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ABSTRACT

This instructional packet is one of 14 school environmental education programs developed for use in the classroom and at the Dahlem Environmental Education Center (DEEC) of the Jackson Community College (Michigan). Provided in the packet are pre-trip activities, field trip activities, and post-trip activities which focus on energy uses, energy sources, and issues associated with energy. Strategies for using these activities with fourth grade students are also provided. During the pre-trip activities, students identify the variety of ways they can use energy and the sources of that energy. On the field trip, they learn how plants and animals use energy and complete some wind, water, and solar experiments. The post-trip activities extend this information by examining the advantages and disadvantages of various energy sources. In addition, students complete a valuing exercise and conduct an energy conservation project. A list of formal and non-formal objectives for the indoor and outdoor field trip activities at the DEEC are presented in a separate field trip guide. All activities are interdisciplinary (science, mathematics, language arts, social studies, and art) and foster the development of such skills as classification, problem-solving, interdependence, and global awareness. (JN)

Dahlem Environmental Education Center

7117 S. Jackson Road
Jackson, MI 49201
(517) 787-0806 ext. 197

"Energy Around Us" is one of fourteen school environmental education programs developed by the Dahlem Environmental Education Center of the Jackson Community College. Assistance for the project was provided by the Institute of Museum Services Special Project Grant #G008103172, of the U.S. Department of Education.

This packet is the result of the combined efforts of:

Martha Monroe, Project Director
Liz Raduazo, Teacher/Consultant
Jan Wolanin, Program Intern
Deb Bainer, Program Intern
Erica Salzman, Artist

Special thanks go to the following people for their contributions:

Jan Johnson, Teacher at St. John School
Janet Marvin, Teacher at Frost School
Denise Roznowski, Teacher at St. Anthony School

Jackson Community College

2111 Emmons Road
Jackson, MI 49201
(517) 787-0800

Energy Around Us

A Fall Activity Packet for Fourth Grade

We use energy every moment we are alive -- at work, at rest, and at play. But we rarely think about energy and tend to take it for granted. As the world's fossil fuel supplies dwindle, energy is becoming more of an international concern.

The Dahlem Environmental Education Center's fourth grade program, "Energy Around Us," provides students with a background in energy resources and in some of the issues associated with energy. This unique approach to energy education combines pre- and post-trip classroom activities with a field trip. During the pre-trip activities, students will identify the variety of ways they use energy and the sources of that energy. On the field trip, students will learn how plants and animals use energy and do some wind, water, and solar experiments. The post-trip materials will extend this information by adding the advantages and disadvantages of various sources, a valuing exercise, and an energy conservation project.

"Energy Around Us" is built upon fourth grade educational concepts and skills such as classification, problem-solving, interdependence, and global awareness. Highly interdisciplinary, this program includes science, language arts, mathematics, social studies, and art. It was designed to present students with information and issues, while developing the skills necessary to consider solutions and take action. In the years to come, your students may add to this framework and become environmentally responsible citizens.

So summon your strength and tap your resources -- it's time to begin an energy adventure!

Contents

A Note to Teachers

Our society operates on energy. Energy is used to manufacture, grow, and move everything. Since the 1973 oil embargo, our dependence upon petroleum and the importance of energy have become increasingly apparent.

It is painfully obvious that our society cannot continue present energy policies. Energy shortages, price increases, and environmental disruptions could threaten the economic and ecological threads of our lives.

We have three basic choices to avoid the upcoming energy crisis: (1) develop new sources of energy; (2) waste less energy in our present lifestyles; and (3) adopt new lifestyles.[1] In order to make decisions for our future, we need to know more about present energy fuels, and ways we can reduce our energy use.

Along with this new need for information about energy came the realization that energy should be an integral part of the school curriculum. The resulting flood of energy education materials has been rather disappointing, as most are collections of unconnected, diverse activities from safety around electrical outlets to the difference between potential and kinetic energy!

"Energy Around Us" provides students with an understanding of issues related to the energy crisis. After studying their energy use, students will analyze the advantages and disadvantages of many energy resources. The option of energy conservation is also explored -- both at school and at home. We have purposely omitted the more traditional approaches to energy education, because they can be found in most elementary science textbooks. In addition, this packet has been carefully constructed with a specific sequence of activities. For your students to achieve maximum understanding of the concepts presented, we recommend that you follow this order of ideas and handouts.

Many of the energy policy decisions initiated today will involve future generations of consumers and voters -- your students. Providing them with an understanding of these issues will be well worth your energy.

[1] G. Tyler Miller, Living in the Environment. Second Edition. Belmont, CA: Wadsworth Publishing Company, 1979, p. 287.

Goals and Objectives

Program Goal

Fourth graders will become more aware of energy uses, energy sources, and issues associated with energy.

Program Objectives

Students will:

- identify when energy is being used by observing movement, heat, light, or life.
- understand human dependence upon energy by listing past and present uses.
- discriminate among energy sources by categorizing and defining them.
- appreciate the complexity of the energy situation by discussing its contributing factors.
- understand energy in the natural world by comparing the energy uses of wild animals and plants to humans.
- discriminate among alternate energy sources by describing their advantages and disadvantages.
- understand the potential of renewable resources by experimenting with solar, wind, and water energies.
- choose to conserve energy by implementing energy conservation plans at home and at school.
- understand the importance of attitudes in decision-making by examining personal values regarding energy.
- demonstrate problem-solving skills by working on a group energy project.

Pre-Trip Activities

The study of energy will be new and exciting to many of the students in your class. You can prepare them for their field trip by completing the following activities.

1. What is Energy?

We certainly hear enough about it, but what actually is energy? Energy is the ability to do work -- the driving "force" behind everything that grows, lives, moves, burns, or glows. We can tell that energy is being used when we detect heat, light, movement, or life.

Ask five students to move to the front of the room and demonstrate these acts:

1. running in place
2. switching the lights off and on
3. turning on an electric appliance (a fan or record player)
4. dropping a book
5. standing quietly

Explain to the class that each student is using energy. Ask them how they can tell that energy is being used and where it came from.

Observation	Source
1. movement and heat	1. the food the person ate
2. light and heat	2. electrical power, most likely generated from fossil fuels
3. movement, some heat	3. electrical power, most likely generated from fossil fuels
4. movement	4. the food the person ate
5. life -- internal movement of heart, lungs, etc.	5. the food the person ate

As an option, explore other examples of "Energy In Use" by making a bulletin board display of magazine pictures which show energy as heat, light, movement, or life.

