Lexington Children's Museum
Final Report
to the
U.S. Department of Energy
on
EnergyQuest

DOE/ER/75752--71

EnergyQuest was successfully completed.
EnergyQuest opened to the public on August 26, 1995.

EnergyQuest was--and is--a museum-wide exhibit that familiarizes children and their families with energy sources, uses, and issues and with the impact of those issues on their lives. It was developed and built by Lexington Children's Museum with support from the US Department of Energy, Kentucky Utilities, and the Kentucky Coal Marketing and Export Council. EnergyQuest featured six hands-on exhibit stations in each of six museum galleries. Collectively, the exhibits examine the sources, uses and conservation of energy. Each EnergyQuest exhibit reflects the content of its gallery setting. During the first year after opening EnergyQuest, a series of 48 public educational programs on energy were conducted at the Museum as part of the Museum's ongoing schedule of demonstrations, performances, workshops and classes. In addition, teacher training was conducted.

During the first year after opening, 78,688 Museum visitors enjoyed the exhibits, with 1,255 children and families attending the program series. School and other group tour attendance was 17,735, with special attention to energy related education for school groups. On October 17 and 19, 1995, EnergyQuest In-Service training sessions for teachers were held at Lexington Children's Museum. These sessions highlighted the EnergyQuest exhibit and emphasized ways to use energy education to meet Kentucky Education Reform Act guidelines. Attending teachers received a 180-page EnergyQuest Teacher Resource Book with lesson plans, and a specialized program for their class when they returned to the museum for a tour.

The outstanding success of EnergyQuest has gone far beyond the original two year scope of the project, since three years later, five of the six exhibit stations are still providing a frame of reference for dealing with energy topics, and giving museum visitors some understanding of the pervasive nature of energy: that it is important in every aspect of our lives. An additional 130,521 museum visitors have been served during that time. We expect EnergyQuest exhibits to be an important presence in the museum galleries for several more years, serving an estimated 375,000 visitors over at least the next five years.

DISCLAIMER

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Contributions of funds to EnergyQuest

In partnership with DOE, EnergyQuest was funded by Kentucky Utilities and the Kentucky Coal Marketing and Export Council of the Cabinet for Economic Development, Commonwealth of Kentucky.

Acknowledgment of support

Prominent and attractive signage draws attention to the major contributors to EnergyQuest at the entrance of the museum, and at each exhibit station. The order of acknowledgment is: U.S. Department of Energy, Kentucky Utilities, and Kentucky Coal Marketing and Export Council. Supporters were similarly acknowledged in all publications, press releases, media coverage, and opening invitations.

Contributions of services to EnergyQuest

EnergyQuest was also an exceptional achievement in terms of collaborations. Contributors to the exhibits and programs included:

Conservation and Renewable Energy Inquiry and Referral Service
Energy Efficiency and Renewable Energy Clearinghouse
National Renewable Energy Laboratory
National Wind Technology Center
Sandia National Laboratories

and

APS Systems
Center for Renewable Energy and Sustainable Technology
Edison Electric Institute
Kentucky Department of Education
Kentucky Economic Development Cabinet
Kentucky Environmental Education Council
Kentucky Geological Survey
Lexington Children's Theater
NASA
Pacific Gas and Electric
Quadlux
Science Museum of Minnesota
University of Georgia
University of Kentucky
Utility Wind Interest Group
WLEX-TV.

In addition, Lexington Children's Museum Exhibit Volunteers gave 1,222 hours to the EnergyQuest project.

Matching funds caused delays

EnergyQuest was not without challenges. The project received funding from the US Department of Energy in September, 1992. Matching funds for the project were felt to be secure at that time but fell through a month after DOE funding was granted. An immediate search for matching funds was started by the board and staff of the Lexington Children's Museum. Some six months later another source was found, but that, too, fell through.

After 18 months the EnergyQuest project was extended by request for an additional two years in order to find funding and complete the project. In February, 1994, Kentucky Utilities committed to $25,500 of the needed $49,600 match and the Board of the Museum decided to absorb the additional match through the Museum's operating budget. The project was finally begun again after a hiatus of a year and a half. In September an additional $24,800 in funding was secured from the Kentucky Coal Marketing and Export Council of the Kentucky Economic Development Cabinet and the Museum operating budget could comfortably be left out of the matching equation.

At the end of 1992, a presentation on the project was given at the Science Education Directors' Meeting organized by DOE in Washington. Given the situation with the matching funds and the extension to the grant, DOE granted our request not to expend funds to attend the next Science Education Directors' Meeting, saving those funds for travel after the completion of the fund raising and resumption of the project. Accordingly, another presentation was made at the Science Education Directors' Meeting in March of 1995, in which we were pleased to report substantial progress in exhibit development and fabrication, and a planned opening date for the exhibits in August 1995.

Development and fabrication of the exhibit
Development and fabrication of EnergyQuest were fully engaged in July, 1994, when the first of two payments were received from one of the project's co-sponsors, Kentucky Utilities. Here is a short description of each of the project's six exhibits:

Around Our Town: To examine how cities and towns might use some of the many energy sources available to them, and conserve energy from traditional sources, the Museum's existing kid-size community buildings were retro-fitted for alternative energy sources, just as buildings in a real community might be. A flashbake oven and recycling bins were prepared for the Diner. A wood stove and insulated wall with viewing window were installed in the Fire House. A Cookermobile, a play vehicle, uses excess engine and exhaust heat to "cook" food. A bio-diesel pump, based on research at the University of Georgia in using peanuts as fuel, was installed to fuel the Cookermobile. The Bank was fitted with a wind generator, and the Puppet Theater with solar collectors. The Ambulance was converted to electric operation. A Farm was added with cutout "crops," representing biomass energy, which children can position with velcro on the floor and wall. A table with construction pieces was included, for building an energy future. Shade tree cutouts were used to stress the importance of trees in energy conservation.

Elements retrofitted to Around Our Town, making an Energy Village, are accompanied by large, colorful photographs of real applications of alternative energy, for example, a solar powered car race, wind generators in California, and a biomass power plant. Many of the photographs were obtained from DOE agencies around the country. Appropriate text explains the technologies.

Around Our World: This exhibit examines our global interdependence on energy resources. A computer game puts the player in the role of mediator between two countries who are about to go to war over an energy decision: whether and/or where to build a dam. The computer interfaces with a videodisc, enabling the player to meet many live characters (there are 43 in all), each having his or her own point of view about the dam. Using the information pieced together from the characters, and guided by a major character in the game, Laptop, the player completes the decision making process by choosing from a menu of possible recommendations. Outcomes from the chosen option encourage a positive impression of the process, and the importance of a global view of energy issues.

Bicycle Generator: The visitor discovers the nature of energy in the human body by riding a bicycle which generates electricity. The exhibit directly compares the energy in food to that in coal, and features photos of coal powered generating plants in Kentucky.

Natural Wonders: A "solar pinball" game explores the idea of the sun as the source of energy in earth systems, and conservation of energy in natural systems. The visitor puts a definite amount of energy (a number of marbles) into the system (a maze), then predicts how much energy will come out. An electronic readout counts the marbles and lets the visitor know that energy in and energy out in Earth systems are the same.

History and Time: This hands-on exhibit explores energy use in technology of the past as compared with current technology. Children can "cook" a meal in any of four ways: a campfire, a wood stove, a standard electric range, or a microwave oven. The energy use in the different technologies is compared in accompanying text.

Physics and space: An interactive computer/videodisc game, using a NASA videodisc, deals with the energy issues of space exploration. As in the other EnergyQuest videodisc game, the visitor is engaged in a decision making process: the mission objective is to plan a mission to Mars using finite energy resources. As mission managers, visitors must choose between a manned or robot mission, with the outcomes of their decisions emphasizing the greater energy needs of a manned mission.

Programs enhanced and expanded the exhibit themes: EnergyQuest programs were launched at the public opening of the exhibits, with a wall mural about energy created by children using markers, paper, crayons, foil, glue and other materials. The programs stressed hands-on, discovery learning, designed to encourage interaction and to raise awareness of energy issues within themselves, as resources, and as controversy between people.

A series of 48 hands-on programs then extended throughout the school year, and into the following summer. Age appropriate activities covered children grades k-3 and 4-7 visiting the museum with their families. Adults were engaged along with the children. Outstanding examples of the programs include:

The popular **Conservation Station** series: Throughout the year, children reused and recycled many materials--newspaper, paper bags, wall paper, junk mail and other papers, plastic foam, fabric scraps--even tin cans--to make new objects while learning about energy conservation. These materials were turned into notepads and wrapping paper, Chinese globe lanterns, jewelry, origami windmills, holiday ornaments, masks, collages, metal lanterns, hand made paper, toys, piggie banks, mobiles, book covers, wind socks and even ties for Father's Day.

