be easily re-harvested, and into byproducts that harm the environment. Cars are a good example of this. When they burn gasoline, chemical energy from gas is transformed into mechanical energy of the engine, which moves the car forward. However, some energy during this transformation escapes as heat from beneath the hood of the car, as noise, and as waste gases from the tailpipe that pollute our air. This means traditional cars might not be the most efficient form of transportation.

Aside from efficiency, we might also ask ourselves if the ways we use energy are renewable and clean. In comparison to gasoline used by a traditional car, a hybrid gas-electric car could be a better alternative. The hybrid could go farther on less gas, and waste less energy. Although hybrid cars are cleaner and more efficient than traditional cars, they still use an electric motor and battery. Another alternative is solar powered cars. They are dramatically cleaner, and rely on a renewable, easy-to-use energy source. A car powered by solar panels converts sunlight directly into electricity to make the car go.

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

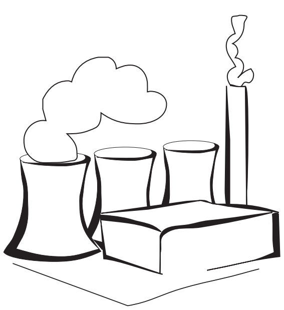
As we have seen, some of our energy choices pollute air, water, and land, while others keep our environment clean. Burning resources for their energy, such as fossil fuels and biomass, pollutes the air. Students can choose to pollute less on their way to school by walking, biking, carpooling, or taking the bus -- instead of driving. Since we have to breathe the Earth's air, drink its water, and eat its food, choosing clean energy improves life for everyone.

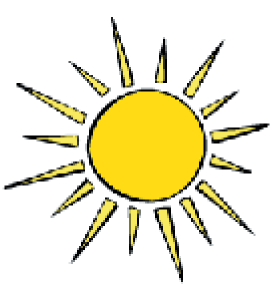
Even clean and renewable energy sources, such as wind or solar power, can have environmental repercussions. A huge field of windmills can limit activities of birds. Installing large solar panels in a desert can harm the fragile desert ecosystem. We can pay attention to issues like these, and help our neighbors and leaders make wise decisions about energy sources we use.

Energy Fact:
The total solar energy reaching the Earth in one hour is more than our yearly global energy demand.

Vocabulary

Here is a list of words that may be used during "The Energy Story" *Discovery Lesson*. Specifics vary according to students' grade level and prior knowledge.





biomass - things that are alive, or were alive a short time ago, such as plant material (like wood), or animal waste. Can be used to make biogas for powering machines.
chemical energy - stored energy that can be released through chemical reaction, found in things like food and batteries
clean energy - energy that does not pollute the environment
conserve - to use carefully, to avoid waste
efficiency - output compared to input. If a device does as much work for us as energy we put into it, then it is perfectly efficient because it is not wasting any energy
electrical energy - energy produced by movement of charged particles, such as electrical currents and static electricity
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 millions of years. We use chemical energy from these fuels for a variety of purposes.
geothermal energy - heat energy from inside the earth
hydropower - energy generated by moving water
kinetic energy - energy of motion. Water flowing over a dam is kinetic energy.
mechanical energy - energy of moving parts pushing or pulling
methane - a gas that is the main ingredient of both natural gas and biogas
nonrenewable - a resource that can be depleted, such as fossil fuels
nuclear energy - energy produced by splitting or joining the centers of small particles called atoms
pollution - contamination of the natural environment with harmful substances as a consequence of human activities; a byproduct of many energy sources
potential energy - stored energy, such as the still water sitting behind a dam, ready to fall.
radiant energy - the category of energy that includes solar and light energy
renewable - a resource that cannot be depleted, such as solar and wind energy
solar energy - energy from the sun's rays. Solar panels can turn solar energy into electricity
sound energy - the vibrations of molecules as sound waves travel
sustainable - practices that can be continued indefinitely, with minimal harm to the natural environment, such as the use of renewable resources
thermal energy - energy from heat

Classroom Activities

Activity #1: "Energy Change"
Objective: To see the effect that height has on the energy of a moving object
You will need: book, pencil, ruler with a center groove, paper cup, scissors, marble
Procedure:

1. Cut a 1-inch square section out from the top of the paper cup, so that it looks like an open doorway when the cup is placed upside-down on a table
2. Place the cup over one end of the ruler, so the ruler touches the back side of the cup.
3. Raise the opposite end of the ruler and put a pencil under it, so the ruler can rest on the pencil.
4. Place the marble in the center groove of the ruler at the ruler's highest end
5. Release the marble and observe the cup
6. Raise the end of the ruler and rest it on the edge of a thick book instead of the pencil. Put the cup back in its spot.
7. Place and release the marble again, and observe the cup. Try with other heights, and notice how far the cup moves each time.
8. What happens? The cup moves when the marble strikes it, and goes farther the higher the marble starts.
9. Why does it happen? The higher the marble sits above the ground waiting to roll, the more potential (stored) energy it has. As it rolls down the incline, potential energy changes into kinetic (moving) energy. More potential energy means more kinetic energy, which causes the marble to strike the cup with more force.