With this definition of energy your students should see that we all depend on energy to live. Because our energy sources are limited, energy has become a world concern.

2. Energy in Our Lives

We use energy every day. The importance of energy and the sources we rely on most will be easy to see through this activity.

Student Handout #1 provides your students with a chart containing a partial list of items which require some form of energy to make them work. Across the top are listed various forms of energy. Have your students work in pairs to first complete the list of items, and then to identify the forms of energy needed. When everyone has finished, compile a master list on the board. Here are some suggestions of items for you to keep in mind in case any of your groups have difficulty.

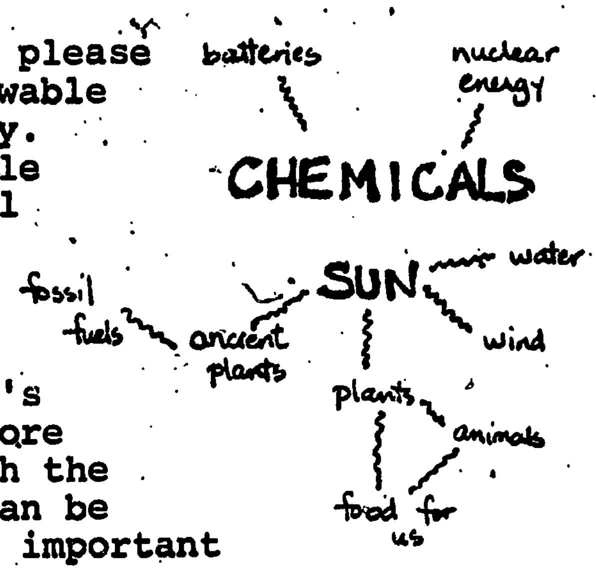
bicycle	scissors	flower
toothbrush	water heater	vacuum cleaner
typewriter	flashlight	furnace
stereo	fan	refrigerator
piano	calculator	sailboat
toaster	lawn mower	kite
television	lamp	

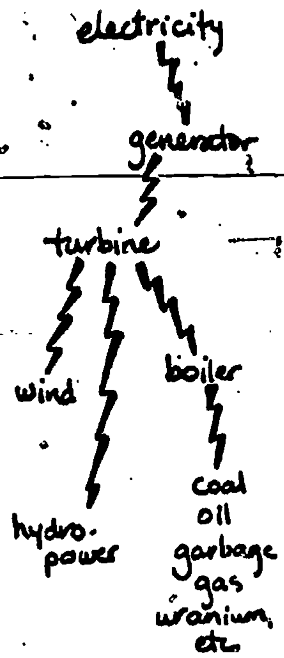
Your students have begun to think about and identify various forms of energy in their daily lives, but that is only the first step. To really understand energy issues they must discover the sources of this energy. How is electricity produced? Where do we get batteries and how do they work? What is the source of food energy?

3. Sources of Energy

Student Handout #2 will help your students better understand the different sources of energy currently being used in our society. It would be most effective if you and your class read and discussed this activity together. Student Handout #3 was designed as a follow-up exercise for students to complete individually. You may also wish to show a movie or a filmstrip to add to their understanding. (See references.)

As you teach this information please stress the difference between renewable and non-renewable sources of energy. The ultimate source of non-renewable energy is either the sun for fossil fuels, or chemicals for nuclear energy and batteries. These chemicals (uranium, zinc, copper, etc.) are storehouses of energy which originated with earth's creation. Burning wood releases more recently stored solar energy. Both the energy in wind and falling water can be traced to the sun. It is a pretty important star!





Electricity is an important form of energy. It must be produced from our energy sources. If the production of electricity is puzzling to your students, your local power company has teaching aids to explain this process. (See references.) Basically, electricity is produced when a coil of wire turns in a magnetic field. Energy is needed to turn a wheel or turbine which rotates the coil of wire. The wire and the magnet make up the generator.

A turbine can be moved by various means. Sometimes a fuel is burned to boil water and create steam. The steam then turns the turbine. Many fuels can be used: coal, oil, natural gas, garbage and uranium. Wind energy or hydropower moves a turbine directly. Solar energy can be converted directly into electrical energy with the use of solar cells, or it can be used to heat water for a steam turbine.

4. Energy Through the Ages

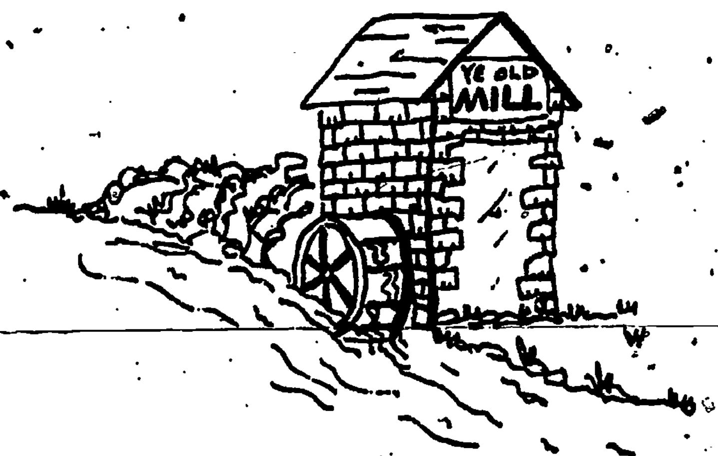
Before looking forward to our energy future, have your class take a look at the past. You may find some startling similarities and differences in energy use and energy sources. Here are some ideas:

- Watch "Little House on the Prairie" or "Father Murphy" and make an energy list for an earlier period of history. Compare this list with the one you made for Activity #2.

- Invite an elderly person to your classroom to speak about energy used during his/her childhood.

•Explore the energy sources in another culture, consulting your social studies text or students who have lived in other countries. In many places, bicycles outnumber cars! Remind students that a different way of doing things is not necessarily inferior.

•What forms of energy have been used by humans throughout history? (food, wood, steam, hydropower, etc.) What is the most recent? (nuclear energy) Trace the "evolution" of energy sources in industrialized nations.



•Try living a day with energy sources from another era. Candles would be fun to use, but can you borrow a horse?

•Visit a historical museum to find photographs or examples of early energy use.

Vocabulary Words

The following words and terms have been introduced in the pre-trip materials.