Coal--A Kentucky Wonder: Children found out what makes coal different from other rocks, where it is found, and how it is used.

Not Just Hot Air: Children created paintings with straws and wind, learned about the wind in nature and wind generated electricity.

Don't Let the Ice Melt: Children invented a conservation contraption using insulation to keep their ice cubes from melting. The longest melt time was the winner, but learning about energy conservation and creativity in applying their knowledge were more prominent.

Energy Hunt: Children did an energy treasure hunt in the EnergyQuest exhibits.

Does Energy Come From the Wall Socket?: Children did experiments about local energy resources such as coal and oil with a coal geologist.

Planes, Trains or Automobiles?: A story and art activity introduced energy use in different kinds of transportation.

Our Mr. Sun--The Story of the Sun's Energy: An astronomer presented a story about the sun and nuclear energy.

Oil and Water Don't Mix: Hands-on experiments with oil and water introduced visitors to some of the possible costs of energy use--oil spills.

Surface Mining: Mining cookies for chocolate chips was a popular program in which children extracted the energy (chips) from the earth (cookies) and calculated how much electricity would be produced. Issues such as how long the energy resource would last, and how to reclaim the surface of the cookie after mining were highlighted.

Secrets of the Earth: Children found coal by coring and learned how miners use maps to find energy sources.

Building Energy: Movement activities and snacks taught children how their bodies get and use energy.

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EnergyQuest restarted after matching funds were found

After 18 months the EnergyQuest project was extended by request for an additional two years in order to find funding and complete the project. In February, 1994, Kentucky Utilities committed to $25,500 of the needed $49,600 match and the Board of the Museum decided to absorb the additional match through the Museum's operating budget. The project was finally begun again after a hiatus of a year and a half. In September an additional $24,800 in funding was secured from the Kentucky Coal Marketing and Export Council of the Kentucky Economic Development Cabinet and the Museum operating budget could comfortably be left out of the matching equation. Development and fabrication of EnergyQuest were fully engaged in July, 1994, when the first of two payments were received from one of the project's co-sponsors, Kentucky Utilities.

Lexington Children's Museum
Progress Report
to the
U.S. Department of Energy
on
EnergyQuest

1995

A plan for a Museum-wide exhibit
EnergyQuest is a project to develop and build six exhibit stations in each of six museum galleries. Collectively, the exhibits examine the sources, uses and conservation of energy. Each EnergyQuest exhibit will reflect the content of its gallery setting. During the first year of EnergyQuest, a series of 48 public educational programs on energy will be conducted at the Museum as a part of the Museum's ongoing schedule of demonstrations, performances, workshops and classes.

Matching funds has caused delays
The EnergyQuest project received funding by the U. S. Department of Energy in September, 1992. Matching funds for the project were felt to be secure at that time but fell through a month after DOE funding was granted. An immediate search for matching funds was started by the board and staff of the Lexington Children's Museum. Some six months later another source was found, but that, too, fell through.

After 18 months the EnergyQuest project was extended by request for an additional two years in order to find funding and complete the project. In February, 1994, Kentucky Utilities committed to $25,000 of the needed $49,800 match and the Board of the Museum decided to absorb the additional match through the Museum's operating budget. The project was finally begun again after a hiatus of a year and a half. In September an additional $24,800 in funding was secured from the Kentucky Coal Marketing and Export Council of the Kentucky Economic Development Cabinet and the Museum operating budget could comfortably be left out of the matching equation.

The project now
Development and fabrication of EnergyQuest have been fully engaged since July, 1994, when the first of two payments were received from one of the project's co-sponsors, Kentucky Utilities. Here is a short description and a status report on each of the project's six exhibits and the educational programming:

Around Our Town: *To examine how cities and towns might use some of the many energy sources available to them, and conserve energy from traditional sources, the Museum's existing kid-size community buildings will be retro-fitted for alternative energy sources, just as buildings in a real community might be.* Many of the elements of the exhibit in this gallery are well underway in fabrication. A flashbake oven and recycling bins are being prepared for the Diner. A wood stove and an super-insulated wall will be installed in the Fire House. The Mail Truck will be re-made into a Cookermobile, a vehicle which uses excess engine and exhaust heat to cook food. A bio-diesel pump will be installed to fuel the Cookermobile. The Fruit Stand will have a new device installed for bio-mass conversion. The Bank will employ a windmill for energy. Our Ambulance will be refitted as an electric vehicle. Exhibit Designer Judy Lundquist is acquiring photo images for use in this area, and gadgeteer Mike Hecko and artist Steve Sawyer are scheduled to begin work soon on the Cookermobile, now that designs are complete.

Around Our World: *This exhibit examines our global interdependence on energy resources. A computer game will put the player in the role of mediator between two countries who are about to go to war over an energy decision. The computer interfaces with a videodisc of graphics and live-action to enhance game play and imagery.* Program design is complete and programming is well underway. Forty-three live-action characters are now on videotape and are being electronically matched with suitable backgrounds for the videodisc; a major character in the game (Laptop, the game-player's guide) is being written and the actor is chosen; and graphics and icons are being developed. Exhibit technician Juan-Carlos Aguilar has been doing paper tests of the game with children, and a few changes are scheduled as a result of his tests.

Bicycle Generator: *The visitor discovers the nature of energy in the human body by riding a bicycle which generates electricity. The exhibit compares the energy in food and in coal and explores different ways of getting and using energy.* The bicycle generator is nearly complete. Work on the display and text is progressing--this is the last step before testing.

Natural Wonders: *A "solar pinball" game explores the idea of the sun as the source of energy in systems and cycles such as the carbon cycle on earth.* A first prototype of the solar pinball game was developed and tested. In general, the game design failed the tests with children. While the game was intensely interesting to them, and engaged them for extended periods, the informational content failed to come across. The second prototype is almost complete and technician Shawn Ewing is putting together the electronics for it. When it works as needed, we will begin testing.

History and Time: *How technology has changed the way we use energy in our daily lives, e.g., open fire vs. microwave for cooking.* This exhibit is scheduled for extensive work later in the schedule.

Physics and Space: *This exhibit examines the use of energy in exploring space through a computer game in which the player chooses various technologies to explore Mars, taking into account their energy costs.* Work progresses on the programming, script writing and image gathering. Steve Sawyer, an artist who is working on the

Cookermobile with us, works in computer art and is developing animations for the game.

Educational Programs: *EnergyQuest's 48 educational programs will be developed during the period May-July by a team of three science teachers who will work closely with the Museum's Education Director, Suzanne Minichillo, who replaced Cynthia Moreno, who was Education Director when the project started.* The search for the EnergyQuest Science Teacher Team was begun in March, 1995, and the team is now hired. Three educators will spend the summer months researching energy-related activities for the Museum's Education Department and preparing us for the August opening of EnergyQuest. Printing of program guides will begin when research has progressed to a point to allow it.

EnergyQuest is scheduled to open to the public in August, 1995. Educational programming will begin in September.

EnergyQuest

Teacher Resource Book

Created by the Lexington Children's Museum

Suzanne Minichillo
Melinda Kuhnhenn
Tomi Lounsbury
Mike Wlosinski

With support from
U.S. Department of Energy
Kentucky Utilities
Kentucky Coal Marketing and Export Council

ENERGYQUEST
Teacher Resource Book

PROLOGUE

When the Museum began researching energy as a subject, we surveyed children to see what they know about energy. The interpreter of that data commented, "If these children learn anything about energy, it will be more than what they now know."

Because energy can be a rather abstract subject, teaching it to younger students can be a challenge. It is our hope that with the information provided in this packet, and a little imagination, you will soon have your classroom "energized" and realizing that energy is everywhere.

Suzanne Minichillo, Director of Education, Lexington Children's Museum
Melinda Kuhnhenn
Tomi Lounsbury
Mike Wlosinski

Our thanks to to all of those who gave their time, talents, and advice in production of this Teacher Resource Book.

About the Lexington Children's Museum

GROUP TOUR INFORMATION

To schedule a group tour at the Museum or to ask additional questions, please call 258-3256.

HOURS

The Museum is open Tuesday - Friday 10:00 - 6:00, Saturday 10:00 - 5:00 and Sunday 1:00 - 5:00

Labor Day - Memorial Day the Museum is closed Mondays.

Memorial Day - Labor Day the Museum is open Monday 10:00 - 6:00.

ADMISSION PRICES

Children 24 months - 17 years are $2 each. Adults are $3. Senior Citizens $2. Children under 2 yrs are free.