This activity adapted from: Physics for Every Kid, by Janice VanCleave, 1991

Activity #2: "Close Encounter"
Objective: To experience the attracting and repelling forces between objects due to their electrical charges.
You will need: 2 round balloons, about 9 inches, masking tape, 6 feet of string, marking pen, and clean, dry, oil-free hair
Procedure:

1. Inflate both balloons and tie their ends. Use the pen to label one balloon A and the other B.
2. Cut the string in half and attach one piece to the end of each balloon
3. Tape the free ends of the strings to the top of a door frame so that the balloons hang down in the open space where the door would be. They should hang about 8 inches apart from each other.
4. Bring a student up to the hanging balloons. Stroke balloon A on her hair about 10 times, and gently release it. What happens? (The balloons attract each other, and look stuck together.)
5. Bring another student up to the balloons. Have one student rub balloon A on their hair again about 10 times, while the other student does the same with balloon B. What happens this time? (The balloons repel each other and drift apart.)

Classroom Activities
continued

6. Why does this happen? All things are made of atoms, which have negatively charged electrons spinning around a positive nucleus. When electrons are rubbed off hair atoms onto a balloon, the balloon becomes negatively charged. First only one balloon is negative, so the two are opposites, and thus attract. The second time, both balloons are negative, so as like charges, they repel.

This activity adapted from: Physics for Every Kid, by Janice VanCleave, 1991.

Activity #3: "Biomass Bonanza!"
Objective: To illustrate the transfer and transformation of energy.
You will need: materials to build a compost bin, compostable items, earthworms
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 above100° 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.

Thy this resource for help with your composting project:
http://projectcompost.ucdavis.edu/

Activity #4: "A Little Drip Means A Big Energy Waste"
Objective: To get students thinking about energy conservation and their own energy use. One drop of water is tiny, but a leaky faucet can add up to thousands of gallons of wasted water per year! If hot water is dripping down the drain, then clean water and energy used to heat it are both wasted.
You will need: measuring cup, faucet, clock, pencil, paper
Procedure:

1. If you have a leaky faucet, use it. Otherwise, adjust your sink faucet to produce a steady drip...drip...drip. Place the measuring cup underneath the dripping faucet, and collect 15 min worth of drip. You might, for example, collect 4 oz of water in 15 min. Now you can calculate how much energy was wasted, using your own numbers (we are using 4oz).
2. Multiply the number of ounces of water by 4 – this gives you the number of ounces per hour leaking through the faucet. *4oz X 4 = 16 oz per hour*
3. Multiply the answer from step 1 by 24 – this gives the number of oz per day leaking through the faucet. *16 oz per hr X 24 = 384 oz per day*
4. Multiply the answer from Step 2 by 356 – this gives the number of ounces per year leaking through the faucet. *384 oz per day X 365 = 140,160 oz per yr*
5. Divide the answer from Step 3 by 128 – this gives the number of gallons per year leaking through the faucet. *140,160 oz per yr / 128 = 1095 gal per yr*
6. That's a lot of water, and it took a lot of energy to make it hot! If it was heated by a gas water heater, you can calculate how many cubic feet of gas were used. Multiply the answer from Step 4 by 1.2. *1095 X 1.2 = 1,314 cubic feet of gas per yr*

This activity adapted from: Energy Conservation Experiments You Can Do, from the Thomas Alva Edison Foundation, 1991.

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).*

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 asks intriguing questions and provides clear, concise answers. Many simple projects using easy to find materials (grades 3-6).*

Javna, John. 25 Simple Things Kids Can Do to Save Energy. The Earthworks Press. 1992. *Overview of energy & the environment; 25 different 'kid power' ideas for saving energy.*

Teacher Advisory Board of The NEED Project, 2007. Elementary Energy Infobook. *Fact sheets about different kinds of energy and energy sources we use (grades 1-6).*

Web Sites

Energy Information Administration Kids Page
http://www.eia.doe.gov/kids/
For kids. Navigate to energy facts, games, activities (science fair projects included), and energy vocab.

National Energy Education Development (NEED) Web Site
http://www.need.org/
Access information about NEED's energy curriculum and materials.

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

Re-Energy: Renewable Energy Education
http://www.re-energy.ca/
All about renewable sources of energy for teachers and students. For lesson plans, go to 'Teacher Materials' ‡ 'Lessons and Activities'.

Kids' Site from US Department of Energy
http://www.eere.energy.gov/kids/
Fun graphics and games that teach kids about energy efficiency and conservation.

Science Standards

CA STANDARDS
Physical Science (**2nd**: 1abcdefg; **3rd**:1abcdh & 2abd; **4th**:1aeg)
Life Science (**1st**:2b; **4th**:2a; **5th**:2g; **6th**:5a)
Earth Science (**K**:3c; **1st**:3c: **2nd**:3e; **3rd**:4de; **5th**:4a; **6th**:3abcd & 4abd & 6ab)
Investigation and Experimentation (**K**:4abcde; **2nd**:4a; **4th**:6cdf; **5th**:6bfh; **6th**: 7abe)

NATIONAL STANDARDS
K-4: A, B, D, E, F

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

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