COAL - A fossil fuel formed from ancient plants. Coal is widely used to generate electricity and is used experimentally in the production of synfuels.

ENERGY - The ability to do work as evidence by heat, light, movement, or life.

FOSSIL FUELS - Energy sources formed over time by tremendous heat and pressure acting on buried plant and animal remains, (e.g., coal, oil, natural gas, oil shale, and tar sands).

GENERATOR - A coil or wire turning inside a magnetic field to produce electricity.

HYDROPOWER - Energy produced from water falling through a dam or natural drop-off and powering a generator.

METABOLIC ENERGY - Energy from food that sustains life processes.

NATURAL GAS - An air-like fossil fuel sometimes found with crude oil and formed from ancient plants and animals.

NON-RENEWABLE - Sources of energy that are in limited supply.

NUCLEAR ENERGY (fission) - Energy released from splitting atoms of uranium and thorium.

OIL - A tar-like fossil fuel formed from tiny ancient plants and animals. Crude oil can be refined to produce gasoline, plastics, fertilizers, motor oil, nylon, etc.

RENEWABLE - Sources of energy that are in unlimited supply.

SOLAR CELL - A light reactive device made of silicon which can convert sunlight directly into electricity.

SOLAR ENERGY - Heat or electrical energy directly derived from the sun.

TURBINE - A wheel that spins, driving a generator to produce electricity.

URANIUM - A metallic, radioactive element used as fuel in nuclear power reactors.

WOOD ENERGY - Energy produced by burning trees and charcoal. If managed properly, wood is a renewable resource.

The following words and terms will be used during the field trip and post-trip activities:

ACID RAIN - Acidic precipitation that results when products of fossil fuel combustion in power plants and cars react with moisture in the atmosphere. Acid rain deteriorates buildings and statues, harms plant life, and kills aquatic plants and animals.

ENERGY CONSERVATION - Efforts to extend the supply of energy resources by increasing efficiency and/or reducing energy use.

POLLUTION - Anything that reduces the quality of the environment, physically or aesthetically.

THERMAL POLLUTION - The unnatural heating of a body of water affecting aquatic life.

Name ____________________

How Do We Use Energy?

Here is the beginning of a list of common items which use energy. Finish the list with items which you use. Then go back and put an "X" under the form of energy which will directly power the item. The first one has been done for you.

Forms of Energy

Item	Electricity	Coal	Gasoline or Oil	Natural Gas	Battery	Sun	Food	Wood	Wind
Lawnmower	X		X				X		

Student Handout 1

Name ______________________

Energy Sources

Think about the sources of the energy you use. Most of it probably comes from oil and coal. From *oil* we get energy to run cars, buses, trains, planes, and even to heat houses in winter. Both *coal* and oil are burned to make electricity, and you know we need a lot of that! Some people heat their homes and cook with *natural gas*.

Oil, coal, and natural gas are *fossil fuels*. They were formed millions of years ago from dead plants and animals that were buried in certain spots of the world. Because large amounts of fossil fuels are not being formed today, we have a very limited supply. This makes them *non-renewable* sources of energy.

In some areas of the country, people get electricity from other sources, such as nuclear power plants. *Nuclear energy* comes from splitting uranium atoms into smaller pieces. *Uranium* is a rock mined from the ground. It is also non-renewable. What could happen if we ran out of non-renewable energy? ______________________________

Renewable energy sources should always be available. The sun is a renewable energy source. *Solar energy* can heat up rooms in buildings and water in pipes. It can also make electricity.

We get *wood energy* from burning trees. Because trees can be planted and harvested like corn, wood energy is renewable. In many countries around the world, wood is the major energy source. *Wind energy* can turn windmills to make electricty. Falling water can also make electricity at dams or waterfalls, creating *hydropower*, another renewable energy source.

Your body uses a different kind of energy. You get that energy from *food*. But how did the food get energy? You can trace your food chain from animals backward through plants to the sun. Your food energy is really bottled sunshine!

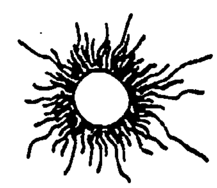
Student Handout 2
Sources of Energy

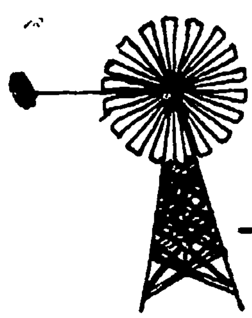
Name _______________

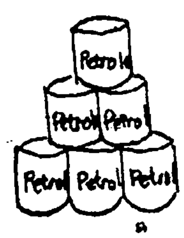
Sources of Energy

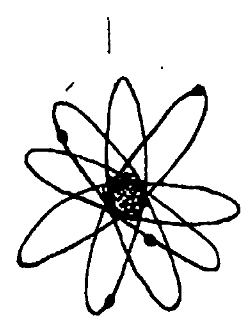
Match each source of energy to its description and picture.

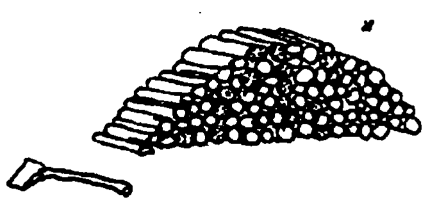
_____Fossil fuel dug from the ground	1. Hydropower
_____Energy from falling water	2. Oil
_____Very powerful energy from splitting uranium atoms	3. Natural Gas
	4. Wood
_____Energy from fast-moving air	5. Coal
_____Made from ancient plants and animals and pumped from the ground as a black thick liquid	6. Solar
	7. Wind
_____A colorless air-like fossil fuel found underground	8. Nuclear Energy
_____Energy that comes directly from the sun that is used for heating and electricity	

_____ 

 _____

 _____

 _____



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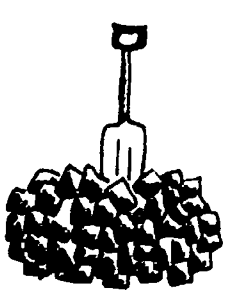
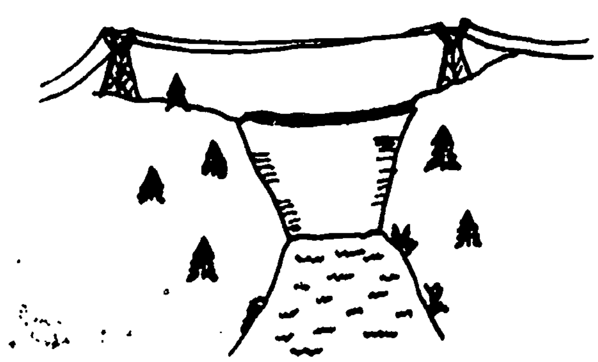
 _____



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_____

Student Handout 3
Sources of Energy

Dear Parents,

Our class is involved in a program entitled "Energy Around Us." We have explored the energy we use and the sources of our energy. This has been in preparation for a field trip to the Dahlem Environmental Education Center. At the Dahlem Center we will see how animals and plants cope with energy shortages and perform some experiments with solar, wind, and water energy. When we get back to school, we'll study some of the advantages and disadvantages of using different sources of energy and do an energy conservation project.