A group tour is any group of more than 10 children. The Museum requires that groups bring one chaperone for every five children. Chaperones are free at the 1:5 ratio. Additional chaperones are required to pay admission.

THE ENERGYQUEST EXHIBIT

Overview
The EnergyQuest exhibit is the first exhibit of its kind and was designed by the Lexington Children's Museum. Its design is made to take a common theme, energy, and highlight it in six of the galleries of the Museum. Therefore, it becomes an ideal resource for schools which are interested in teaching through multiple disciplines and intelligences. An EnergyQuest Navigator sheet has been designed to help tie the different exhibits together with a overall activity. A copy of this sheet can be found on page ___. The answers to the sheet are found by pressing a stamp at each EnergyQuest station. The answers are printed on your sheet in the circles.

Natural Wonders (Natural Science)
SOLAR PINBALL MACHINE
Content:
- The ultimate source of energy for the Earth is the Sun.
- Once sunlight reaches the Earth, it powers the natural cycles that sustain life.
- The sun's energy moves through many cycles and is converted into many forms, but it is not lost--eventually it is reradiated back into space.

Exhibit:
By placing marbles representing the sun's energy into a pinball machine, children learn that the Earth does not "use up" the energy. Before placing marbles into the machine, children are asked to predict how many marbles will come out of the bottom of the machine. The machine always returns all of the marbles placed into the machine back to the children at the bottom; the number of marbles entered into the machine is always equal to the number that is returned to the child **unless the machine is &#%$ed up.** By experimenting with the marbles, children will learn usually pick up on the content goals outlined.

Physics and Space
MISSION TO MARS
Content:
- Space flight uses enormous amounts of energy.
- Scientists use robotics and long-distance telemetry to reduce the energy needs of space exploration.

Exhibit:
Through a computer game, the visitor assembles the tools, equipment, and materials necessary for a mission to the Red Planet. As the needs of the project scientists are addressed, the energy cost of the mission is assessed by the computer and the visitor finds that this mission may -- or may not -- fly. Questions of weight, life support, project and scientific priorities, and cost are involved in making final decisions about what to take and what to leave behind.

Around Our World (World Cultures)

THE QUEST FOR PEACE

Content:

- All societies, regardless of their level of development require energy.
- Geography is not fair. Available energy resources are not evenly distributed and may result in conflict.
- There can be no single, simple solution to the world's energy problems; for example, environmental consequences of energy use can have important social outcomes.
- Developing solutions to conflicts over energy requires creativity; it is difficult but very rewarding.

Exhibit:

The visitor discovers through an interactive computer/videodisc-based decision making game the value of cooperation vs. competition among countries for energy resources. A specific scenario is developed in which the visitor must consider many sides to a conflict and develop a plan to resolve it. Two nations, Xenophobia and Discordia, are in confrontation to the point of war about whether or not a hydroelectric dam should be built. The visitor plays the role of mediator in the dispute. Positive outcomes will encourage visitors to think of energy problems as challenges that, while complex, are soluble.

History and Time

ENERGY OVER TIME

Content:

- Energy may be used in different ways to accomplish the same work.
- Different ways of using energy have developed over time.
- Different ways of using energy have different consequences.

Exhibit:

This hands-on exhibit explores energy use in technology of the past as compared with current technology. Visitors experiment with technologies which have changed over time, comparing a camp fire, wood burning stove, electric stove and microwave, all of which have been used to accomplish the same task. They are asked through leading questions to experiment with some of the sources, amounts and consequences of energy use in the different technologies.

The Me Gallery (the physical and sensory self)

BICYCLE GENERATOR

Content:

- Energy is required to do work.
- More energy is required to do more work.
- Energy required for muscles to do work is derived from food.
- Energy derived from food is comparable to other energy sources such as oil, though they operate in different systems. (We don't swallow lumps of coal, nor do we try to burn bananas in the power plant.)

Exhibit:
Visitors operate a bicycle generator to light up light bulbs. As the visitor bicycles faster, a column of cereal bowls lights up which indicate the amount of calories that the rider needs to keep up that speed for eight hours. A lump of coal is displayed that can generate the same amount of energy as the rider for eight hours.

Around Our Town (the community)
ENERGY VILLAGE
Content:

- There are many new ways to obtain the energy necessary to maintain societies, and to increase energy efficiency.
- Experimentation, imagination, creativity and dreaming are essential to solve the difficult challenges of energy.

Exhibit:
In the community gallery, the visitor explores an "Alternative Energy Village" through art and hands-on models. This model town uses many of the available alternative energy sources such as wind, solar, geothermal, biomass conversion, and especially conservation. Some examples are: a flashbake oven, recycling bins and menu converted into energy in the dinner; an electric battery in the ambulance; shade trees; solar panels on the puppet theater; a windmill on the bank; insulation and wood burning stove in the fire station; a cookermobile (automobile that runs on alternative fuel--peanuts--and lets the visitor use the energy produced when the car is running to cook.)

EnergyQuest

Search

Sound is energy.
Where in the Museum can you play a song with your feet?
Where in the Museum can you play a song by using your finger and a little water?
What is 550 feet long and lets you hear sound travel in the Museum?
How long does it take for sound to travel 550 feet?

Food is energy.
How many different places in the Museum can you cook dinner?

Light is energy.
In the Museum, there is a place where we use a bright flashing light in a dark room with a special wall. What can you create on the wall?

Exercise uses energy.
What gives our bicycle the energy to light up lightbulbs?

Weather is energy.
Where in the Museum can you make a tornado?
Where in the Museum can you see the effects of rain?

Coal is energy.
Where in the Museum can you find what we burn to make energy?

Wind is energy.
What moves over the bank when the wind blows to make energy?