This is a good opportunity for you to share with and learn from your fourth grader. S/he may return from the field trip eager to talk to you about energy. Why not encourage your child to learn more about the subject by doing some of the following activities with him/her?

1. Ask your child what s/he learned about energy at school and at the Dahlem Center.

2. Tour locations in our area associated with energy -- a solar home, an electrical generating plant, the Cook Power Plant, an oil well, home insulation displays, etc.

3. Plan a "Save Energy" weekend. Walk or bike instead of driving. Eat lower on the food chain with less meat. Read or play games instead of watching TV. Hang clothes outdoors instead of using the dryer. Wear sweaters and keep the house cooler.

4. Encourage your entire family to help your fourth grader with his/her home energy conservation project. This includes exploring your home for ways to save energy, devising a plan, following the plan, and reading the electric meter.

5. Discuss energy issues in the news.

Sincerely,

Fourth Grade Teacher

P.S. Please listen to the weather report on the day of the field trip and make sure your son/daughter is appropriately dressed, especially in the case of rain or snow. Layers of clothing and waterproof shoes are recommended.

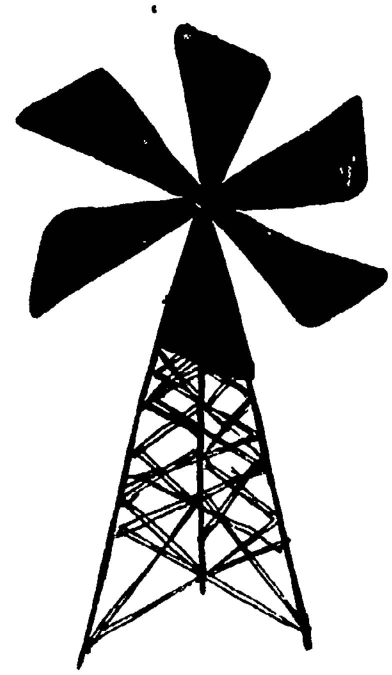
Field Trip

By now your students know why energy is often called the lifeblood of our society -- we depend on it for so many things! With the previous introduction to energy, your class is now ready for their field trip to the Dahlem Environmental Education Center.

Your excursion will begin with an indoor review of our energy sources and a brief explanation of the complex issues surrounding our energy future. Because so much of the energy your students use and could conserve is electrical, we will demonstrate how electricity is generated. The students will gain an appreciation for alternative, renewable energy sources through experiments and discussions of wind, water, biomass and solar energies. They will also explore how plants and wild animals use energy to meet changing seasonal needs.

This field trip experience will be supplemented with several post trip activities in the following pages. Before your trip, please remind your students they will be outside for a few hours, and stress the importance of dressing for the weather. Layered clothing and sturdy shoes are recommended

We are looking forward to your visit!



Post-Trip Activities

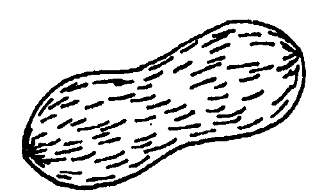
The activities in this section will relate the concepts introduced earlier in the program to our future. The first activity leads your class through a role play illustrating the limits of a non-renewable energy supply. Then students will analyze our energy options and their attitudes about using energy. The last activity outlines a plan for energy conservation at home and at school.

1. Energy Bank

Fossil fuels were formed a long time ago under special conditions. During the last one hundred years, western countries have used these fuels at a rapid rate. This activity will simulate the slow build-up and rapid depletion of a resource, illustrating the need for better global cooperation.

For this activity you will need a shoebox with a hand-sized hole in the lid and a bag of peanuts.

Explain to your class that the box represents the earth, and the peanuts represent fossil fuels. Pretend it is the Coal Age. Just as the fossil fuels were slowly deposited in the earth, the peanuts will be dropped in the box at a rate of five every hour for one week.



At the end of the week, assign students to play the roles of these western countries: England, the United States, and Germany. Invite each of the remaining class members to choose a country to represent. Be sure oil producing and developing countries are represented.

Announce that time has flown by -- it is now the beginning of the Industrial Revolution. Since England has discovered how to mine and burn coal in huge quantities, the student representing England should grab a handful of peanuts from the earth's store. The U.S.A. discovers oil (another handful goes), and Germany, representing other European nations, follows suit as time marches into the Industrial Age.

Count the remaining peanuts and ask the entire class how they should be distributed -- to those who "need" them the most? Those who can get them first? To those with the biggest army? How do the peanut-less countries feel about not having any fossil fuels? Do they have a right to the peanuts? Can the peanuts already taken be retrieved? How can everyone get the most out of what's left? (rationing, conserving, relying on alternatives, increasing price...)*

Best of luck to you if the activity spawns an OPEC in your classroom that takes over the shoebox!

**Adapted from "Bank of BTU's" by Lorraine Davis, and printed with permission from Kent County Intermediate School District, Grand Rapids, MI.*

2. Questions and More Questions

Thomas Jefferson believed that people will make wise decisions if they are given all the necessary information. This section is packed with information for wise decision-making. A chart of advantages and disadvantages of energy resources is included with a variation of the game "Twenty Questions" -- a fun way to learn or review this information.

Student Handout #4 can be duplicated for groups of students or enlarged into a wall chart. Handout #5 will help your students summarize the characteristics of each energy source; the empty spaces should encourage the contribution of additional criteria.

Energy's Ten Questions

Place slips of paper, each with the name of an energy source, in a box. Divide your class into two teams. Team A should start by drawing a name and answering "yes" or "no" to questions posed by Team B. Team B will try to determine the identity of the mysterious energy source. If Team B guesses correctly in ten questions or less, they get one point. Teams should take turns drawing and guessing. The students may need the worksheet to get started, but, after a few rounds, should no longer need to refer to it.

Other Energy Sources

There are a host of energy sources not widely used today that have the potential to alter our energy future. Here is a list of some that your students may want to research:

19

Biomass - burning crops, garbage, and agricultural wastes
Fusion - joining hydrogen atoms to create helium and energy
Geothermal - tapping hot underground steam
Ocean Thermal Energy Conversion - using the temperature difference between the surface and the depths of the ocean
Oil Shale - extracting fossil fuel from sedimentary rock
Synfuels - making energy sources from coal, oil, garbage, or organic wastes
Tidal - damming high tide water and releasing it over a turbine during low tide

<u>Energy Futures</u>

Your students have just digested a lot of information about the pros and cons of our energy sources. What do they think about it all?

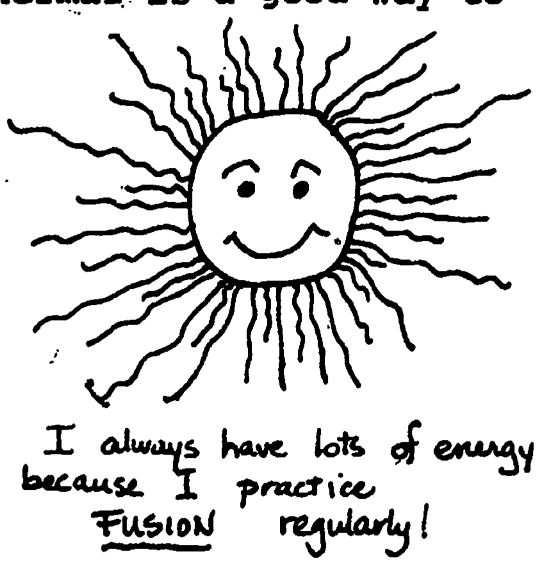
Lead a discussion about our energy future. If your students were to advise the President or the Governor, what policies would they recommend? How do they plan to heat their future homes? Which energy sources look better? These activities will help them think about their energy they'll use in years to come.

•Make bumper stickers with energy slogans: "Clean up your act -- burn garbage" or "Geothermal is a good way to blow off steam."

•Design a car that does not use fossil fuels.

•Invent a new energy source.

•Create a sun mobile with all of the solar derived energy sources.



3. Energy Attitudes

In the generations since Thomas Jefferson, educators have discovered that people make decisions not only on the basis of information, but also according to the attitudes and beliefs. This activity will help your students become more aware of their attitudes toward energy and how our beliefs affect the energy decisions we make.

Remember the list of energy uses compiled as a result of pre-trip activity #2? Dig out that list and ask each person to generate a list of fifteen electrical items they use. Then ask them to individually rate each item as follows:

•Circle all the necessities -- items you need for survival.

•"X" all the luxuries -- items you can easily live without.

•Check the items that are nice to have, but aren't necessary for survival.

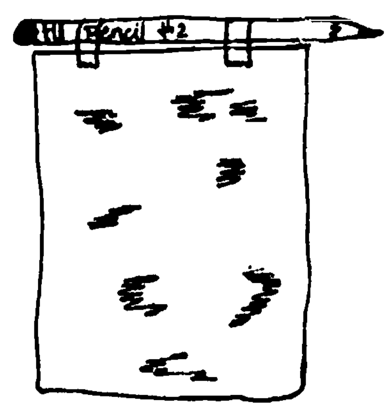
Invite your students to compare and discuss their choices. What would they do if your community had a "brown out" (power shortage) every evening? What would they do if all of their electricity were cut off? How can they conserve energy?

4. Conserving Energy at School & at Home

The energy issues facing our world are so immense that your students may wonder if one person can do anything to help. Remind them that conservation is one answer to the problem of limited energy resources. There are many things they can do each day to conserve energy. When they become car-buyers, home-owners, and voters, they'll be able to do even more.

The first step to conserving energy is discovering where energy is used and lost. Arrange for a custodian to take your class on a tour of your school building, pointing out where energy is used (boiler, kitchen, lights, etc.) and where it is lost (windows, doors, etc.). Have your students make a simple draft detector, as shown below.

•Cut a 12 cm by 25 cm strip of plastic food wrap, and tape it to a pencil as shown. Because the plastic responds to air movement, it will move with the slightest breeze. Students can test their home and school for air leaks by holding the draft detector near the edges of windows and doors.



•How can leaks be stopped?

After the tour, help your class brainstorm ways to save energy. Some suggestions are likely to be impractical, but others may be very workable. Discuss the options and formulate three plans to save energy.

Invite your principal to listen to your students' plans. Perhaps your principal will give your creative thinkers the okay to carry one out!

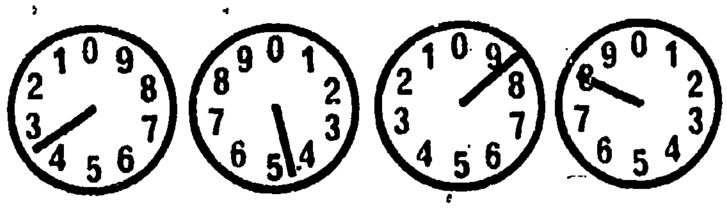
Here are some ideas that other schools have put into practice:

- turning off lights in empty rooms or halls
- using only the main entrance in cold weather
- organizing car pools to transport students
- installing a bicycle rack.
- reusing paper that is only used on one side
- recycling paper that is used on both sides
- composting and recycling lunchroom trash
- decorating the halls with posters of energy-saving ideas
- presenting a play or puppet show to other classes about energy

The same process can be used to conserve energy at home. Encourage your students to take an energy tour of their homes and to list their conservation ideas. A class discussion may generate many energy-saving tips. Encourage your students to discuss their ideas with their families and to carry out as many as possible.

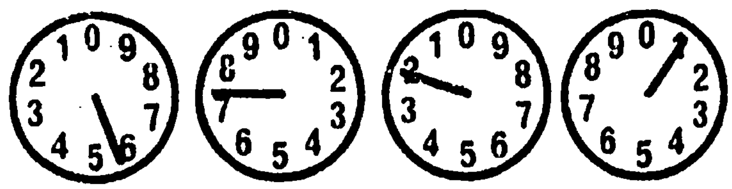
It is relatively easy to determine how much electricity each home actually uses by reading the meter on the outside of the house. The dials on the meter spin around, measuring kilowatt hours of electricity.