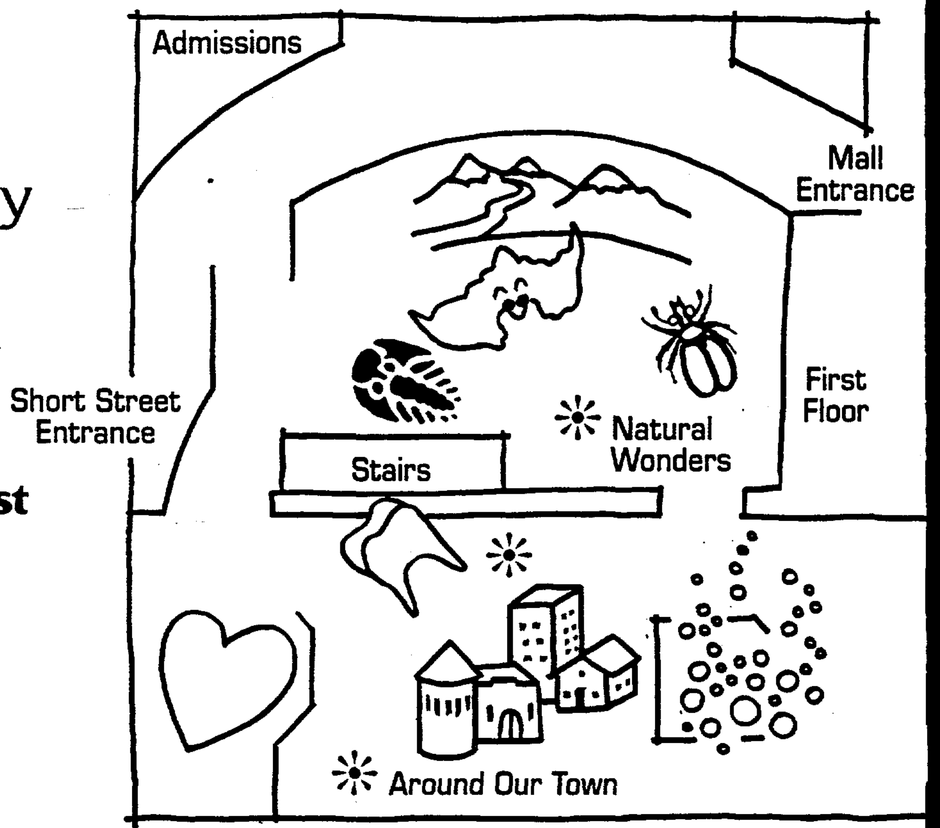
EnergyQuest

NAVIGATOR

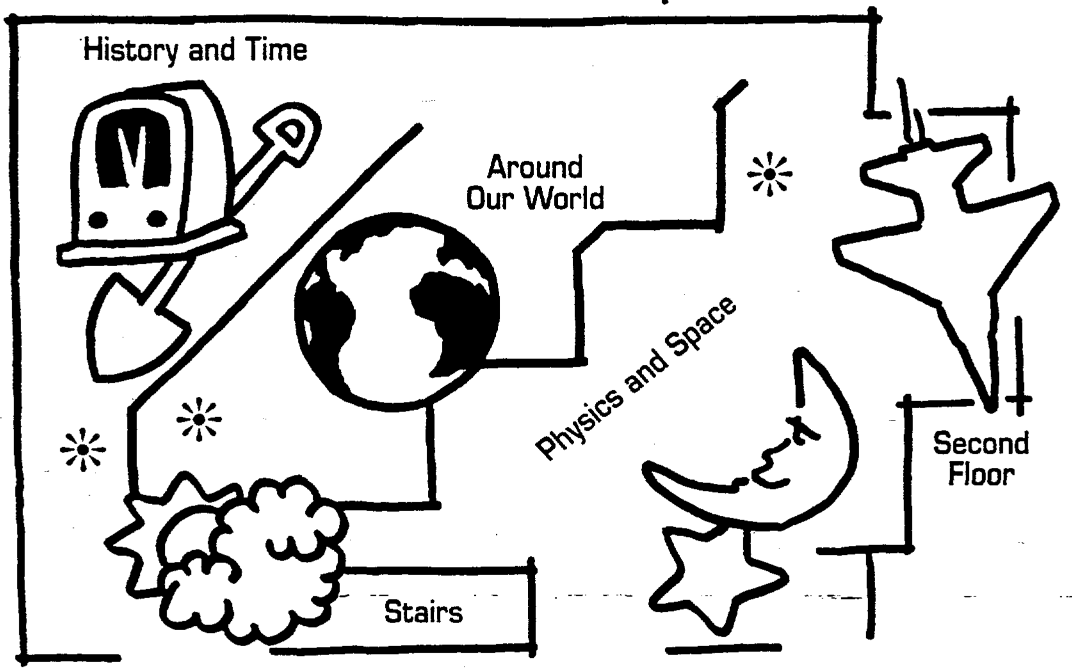
There are six EnergyQuest adventures.

YOUR MISSION IS TO:

1. Find them.
2. Play each one.
3. Log each one by stamping your log on the back of this map.



Look for the EnergyQuest sign in each part of the Museum.



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and Export Cou

EnergyQuest LOG

Earth's Energy

Experiment with earth's energy. Where does it come from? Where does it go? What does it do in between? Follow the directions and use your Sherlock Holmes powers of observation.

Where does the Earth get its ENERGY?

The Sun

Your Energy

You have lots of energy, don't you? Prove it by pedaling the Bicycle Generator. Where do you get all that energy? Energy is energy, whether it's in you or in a lump of coal.

Where does your body get its ENERGY?

YOU!

Energy Futures

We usually burn coal to get electricity for energy in our homes, farms, factories and schools. But there are other ways to get energy. Snoop around Energy Village. How many can you find?

What nation will be first to make new ways of getting ENERGY?

Imaginati

Energy In Space

A voyage to Mars is in your future. Explore the red planet to find a site for a new research station. But watch out! Your energy resources are limited!

Which needs more ENERGY to get to Mars, people or robots?

People

Global Energy

Hurry to the countries of Discordia and Xenophobia to prevent a war over energy. But take care -- it's a real balancing act!

All countries have the same ENERGY resources, right?

WRON(

Energy In Time

So you think you know how to cook an egg? Try four different ways, but don't waste any energy!

Campfire, Wood stove, Electric stove or Microwave: Which uses the least ENERGY?

Microwa

MUSEUM SEARCH FOR ENERGY

Approximate Time Needed:
- 1 class period

Materials:
- Sheets of paper to write down possible energy in the museum.
- Scavenger hunt sheet with a list or picture of energy sources.
- **NOTE:** Pictures would be particularly good for little ones.

Students Grouping
- Groups of two or singly

Background:
- What is energy?
  - Is it moving?
  - Do we have something when it's used?
  - How do we know it's there or was there?
  - Can we recycle energy? (Yes, it's all recycled -- energy cannot be made nor destroyed.)

Preparation for Activity:
- A selection of energy sources should be listed. Include obvious and discrete energy sources.

Instructions:
- As a group or in pairs or singly, tour the museum for energy sources.
  - Lights, motors, waves, etc.
  - Plastics, wood, metal, etc.
  - Animals, plants, sunlight, etc.

Assessment:
- List the groups energy sources.
- Which are obvious? Which are not?
- If it is an object, can you identify the original energy source?
- Can any of these sources be recycled?

Extensions:
- Do a search at your school. Where can your school conserve? Is conservation important?
- Do a "green audit" at your home (see page L-19 for help).

Book Ends: An Introduction and Conclusion to Energy

ENERGYQUEST FUN FACTS

Recycle and Conserve Energy

If everyone in the U.S. recycled their Sunday newspapers, we'd save 500,000 trees a week.

Each American uses about 580 pounds of paper a year! (or a stack two stories high)

Every ton of recycled paper saves more than 3 cubic yards of landfill space, 380 gallons of oil, 17 trees and 7,000 gallons of water.

Every American uses about 7 trees a year in paper, wood and other products.

One 15 year old tree = 700 paper grocery bags

It takes a piece of paper 30 days to decompose. A wool sock 365 days to decompose and a soda can 200 years.

We use over 65 billion aluminum soda cans every year.

Energy saved from recycling just one aluminum can could keep a TV running for 3 hours.

The energy saved from recycling one glass bottle will light a 100 watt bulb for four hours.

For American to water their lawns every week, it takes 540 billion gallons of water. That's enough to give every person in the world a shower for four days in a row.

One gallon of gas can contaminate 750,000 gallons of drinking water.

We open our fridges 22 times a day = 8,000/yr.

School cafeterias probably provide over 1000 milk cartons every week. What does your school do with them?

All plastic is made from petroleum, a non-renewable resource.

Even biodegradable plastic bags never completely disappear. They break up into little pieces.

Americans use 2.5 million plastic bottles every hour.

Styrofoam, a type of plastic, is not recyclable.

Americans produce enough styrofoam cups every year (25 billion) to circle the Earth 436 times.

Over a billion trees are used to make disposable diapers every year.

Place a small juice bottle, filler with water and capped tight, in your toilet tank. It can save 1-2 gallons per flush.

Laid end to end, the 18 billion disposable diapers thrown away in the U.S. each year could reach back and forth to the Moon 7 times.

In one year, traffic congestion alone can waste 3 billion gallons of gasoline.

Landfills have the following:

38% paper/paperboard
18% plasic
28% other
14% metals
2% glass

One quart of used motor oil dispersed in water can creat an oil slick 6 acres in size.

Each 4' stack of newspaper that is recycled saves the equivalent of a 40' pine tree.

Making paper from scrap instead of wood pulp cuts energy and water use by 50%.

If the U.S. recycled 1/2 the newsprint it uses a year, it would divert 6 million tons of material from landfills--enough to fill 3200 garbage truck a day.

It costs $4 billion/year to dispose of America's trash.

Every year, Americans throw away:
Enough aluminum to rebuild the fleet of a major airline 71 times.
Enough steel to reconstruct Manhattan.
Enough wood and paper to heat 5 million homes for 200 years.

The amount of wood and paper we throw away each year is enough to heat 50 million homes for 20 years.

99.5% of all fresh water on Earth is in icecaps and glaciers.

About 110 million Americans live in areas with levels of air pollutant the federal government considers to be harmful.

Americans dump 16 tons of sewage into their waters every minute of every day.

Americans throw away 2.5 million plastic beverage bottles every hour.

How much do you use?

1 toilet flush	3 1/2 - 7 gallons
1 bath	25-30 gallons
10 minute shower	50-70 gallons
1 washing machine load	30-60 gallons
1 dishwasher load	9 1/2-12 gallons
Toothbrushing	2 gallons (tap running)
Hand Washing	2 gallons (tap running)
Shaving	3-5 gallons (tap running)
Dishwashing	20 gallons (tap running)
Outdoor watering	5-10 gallons every minute

Every year, the typical American family throws out:
2,460 pounds of paper
540 pounds of metals
480 pounds of glass
480 pounds of food scraps

Americans throw away about 40 billion soft drink cans and bottles every year. Placed end to end, they would reach to the Moon and back 20 times.

84% of a typical household's waste can be recycled. Only about 10% of our trash is recycled. About 80% of our waste ends up in landfills. At this rate, 1/2 of the country's landfills will be full by the year 2000.

Using recycled paper for one print run of the Sunday edition of The New York Times would save 75,000 trees.