Each meter has four or five dials, each with one arrow and the numbers 0 - 9 arranged around the circle. The numbers are arranged clockwise on some dials and counterclockwise on others.



To read this four dial meter, read the row of dials from left to right. Choose the smaller if the arrow lies between two numbers. You should end up with a four digit number. This meter reads 3488.

You can help your class practice meter reading by making models from paper plates. Here are some samples:



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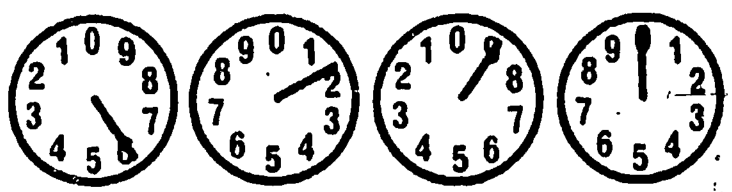

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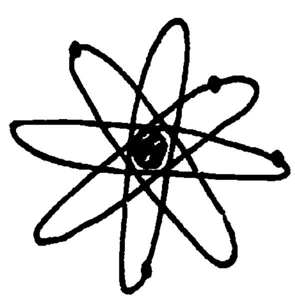
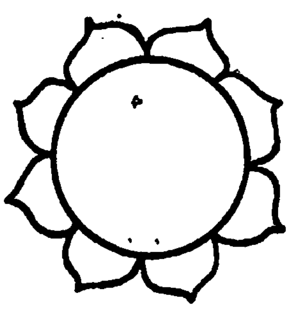
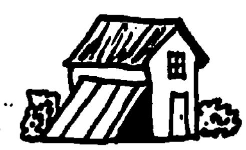
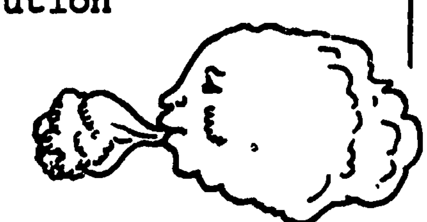
Before and after their energy conservation experiments, students should log their meter readings on Student Handout #6. If the readings in the column "daily electricty used" are smaller during their conservation project than the readings before the project, your students were successful conservationists!

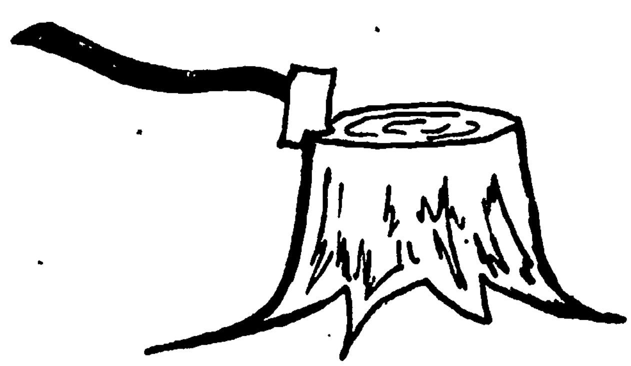
If your students want to do other meter reading projects, they can compare daytime to nighttime energy use, or hours of low appliance use to hours when many energy-demanding appliances are in operation.

Congratulations! You did it -- you energized your students! They now know what energy is, where it comes from, and why awareness and concern about energy may help make the world a better place. So sit down and take a break. You need to recapture some of the energy you used in teaching your students about energy!

Energy Pros and Cons

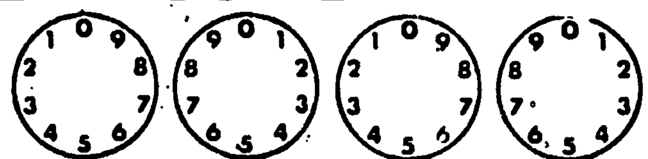
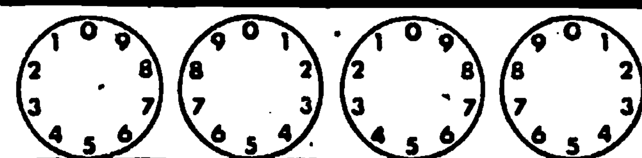
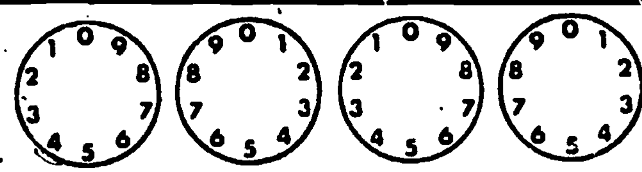
Source	Good Things	Problems
Coal	+ lots of it in the U.S. + easy to get out of the ground 	- burning causes air pollution - accidents and diseases from mining - causes acid rain - limited supply - strip mines hurt land
Oil  	+ easy to get and store + used for many things, like fuel, plastic, paint, medicine, fertilizer, etc.	- limited foreign supply - not much in the U.S. - oil spills cause pollution - burning causes air pollution - costs a lot, and keeps going up
Natural Gas	+ easy to transport and store + burns cleanly + can be used for heating, cooking, and light	- limited supply - costs a lot, and keeps going up - can accidently explode and burn
Nuclear Energy	+ uranium is in the U.S. + makes a lot of energy + no air pollution 	- power plants are expensive to build and run - makes dangerous wastes - power plants can leak harmful radiation - stolen fuel can be made into bombs - causes thermal pollution