If every American recycled 1/10 of their newspapers, we would save about 25 million trees a year.

More than 1/2 of the trash Americans throw away is organic. In fact, every year each of us throws away about 1,200 pounds of organic garbage. Worms help composting. They eat rottn garbage and actually make great soil.

The Sun is the supplier of nearly all the energy on Earth.

Energy from wind is caused by the Sun.

Lightning = electrical energy, heat energy, light energy and sound energy (thunder)

Water wheels were used for irrigation as long ago as 600 BC.

Water can change the shape of land.

More than 1/2 your weight is water. All living things need water. We can survive longer without food than water.

Wind is one of the earliest forms of power people learned to used. Wind was used to move boats with cloth sails as long ago as 3500 BC. Wind mills 700 AD--Persia.

Your brain operates on only 10 watts of electricity. That's the same amount needed to light up one bulb on a string of outdoor lights.

The electricity in your body helps injuries heal faster. When you cut yourself, electricity begins to flow from the cut, creating an electric current. This makes nerves in the injured area grow faster and triggers cells to divide and fill in the cut to start the healing process.

Your body makes electrical energy (needed in your cells) from the food that you eat.

If all countries were as energy efficient as Japan, the world would be able to produce its current output with only 2/3 of the energy it now consumes; fewer countries would be dependent on imports; and energy use would be more equally distributed.

ENERGY WALL: An Introduction to Energy

Approximate Time Needed:

- 1 class period

Materials:

- Scissors
- Glue
- Tape
- Scrap paper (some colors)
- Crayons
- Markers
- Other miscellaneous art supplies

Student Grouping:

- Individual

Background:

- The concept of this activity is to serve as an introduction to energy. This activity illustrates initial perceptions of energy.
  - What is energy?
  - Where can you find it?

Instructions:

- Create something that you think has energy.

Assessment:

- List the things created.
- Which are obvious, which are not?
- Which are creative or use new types of energy?
- Which conserve or save energy?

Extensions:

- After several energy lessons have been taught, write about how your perceptions of energy have changed.

ENERGY MURAL: A Conclusion to Energy

Approximate time needed:

- 1 class period to several class periods

Materials:

- washable tempera paint
- smocks
- sponge brushes (wider than bristle brushes)
- butcher paper
- a large, flat wall
- containers for the paint

Student Grouping:

- Entire class can participate, but it's suggested that shifts of 4-5 students work at a time.

Background:

- Several class periods devoted to energy, its sources, uses, and conservation
- What have you learned about energy?
- Did you have ideas about energy before that were wrong? What were they?

Preparation:

- Prepare materials.
- Do several classes on energy, its sources, uses, and conservation.
- Decide as a class what will be the theme of your mural. Some ideas:
    - Things We Can Do to Save Energy
    - An Energy Village
    - Energy Over Time

Instructions:

- Put the paper on the wall using tape.
- Place some paper on the floor immediately beneath the mural to catch paint drips.
- Using pencils, sketch out the general design of your mural.
- Place each color of paint in a container.
- Have each student wear a smock to protect clothing.
- Each shift of students paints a portion of the mural.
- **NOTE:** This activity can be extended over numerous class periods, depending on the size of the mural and the number of students involved.

Assessment:

- Will be handled throughout the activity

Extensions:

- Conduct an Energy Carnival by making carnival games from recycled products. Use your mural to decorate.

- Have your class help plan a conservation mont at your school. Each morning make an announcement to the school of an energy fun fact or energy saving tip.
- Conduct an energy contest. Which class can recycle the most aluminum cans? Use the proceeds to plant a tree at your school, in a public park, or in public housing.

Multicultural Energy

ENERGY OF THE SPIRIT

Approximate Time Needed:

- 1 hour

Materials:

- Bags (muslin, with ties -- these can be purchased at Good Foods Co-op)
- Feathers
- Polished Rock
- Stamps of animals to stamp bag
- Native American stories

Student Grouping:

- Single

Background:

- Native American lifestyle
- Idea of inner strength
- Diversity of religion
- Values

Preparation for Activity:

- Have a bowl of different colored polished rocks. Each representing personal strength that is valued: physical, intelligence, wisdom, character.
- Have a bowl of different colored feathers. Each representing the color that best describes the child as a whole. This is just personal preference.
- Stamps of animals to stamp their bags. Examples would be:
- Black bear -- Guardian of the west. Lightens the weight of emotional burdens, eases your most difficult decisions, and deepens your introspective capacities.
- Mountain lion -- Guardian of the north. Fortifies your courage, particularly when striking out on challenging paths, helps in clarifying your personal stand in your relationships and career.
- Badger -- Guardian of the south. Helps you focus your attention and deepen your energy. It is an antidote to not doing anything about a problem, be more goal oriented.
- White wolf -- Guardian of the east. Stimulates your intuition, helps you integrate new information intellectually, intensifies romantic expression.
- Eagle -- Guardian of the upper regions. Helps you see the "Big Picture," achieve grace through knowledge and work. It can connect you with bigger truths, enhancing intuitive and creative abilities.
- Mole -- Guardian of the Lower regions. Amplifies your connections with the Earth and female energies.

Instructions:

- Read Native American stories such as "Fallen Stars Ears," Thanks To Trees," and "How

Fox Brought Forth the Sky."

- Animal representations will have to be age appropriate and be available on a stamp.
- After children hear Native American folk tales about the sun and the energy of the Earth and inner strength (energy), they will have the opportunity to design their own fetish bag (Southwest tribes) or totem bag (Northwest tribes).
- The bag will represent how they view themselves and will allow them to "talk to" or "draw energy" from themselves.
- This will help them focus on problems they may have and help with problem solving.

Assessment:

- Add one or two items you hold dear to your bag when you get home.
- Explain to someone your fetish bag. It must be someone you respect, like your teacher, your mom, or dad, etc.
- At school write about the energy you get from your fetish bag. How does it help you make wise choices and decisions? Remember, your fetish bag is a reflection of you!

Extensions:

- Discover other Native American energy sources.
- Find other ways different cultures have of developing inner strength.

SUN TRADITIONS

Approximate Time:
- 30 minutes to introduce
- 1 week to prepare presentation
- 1 class period for presentations

Materials:
- Slips of paper with different cultures/countries (i.e., Greece, Egypt, Native Americans)
- Books on holidays
- A world map
- Stories of each culture's Sun god
- Examples of Sun designs (see page T-1)

Student Groupings:
- Individuals or pairs

Background:
- Read a story from one of the cultures that is not going to be used by a child in the class that is about the Sun.
- Discuss:
    - How do things grow (need sunlight)?
    - How did people get food before grocery stores?
    - Why is the Sun important to Ancient cultures?
    - What holidays are celebrated with lights or fire?
    - How does the Sun effect you today?

Preparation for Activity:
- A brief history of how ancient cultures did not know as much about the Sun.
- Ancient cultures counted on the Sun for crops.
- A brief scientific history lesson of how our perceptions of the solar system have changed, from geocentric (Earth-centered) to heliocentric (Sun-centered).

Instruction:
- Draw a slip of paper.
- Locate your country or culture on the world map.
- Research that country or culture's views on the Sun.
- Present your findings to the class orally.

Assessment:
- Did they have a Sun God?
- Why do you think they worshiped the Sun?

Extensions:

- Write your own legend or myth about the Sun. Think about what it would be like to see and feel sunlight but not understand it as well as we do now. Your legend or myth can be in the form of a poem.
- Draw your own Sun symbol. Make it represent how you feel about the Sun. Does the Sun make you feel cheerful, angry, kind, serious, mischievous? Do you think of the Sun as a male or female, or a geometric pattern?

ENERGY DISTRIBUTION

Approximate Time Needed:

- 1 hour, allow more time if you want to have trading or extensive discussion.

Materials:

- World map
- M & M s

Student Groupings:

- Students will be divided into proportionate groups that represent the world's population:
  - Asia 55%
  - Africa 15%
  - Australia <1%
  - Europe 10%
  - North America 5%
  - South America 15%

Background:

- Distribution of energy (in this case, food)
- Continents
- Trade

Preparation:

- Divide the class into groups according to the percentages above.
- Divide M & M s into proportionate amounts according to these percentages:
  - Asia 60%
  - Africa 2%
  - Australia 1%
  - Europe 10%
  - North America 22%
  - South America 5%
- Place the M & Ms into labeled cups for each continent.

Instructions:

- After dividing the class into groups, pass out cups with M & Ms to each group.
- Let the discussion lead itself. It will tend start with an initial conflict.
- Encourage trading if they do not come up with this solution.

Assessment:

- Do you think energy differences could cause countries to go to war? Why or why not?
- How did your group feel about the energy you were given? Do you think it was fair?
- How did you solve your conflict with other groups?

Extensions:

- Make sidewalk chalk (an exothermic reaction!) [plaster of paris, tempera paint, a little water mixed into a dixie cup until pancake batter texture]. Draw a map of the world to scale (approximate) onto playground blacktop. These are the percentages for the area of each continent:
    - Asia 33%
    - Africa 23%
    - Australia 6%
    - Europe 8%
    - North America 17%
    - South America 13%
- Assign each group to their area. Discuss density and overpopulation.
- Study Japan's energy situation (one of the world's best.) How can we learn to conserve more as a country? What are some good examples they give us to follow? Assign each group a different country to present in the same way -- possibly a country within their continent.
- Add other energy sources (gas, coal, oil, etc.) into the lesson.

(For more details, see the Appendix T2-T5.)

History of Energy

ENERGY CLOCKS

Approximate Time Needed:
- 1 class to several classes, depending on how many clocks are built

Materials:
- Candles
- Sand
- Funnel
- Bottle
- Clocks of all ages
- Sundial

Students Grouping
- Individuals

Background:
- Different ways of telling time historically.
- How energy sources were used to produce clocks.

Preparation for Activity:
- Design, build, and label different types of clocks used through time

Instructions:
- Candles burned and each different one marked off into days, hours, hours and minutes, days and hours and minutes.
- Hour glass: home made, one from a game, possibly an antique one all labeled according to time and when it was made for use.
- Grandfather clock
- Pocket watch
- Wristwatch
- Sundial
- (See pages T6 - T7 for help)

Assessment:
- Discuss why there were no clocks 600 years ago and why they used candles or hour glasses.
- How does a sundial work?
- What kind of watch do you wear? Is the face the same as the grandfather clock?

Extensions:
- With your class design a sundial for your school. There are many plans and some require little fancy equipment.

- Build a hour glass.
- Take apart an old watch. What makes it run? Try to list the parts. Where does the energy come from?
- Research grandfather clocks. Where do they get their energy?
- Design your own clock. Use a computer draw package and make it to scale.
- Visit an historic home. How many different types of clocks can you find? In which ways does the house use energy differently than we do today?
- Do the Time Out activity (see pages T8 - T10 for help).

PLANES, TRAINS, AND AUTOMOBILES

Approximate Time Needed:
- 1 hour

Materials:
- Books about different means of transportation:
  - (see bibliography)
  - Coiley, Parker, Rogers, Stott (suggested)
- Match Box cars
- Paint
- Paper
- Smocks

Students Grouping:
- Individual

Background:
- Brief history of transportation (depending on age)
- How did you get here today?
- How did the Trans-Continental railroad affect the U.S.?

Preparation for Activity:
- Gather materials.
- Go to library for books (optional).

Instructions:
- Discuss:
  - What kind of energy do the different types of transportation use?
  - Why and how have these different inventions changed the way we live today?
- Using Match Box cars, and other models of transportation, create a painting by driving the car through the paint.

Assessment:
- Each method of transportation has pros and cons. List them. Then, decide which method is best for different tasks:
  - Going to the grocery, going to school, moving all of your furniture in your house to a new house, shipping cars from Europe to the United States, visiting friends in California...

Extensions:
- Visit an antique car museum (Lexington has one on New Circle Road, and they can be found in most larger cities.)
- Go to the airport. Most city airports offer tours.

- Visit a train depot or switchyard.
- For younger students, place pictures of different kinds of road transportation around the necks of the students. Let them pretend they are that method of transportation. Draw roads and street signs. Teach them the safety rules of driving. Strongly enforce left and right.
- For older students, do efficiency story problems involving the different methods of transportation.

Magnetic Energy

ELECTROMAGNETIC SWINGS

Approximate Time Needed:
- 30 minutes

Materials:
- Masking tape
- A cell (use one "AA" battery or larger for stand alone)
- Sewing thread
- Two straws
- A piece of insulated wire about one meter long (cut into strips).
- A chunk of modeling clay
- A flashlight bulb and socket
- A battery holder and a switch ((both optional)
- Two small bar magnets each about 2.5 cm long).

NOTE: For a stand alone all material may need to be heavier duty for prolonged use and some abuse.

Student Grouping
- No standard

Background:
- Electricity
- Circuits
- Magnets
- Electromagnets

Preparation for Activity:
- Gather materials to produce a stand-alone demonstration

Instructions:
- Build a stand from which to hang the magnets.
- Attach a string to the magnets, so they may hang off the stand swing freely.
- Directly under the swing place a coiled insulated wire (use a 10 penny nail, copper wire, and a battery).
- Attach the wire to a battery for power. The children would be able to easily see, but not touch.
- Include in the line an on/off switch so children can turn it on and off. They can then see how electricity can produce a magnetic field in the coil that attracts and repels a magnet.
- (See pages T11 - T12 for illustrations and help.)

Assessment:
- What properties of magnets make the electromagnet work (attract and repel)?

- What properties of electricity make the magnet move when they don't even touch? (It produces a field.)
- How can you make the swing move in another way? (A hand held magnet)
- What does coiling the wire do? (It makes the field stronger.)

Extensions:

- Collect old nonworking appliances, electric race cars, small electric motors, and take them apart. There will be coiled copper wire wrapped around a magnet. Allow the students to discover this themselves.
- Create another way to use an electromagnet.
- For older students, create a Maglev, a magnetic levitated train (instructions included on pages T13 - T16).
- Read Switch On, Switch Off (for younger students, see the Bibliography), and then let the children make an electromagnet.

MAGNET RACES

Approximate Time Needed:
- 30 minutes

Materials:
- Magnets
- Posterboard with lanes or streets drawn on it
- Art supplies to decorate magnets
- Stopwatch or watch with second hand

Student Grouping:
- Individual

Background:
- Poles
- Magnetic attraction

Preparation for activity:
- Gather supplies.
- Design the posterboard with lanes or streets and a finish line.

Instructions:
- Decorate your magnet to look like an animal, car, or something that moves.
- To set up the race track:
  - Lay the posterboard across two chairs so that the edges are on the chairs, but the middle is not. When the students place their racing magnet on the top of the posterboard, place a plain magnet directly underneath it.
- Race in pairs.
- To move your racing magnet, you can only move the magnet underneath the posterboard.
- Time the races. See who gets the fastest time.

Assessment:
- What happened when you moved the magnet underneath the posterboard?
- What caused the racing magnet to move? How?
- What happened when you tried to move the magnet too fast? Why?
- When would a magnet be helpful in moving something or finding something?

Extensions:
- Demonstrate with magnet filings or magnets with holes in the center placed on a bamboo skewer to show poles better.
- Look for things that are attracted by magnets. Is there a pattern?
- Try different kinds of rocks to see if they attract magnets. (Use a magnetite rock, nature's magnet.) Is there a pattern?

MAKING COMPASSES

Approximate Time Needed:
- 45 minutes

Materials:
- Tub with water in it
- Compass
- Large flat magnet
- T-shaped pins
- Small corks
- Examples of maps

Student Grouping:
- Pairs or individual

Background:
- Directions: north, south, east, west
- Maps
- Invention of compass -- boating, orienteering.
- Magnetic power
- Magnetic poles

Preparation for Activity:
- Get materials together.

Instructions:
- Each individual or team should get:
  - One cork
  - One T-shaped pin
- Magnetize your pin by using the large magnet. Stroke the magnet repeatedly against one of the poles of the magnet.
- Insert your pin into the cork so that the "T" is flat against the cork.
- Place your pointer into the water in the tub.

Assessment:
- What happens to your pointer when it is placed into the water? (it points north) Why?
- Why is it important that you stroke that pin the same direction in order to magnetize it?
- Can you think of times when it is good to have a compass?

Extensions:
- For older children, advanced orienteering lessons. A trip to a nature preserve or forrest could be planned to try out orienteering skills.
- Make a map of your bedroom, house, classroom, school, or the Museum.

- Write out directions from how to get to school from your house using north, south, east, and west in your directions.
- Contact a cartographer. Have them visit your classroom.
- Study several different types of maps.

(For more information see Appendix pages T19 - T21.)

Electric Energy

MAKING ELECTRICITY WITH FRUIT

Approximate Time Needed:
- 45 minutes

Materials:
- Paper Clips
- Apples
- Uninsulated copper wire
- Voltmeter

Students Grouping:
- Pairs

Background:
- Positive and negative charges
- Voltage
- Leads
- Electrodes
- Cells

Preparation for Activity:
- Gather materials.
- Cut the copper wire into lengths 3cm long.