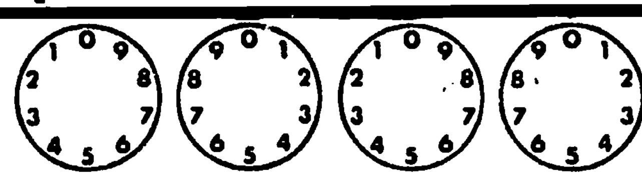
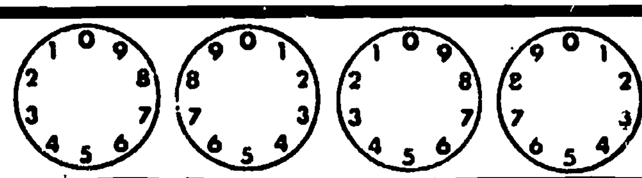
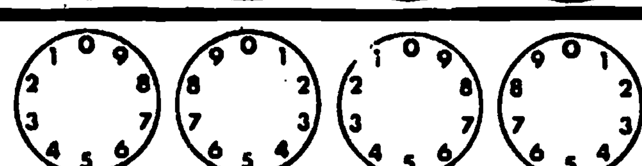
Source	Good Things	Problems
Hydropower	+ cannot run out + water is free + no pollution	- only possible near swift rivers - dams flood farmland and change animal homes - dams are expensive, making hydropower expensive to use
Solar Energy 	+ cannot run out + no pollution + the sun is free + available anywhere	- sun doesn't shine all the time - equipment is expensive - needs more research - difficult to store energy 
Wind Energy	+ cannot run out + wind is free + no pollution 	- wind doesn't blow all the time - windmills need a lot of room but make only a little electricity - more study needed
Wood Energy	+ wood is cheap + the U.S. has a lot of wood + more trees can be planted	- causes air pollution - wood storage needs a lot of space - increases fire possibilities



Name ______________________________

My Meter Readings

I. Before the Family Conservation Project				
date	time	positions of the arrows	reading	daily electricity used
			A=	Day 1 B - A =
			B =	Day 2 C - B =
			C =	

II. During the Family Conservation Project				
date	time	position of the arrows	reading	daily electricity used
			D =	Day 3 E - D =
			E =	Day 4 F - E =
			F =	

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J621.47 B — Berger, Melvin. Energy from the Sun. New York: Thomas Y. Crowell, 1976.

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These books are available at the Jackson District Library. Similar titles may be found at the Jackson District Library's 16 branches under the same Dewey Decimal numbers.

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AT REMC...

The following motion pictures are available at the Jackson County Intermediate School District's Regional Educational Media Center:

"Coal -- The Rock That Burns" MP 2378

"Electricity -- The Way it Works"	MP 2759
"Energy"	MP 366
"Energy -- Choices, Options, Decisions"	MP 368
"Energy for the Future"	MP 370
"Energy in Our Rivers"	MP 910
"Learning About Nuclear Energy"	MP 2576
"Learning About Solar Energy"	MP 942
"Oil -- From Fossil to Flame"	MP 1160
"Power From the Earth"	MP 1262
"Putting the Sun to Work"	MP 1311
"Recycling Our Resources"	MP 1331
"Recycling Wastes"	MP 1332
"Sun, Plants and Animals"	MP 2038
"The Sun: Its Promise and Power"	MP 2620
"To Bottle the Sun"	MP 1569
"Winds and Their Causes"	MP 2108

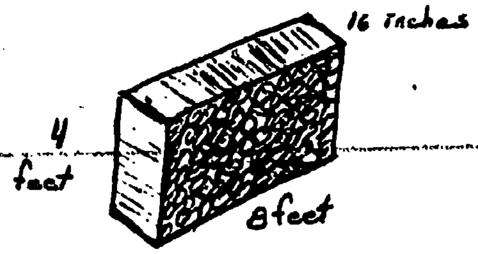
THE WOODLOT

YOUR MISSION: Find out how much fuel wood is in this forest.
Find out how many years this forest will give firewood.

TO ACHIEVE SUCCESS ON YOUR MISSION, FOLLOW THE STEPS BELOW.

1) As a group, decide which trees in your plot are suitable for firewood. Count these trees in 3 groups -- small, medium, and large trees.

2) To find out how many face cords (a measurement of firewood) your plot has, fill in the blanks with your tree totals, and compute the answer.



_____ large trees X 2 = _____ face cords

_____ medium trees X 1 = _____ face cords

_____ small trees ÷ 2 = _____ face cords

This stack of wood 8 feet long and 4 feet tall is one face cord.

NOW REJOIN YOUR GROUP

3) Average all the groups' face cord scores = __________.

4) To find the number of face cords in the whole forest, you need to know that there are 160 plots in the whole forest.

_____ Average face cords per plot X 160 Plots per forest = __________ Face cords per forest

5) To find out how long this wood will heat a home, you need to know that an average of 15 face cords are used to heat a home, Why would this vary from home to home?

_____ Face cords per forest ÷ 15 cords per year = __________ Years this forest can supply fuel.

BUT -- WHAT ABOUT THE FOREST?

6) A forest needs at least 80 years to replace cut trees. If you use wood faster than trees can grow, what happens to the forest? What happens to the animals?

7) To maintain a forest, with animals and trees you can only cut 2 plots each year. Is that enough wood to heat the house (you need 15 cords)? If not, how will you keep warm?

On the average a 10 acre forest (or 400 plots) is needed to heat a house and maintain the forest.

DATA SHEET: WIND

Write the angle reading from the protractor and the wind speed from the chart at each location in the proper blank.

LOCATION	ANGLE (°)	WIND SPEED
Arboretum	______	______
Stream	______	______
Oak Woods	______	______
Wetland	______	______
Field	______	______
Hill Top	______	______

Notice differences in wind velocity from area to area. Where is the wind strongest? Weakest?

Chart telling wind speed from the angle reading.

ANGLE	MILES PER HOUR
90°	0
85°	5.8
80°	8.2
75°	10.1
70°	11.8
65°	13.4
60°	14.9
55°	16.4
50°	18.0
45°	19.6
40°	21.4
35°	23.4
30°	25.8

ENERGY

Fourth Grade Field Trip

Formal Objectives:

Students will:

-Understand human dependence upon energy by listing past and present uses.

-Discriminate among energy sources by categorizing and defining them.

-Appreciate the complexity of the energy situation by discussing its contributing factors.

-Understand energy in the natural world by comparing the energy uses of wild animals and plants to humans.

-Discriminate among alternate energy sources by describing their advantages and disadvantages.

-Understand the potential of renewable resources by experimenting with solar, wind, and water energies.

Non-formal Objectives:

Students will be given the opportunity to:

-Understand the generation of electricity.

-Do a role play introducing energy sources.

-Experiment with and discuss renewable energy sources: solar, hydro, wind, and wood.

-Enjoy the outdoors.

Indoors

Welcome the group. Introduce yourself and the Dahlem Center. Find out how much they know about energy.

1. Energy is defined as the ability to do work. Discuss how we use energy. It will become apparant that energy, in the form of electricity, is very important to us.

2. Demonstrate how electricity is made. First describe or draw a magnet moving inside a coil of wire. Now demonstrate how the hand generator works. Use volunteers to turn the crank. Ask the kids how power companies turn the crank when they generate electricity for cities.