Instructions:
- Unbend the paper clip so that it forms a straight wire, then insert one end of the clip about 2cm into the apple.
- Insert the copper wire into the apple at a different point so that the two wires are not touching.
- Attach the negative lead of the voltmeter to the paper clip and the positive lead to the copper wire. Turn on the voltmeter and, if necessary, set its range for 0-5 volts DC.

Assessment:
- What is the voltage produced by this cell?
- Does pushing the electrodes further into the apple affect the voltage?
- Does inserting the electrodes closer together affect the voltage?
- If the paper clip is replaced with a piece of zinc, how does this affect the voltage?

Extension:
- Try constructing cells using other fruits. Does the kind of fruit affect the voltage?
- Connect several cells in a series and measuring the new voltage. Connect all of the class' cells in series and measure the battery's potential difference (voltage) when combining all the cells.

- Try conducting electricity with rocks or liquids.
- For more information, see Appendix pages T22 - T23.

BALLOONING INTEREST

(taken from Science and Children Magazine, November/December 1991, pages 16-18)

Introduction:

- With the use of balloons, children's interest in energy can be started and exposed with minimal cost and supplies. The following activities are geared to early primary students:

Approximate time needed:

- 20 minutes

Materials:

- Balloons (number will depend on the number of students).
- Bubble soap and instruments to make bubbles

Student Grouping:

- 1-2 students

Preparation:

- Get materials together

Activities:

- Have students rub the balloons on their clothes and hair then throw them up in the air together.
- Repeat the process with the balloons, but this time blow some soap bubbles in the air and have the students bring their balloons close to the bubbles. This better exemplifies the positive and negative charges and the reactions of each.

Background:

- Discuss:
  - static electricity
  - lightning
  - positive and negative charges

Assessment:

- What happens to the balloons?
- What happens to the bubbles? Why?
- What other examples illustrate static electricity?

Extensions:

- Demonstrate a Van de Graaff generator.

Your Body's Energy

MENU CONVERSIONS

Approximate Time Needed:
- 1 hour

Materials:
- Calorie conversions (for a child):
  - Running 22 calories/min.
  - Walking 5 calories/min.
  - Watching TV 2.25 calories/min.

NOTE: These can be simplified for younger children.
- Energy Village menus

Students Grouping:
- Individuals or pairs

Background:
- Calories
- Energy from food (intake)
- Physical energy (output)

Preparation for Activity:
- Gather materials.

Instructions:
- Using the Energy Village menus, order your favorite breakfast, lunch or dinner.

Assessment:
- Does your meal give you the energy to do your normal activities?
- What do you think happens to the energy you eat that you don't use?

Extensions:
- Using the conversions and a calorie counter book, make your own menus.
- Track your intake for a week. Convert this intake to physical activity.
- Add other elements -- fat, protein, etc.

"SIMON SAYS"

Approximate Time Needed:
- 45 minutes

Materials:
- Pencils
- Paper
- Crayons/markers
- Powered toys (things run by electricity, batteries, rubberband, muscle)
- Magazines to cut from
- Scissors
- Glue sticks

Student Grouping:
- individual

Background:
- Discuss:
  - Food energy/ calories
  - What did you have for breakfast? Let this lead to short discussion on digestion.
  - Energy and the body (cells burn food for energy).

Preparation for Activity:
- Get materials together.

Instructions:
- After Background discussion, lead kids in quick game of "Simon Says".
- Explain that every time they performed the actions, they used energy.
- Lead them to discover it is the food they eat that gives them this energy.
- Let the students experiment with different action toys. Each of these are also using some form of energy.
- Students make an energy collage of drawings and/or pictures cut from magazines showing ways they use energy in their life.

Assessment:
- When you use up most of the food energy your body has stored, what happens? (You get hungry)
- When you eat, the digested food becomes a source of energy.
- What do you have in common with all the toys? (you move and you use energy to do this)
- How do **you** use energy?

Extensions:

- Write menus with calorie intake in mind.
- Convert calories into physical activities.
  - Calorie conversions (for a child):
    - Running 22 calories/min.
    - Walking 5 calories/min.
    - Watching TV 2.25 calories/min.

NOTE: These can be simplified for younger children.

ENERGY VILLAGE DINER MENU
LUNCH

FOOD ORDERED	GIVING YOU ENOUGH ENERGY	TO RUN FOR	TO WALK FOR	TO WATCH TV FOR
ENTREE				
MEDIUM FRENCH FRIES	220 CALORIES	10 MINUTES	42 MINUTES	89 MINUTES
GRILLED CHEESE	452 CALORIES	20 MINUTES	86 MINUTES	201 MINUTES
PEANUT BUTTER AND JELLY	379 CALORIES	17 MINUTES	72 MINUTES	168 MINUTES
HOT DOG	214 CALORIES	9 MINUTES	40 MINUTES	95 MINUTES
1/2 CUP JELLO	81 CALORIES	4 MINUTES	15 MINUTES	36 MINUTES
TOMATO SOUP	106 CALORIES	5 MINUTES	20 MINUTES	47 MINUTES
DRINKS				
ORANGE JUICE	111 CALORIES	5 MINUTES	21 MINUTES	49 MINUTES
MILK (2%)	121 CALORIES	5 MINUTES	22 MINUTES	53 MINUTES
MILKSHAKE	383 CALORIES	17 MINUTES	73 MINUTES	170 MINUTES
COLA	151 CALORIES	7 MINUTES	29 MINUTES	67 MINUTES
PINK LEMONADE	82 CALORIES	4 MINUTES	15 MINUTES	36 MINUTES
DESSERTS				
1/2 CUP CHOCOLATE ICE CREAM	280 CALORIES	13 MINUTES	53 MINUTES	124 MINUTES
1/2 CUP VANILLA ICE CREAM	269 CALORIES	12 MINUTES	51 MINUTES	119 MINUTES
2 FIG NEWTONS	100 CALORIES	5 MINUTES	19 MINUTES	44 MINUTES
2 PEANUT BUTTER COOKIES	140 CALORIES	6 MINUTES	27 MINUTES	62 MINUTES
3 OREO COOKIES	149 CALORIES	7 MINUTES	28 MINUTES	66 MINUTES

CALORIES MEASURE THE AMOUNT OF ENERGY IN FOOD.
REMEMBER--TRY TO EAT HEALTHY FOOD, IT WILL MAKE YOUR BODY WORK BETTER.

ENERGY VILLAGE DINER MENU
DINNER

FOOD ORDERED	GIVING YOU ENOUGH ENERGY	TO RUN FOR	TO WALK FOR	TO WATCH TV FOR
ENTREE				
SPAGHETTI IN TOMATO SAUCE	190 CALORIES	9 MINUTES	36 MINUTES	84 MINUTES
HAMBURGER	263 CALORIES	12 MINUTES	50 MINUTES	119 MINUTES
CHEESEBURGER	318 CALORIES	14 MINUTES	60 MINUTES	141 MINUTES
SMALL PIZZA (6 SLICES)	480 CALORIES	21 MINUTES	91 MINUTES	213 MINUTES
FRIED CHICKEN (DRUMSTICK)	147 CALORIES	7 MINUTES	28 MINUTES	65 MINUTES
MIXED VEGETABLES	54 CALORIES	2 MINUTES	10 MINUTES	24 MINUTES
DRINKS				
ORANGE JUICE	111 CALORIES	5 MINUTES	21 MINUTES	49 MINUTES
MILK (2%)	121 CALORIES	5 MINUTES	22 MINUTES	53 MINUTES
MILKSHAKE	383 CALORIES	17 MINUTES	73 MINUTES	170 MINUTES
COLA	151 CALORIES	7 MINUTES	29 MINUTES	67 MINUTES
PINK LEMONADE	82 CALORIES	4 MINUTES	15 MINUTES	36 MINUTES
DESSERTS				
1/2 CUP CHOCOLATE ICE CREAM	280 CALORIES	13 MINUTES	53 MINUTES	124 MINUTES
1/2 CUP VANILLA ICE CREAM	269 CALORIES	12 MINUTES	51 MINUTES	119 MINUTES
2 FIG NEWTONS	100 CALORIES	5 MINUTES	19 MINUTES	44 MINUTES
2 PEANUT BUTTER COOKIES	140 CALORIES	6 MINUTES	27 MINUTES	62 MINUTES
3 OREO COOKIES	149 CALORIES	7 MINUTES	28 MINUTES	66 MINUTES

CALORIES MEASURE THE AMOUNT OF ENERGY IN FOOD. REMEMBER--TRY TO EAT HEALTHY FOOD, IT WILL MAKE YOUR BODY WORK BETTER.