3. "The Best Present of All"

This role play will illustrate the good and bad points of the energy sources just listed by the kids. Assign parts to volunteers and explain how the role play works.

You are the Narrator. Read your first sheet to start the play. Make sure the players speak clearly and come out in the proper order (the cards are numbered). Make sure that Natural Gas and Oil understand how to use their card (when to speak separately and together). You will finish the story by reading your second sheet, after Conservation is through.

Discuss which energy sources are non-renewable and which are renewable. Discuss Conservation. Is saving electricity really saving fuel and resources? I should say so!

Tell the group they will be going outside to discover how we can use some of these renewable sources of energy. Divide them into groups of 4-6 kids first.

Outdoors

During the hike, groups will stop at certain "stations" along the trail to carry out activities concerning renewable energy sources.

1. Outside the Center -- Show kids the solar grill that has been set up. They can observe the results later. Ask them to predict how well the marshmallows will do, based on the weather. Now herd them to the Pavilion.

2. Pavilion -- The kids will experiment with hydro-power. Each group stands at a station consisting of a paddle wheel set over a tub. A gallon jug of water is beside it. They will attempt to lift an object by pouring water over the paddle wheel. Demonstrate how to pour the water and place an object on the hook. Let the chaos begin.

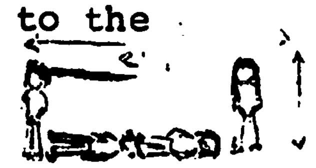
   After clean-up, discuss the power of water. What can water do? What has it done in the past (grist mills, saw mills)? What does it do today?

   Next, give each group a clipboard with the wind and woodlot data data sheets attached. Explain the wind sheet and demonstrate how to use the protractor. Have them record their first reading (Arboretum).

3. Stream -- Use the tinker toy demonstration paddle wheel to see if the stream can do work (leave it at the stream for another group if necessary). Talk about water power, pros and cons. Ask the kids what happens to a river once it's dammed. Possible topics include siltation, habitat loss, use conflicts, limited number of dammable rivers, economics, and amount of power generated (less than 15% of total need). Don't forget though that dams help control flooding, and provide relatively cheap and pollution free power. Finally, take a wind reading and record it.

4. Forest -- Have each group look at their woodlot worksheet. Read the objectives (Mission) aloud. Tell them that wood can be a good fuel, but we must be careful how we use it. This activity will give them an idea of how complicated it can be to use fuels wisely.

Each group will be given a plot in this forest. Every group will complete steps 1 and 2 on their sheet, add up the total number of usable cords on their plot, and then return to the leader. (You can demonstrate a face cord by finding 4 kids, 4 feet tall. Have 2 lie down end to end and the other 2 stand at either end)



Before starting, demonstrate the difference between small, medium and large trees. Clearly explain that thin trees don't count (trees less than 5 inches in diameter). Assign each group a plot and let 'em do it.

Upon return, go over steps 3, 4, & 5 together. Step 4 states there are 160 plots in this forest (40, 33' x 33', plots per acre with 4 acres in the forest equals 160 plots). If they have trouble understanding the formula in step 4, explain that taking the amount of wood in one plot and multiplying it by all the plots in the forest is an easier method of discovering the amount of wood in the whole forest than counting every tree.

For step 5, we arbitrarily selected 15 cords as the amount needed to heat a home. Actually, the amount can range from 10 to 20 face cords, or more, depending on house size, amount of insulation, number of windows, quality of wood, etc. Red oak, white oak and hickory are all excellent fire woods. Ask the kids what kinds of things could affect the amount of wood needed as fuel.

The mission is accomplished, but what does it all mean? Read step 6 aloud. Have them answer the questions. Will this forest last forever? (Probably Not!) Ask them if they want to keep this forest? If and when they say yes, go to step 7.

Read 7 aloud. Answer the questions. Have the kids decide what they want to do with this forest, keep or cut. Or is there a way to do both? If they cut only 2 plots each year and find another fuel source to complete their heating needs, they can use wood for fuel, maintain the forest, and use less of another fuel.

Discuss problems with wood for fuel - pollution, habitat loss, less diversity due to tree farming, etc.

Oh yes, don't forget that wind reading.

5. Wetlands -- Before or after taking the wind reading, instigate a discussion about energy use by animals. A good way to start is to review where we get our energy. They know it's from food. Ask them what they had for lunch or breakfast. Trace it back through the food chain to the sun. Challenge them to think of any living creature that doesn't get its energy from the sun. Ingrain into their minds that the sun is the source of energy for all life.

This energy travels from one organism to next by way of food chains and food webs. Unfortunately, it is a law of nature that energy is lost as it gets transferred from organism to organism along a food chain. As a general rule, energy loss is 10% on each transfer (aquatic chains are more efficient). Example:

	SUN	PLANT	INSECT	BEETLE	SHREW	HAWK
kilocalories =		10,000	1.000	100	10	1

According to this chain, a shrew needs to eat 10 beetles to get 100 kcal. while a hawk must eat 100 shrews to get the same. Hence, a large number of plants and plant eaters are needed to support a relatively small number of meat eaters. Basically, 1 pound of corn gives 10 times more energy than 1 pound of beef. You can illustrate this by having the kids form a human pyramid (if the ground is clear) -- 3-2-1. The base always needs to be wider to support the top.

When food is scarce, and the climate harsh, as during winter, an animals survival depends on how well it utilizes its available energy supply. Mention some of the adaptations animals possess to conserve or store energy - hibernation, insulation, torpidity, migration, storing food, finding warm spots, i.e. logs, soil or mud.

6. Field & Hill -- After taking the final wind readings, discuss wind energy, pros and cons. It will be obvious that wind speed varies from place to place. Ask them where the best spot for a wind generator would be? (High on the hill.) Wind power is most feasible in only a few places throughout the world. It is a fickle resource. Mention some of the historical uses - Holland's wind mills, pumping water on farms.

Return to Center to observe solar cooker.

<u>Summary</u>

Review energy sources. Remind kids that each source has strengths and weaknesses. Stress the importance of applying different sources to their most efficient or best uses. No one source will solve all our problems. Finally, tell them that conservation can help decrease the amount of energy we'll need. Americans waste almost 50% of the energy we use. Of that, 60 to 80 percent could be saved. With a little effort, and a few changes in the way we live, Americans could save energy, resources, and money.