ENERGY VILLAGE DINER MENU
BREAKFAST

FOOD ORDERED	GIVING YOU ENOUGH ENERGY	TO RUN FOR	TO WALK FOR	TO WATCH TV FOR
ENTREES				
2 SLICES OF BACON	73 CALORIES	3 MINUTES	14 MINUTES	32 MINUTES
DOUGHNUT	110 CALORIES	5 MINUTES	21 MINUTES	49 MINUTES
FRIED EGG	90 CALORIES	4 MINUTES	17 MINUTES	40 MINUTES
BAGEL	163 CALORIES	7 MINUTES	31 MINUTES	72 MINUTES
3 PANCAKES	180 CALORIES	8 MINUTES	34 MINUTES	80 MINUTES
1 BOWL OF APPLEJACKS	110 CALORIES	5 MINUTES	21 MINUTES	49 MINUTES
DRINKS				
ORANGE JUICE	111 CALORIES	5 MINUTES	21 MINUTES	49 MINUTES
MILK (2%)	121 CALORIES	5 MINUTES	22 MINUTES	53 MINUTES
MILKSHAKE	383 CALORIES	17 MINUTES	73 MINUTES	170 MINUTES
COLA	151 CALORIES	7 MINUTES	29 MINUTES	67 MINUTES
PINK LEMONADE	82 CALORIES	4 MINUTES	15 MINUTES	36 MINUTES
FRUIT				
1/2 CANTALOUPE	57 CALORIES	3 MINUTES	11 MINUTES	25 MINUTES
3 OZ. RAISINS	180 CALORIES	8 MINUTES	34 MINUTES	80 MINUTES
SMALL BANANA	105 CALORIES	5 MINUTES	20 MINUTES	47 MINUTES
MEDIUM SIZE ORANGE	65 CALORIES	3 MINUTES	12 MINUTES	29 MINUTES

CALORIES MEASURE THE AMOUNT OF ENERGY IN FOOD. REMEMBER--TRY TO EAT HEALTHY FOOD, IT WILL MAKE YOUR BODY WORK BETTER.

Wind Energy

PINWHEEL POWER

Approximate Time Needed:
- 30 minutes

Materials:
- Pinwheel pattern for each child (see pg. T24 in appendix)
- Straws
- Straight pins
- Balloon full of air
- Paper dolls that will stand

Student Grouping:
- Individual

Background:
- Use the paper dolls to demonstrate wind. Deflate the balloon letting it blow over the dolls.
- Wind as energy:
  - What is moving air?
  - List some things wind moves (grass, blows hair...)

Preparation for Activity:
- Gather materials.

Instructions:
- Construct a pinwheel:
  - Cut from the corners of the pinwheel into the center. **Do not cut all the way to the center.**
  - Insert a pin through the dots (a, b, c, d, and center) of the pattern.
  - Secure the end of the pin in a straw handle or the eraser of a pencil with enough pin on the pinwheel to allow it to turn.
- BLOW!

Assessment:
- What makes your pinwheel turn?
- If you walk faster holding your pinwheel or blow harder, does it spin the same?

Extensions:
- Make animated cartoons by using a spinning bucket.
- Put your pinwheel close to a fan, then pull it back. Does it turn the same way? Why or why not?
- Have a pinwheel parade. How fast must you march to make your pinwheel turn?

ORIGAMI WINDMILLS

Introduction:

- Read story book/s about the wind and make a cardboard windmill or origami paper windmill.

Materials:

- Read books about the wind such as:
  - Feel the Wind by Arthur Dorris
  - Blow Away Soon by Betsy James
- Read the Sun Legends sheet (attached)
- plastic straws
- cardboard (you will need 4 pieces of 15 X 25 cm for each windmill)
- straight pins
- pencils
- scissors
- tape
- origami paper
- origami instructions

Instructions:

- Read book/s about the wind.
- Discuss wind as a natural form of energy.
- What is a windmill? (maybe have pictures)
- Explain how we use/used windmills historically and today.
- Let each child make a windmill (instructions attached).

Assessment:

- Can you think of ways that people use wind as energy?
- How does a windmill make electricity out of wind?
- List several types of windmills, and what they're used for.
- List the pros and cons of using wind as an energy source.

Extensions:

- Visit a farm where they use a windmill for power.
- Paint a picture by blowing paint around on the paper with straws.

WIND SOCKS

Approximate Time Needed:
- 30 minutes

Materials:
- Plastic disposable cups
- Exacto knife
- Streamers or ribbons
- Stickers
- Hole punch (with ribbons)
- Scotch tape (with streamers)
- Yarn

Students Grouping:
- Individual

Background:
- Wind as power

Preparation for activity:
- Gather materials.
- Cut the bottoms out of the cups using the exacto knife.
- Cut the streamers or ribbons into lengths of about 18".
- Hole punch two holes directly across from each other just below the top rim of the cups.
- Cut the yarn into 12" lengths.
- If using ribbons, punch a series of holes around the bottom rim of the cups.

Instructions:
- Tape 5-6 streamers into the inside bottom of your cup.
- Decorate your cup with stickers.
- Tie a piece of yarn into the two holes at the top of your cup to serve as a "handle" for your wind sock.

Assessment:
- Would it make a difference if you made a windsock with the cup upside-down? Why or why not?
- Spin in circles with your wind sock extended at arms' length. As you spin faster, what happens? Why?

Extensions:
- Visit an airport. Observe their wind socks.
- Sew a decorative wind sock.
- Make a weather station. Include a rain gauge (see pg. T95)

PING PONG BLOW RACES

Approximate Time Needed:

- 30 minutes

Materials:

- Water table, water tub, sink, or large bucket
- Straws
- Ping-pong balls
- Water
- Ribbon
- Tape

Students Grouping:

- Individuals, race in pairs

Background:

- Wind as power

Preparation for Activity:

- Put ping-pong balls in the water table, tub, sink, etc.
- Mark the water table into two "lanes" for racing.

Instructions:

- Blow air through straws to make the ping-pong balls move through the water.
- Race a friend.

Assessment:

- This part of the lesson will be handled as the activity is going on. It will vary greatly according to the age of the students.
- With older children, the races can be timed and the rate of speed can be calculated.

Extensions:

- Make a track on a table. Try the same activity without the water. What happens?
- Try again, but with a curving path on the table. What happens? You cannot use your hands!

Potential and Kinetic Energy

GRAVITY ENERGY

Approximate Time Needed:
- 45 minutes

Materials:
- A block of wood
- A broom handle
- A wooden dowel and a drill
- Glue and tape
- Cardboard
- Wire

Students Grouping
- No specific number.

Background:
- Gravity
- Potential energy
- Kinetic energy

Preparation for Activity:
- Gather materials
- Wind a length of wire around the broom handle to make the spiral. Take care to make the loops of the spiral evenly spaced. Slide the finished spiral off the handle.
- Drill a hole in the block of wood. Glue the dowel in the hole.
- Slip the wire spiral over the dowel. Use a piece of tape to hold it in place on the block.
- Make a cardboard windsock and control tower, and then glue them to the block.
- But out the parts for the two cardboard planes. Make two slits in the body and slide the wings and tail through each. Glue the wheels under the wings.
- Gently hold the body of one plane between your thumb and finger to find the place where it balances. Make a small hole in the body at this point.
- Bend a second length of wire into a hanger shape. Make a loop in the middle to fit over the wore spiral and bend small hoods at each end.
- hang the planes on the hooks and put the hanger on the top of the spiral. Let it go, and see if it runs smoothly down the spiral. Adjust where necessary.

Instructions:
- Demonstrate the stand-alone to lead the discussion.

Assessment:
- What causes the planes to go down. (gravity)
- Where is there potential energy? (Top) Kinetic energy? (During its trip down)

- Why is gravity important to us?
- Design an experiment about gravity? How would you test how fast something falls or if all objects fall at the same rate?

Extensions:

- Explore other planets of our solar system. Do we have the same gravity? Design a math problem that will show how much you weigh on the moon or Jupiter or some other planet.
- Use CD-ROM's and computer software to explore gravity.
- Write a paper telling what might happen to us if we have to adapt to another planet.

RUBBER BAND ENERGY

Approximate Time Needed:

- 1 hour

Materials:

- Balsa wood
- Thick needle
- Heavy cardboard
- Wire or thin nails
- Plastic propeller
- Thick rubber bands
- Beads
- A cork
- A stapler
- A paper clip
- A craft knife
- **NOTE:** For safety, some materials may have to be precut or modified.

Students Grouping

- Individuals

Background:

- Potential energy
- Kinetic energy
- Newton's laws

Preparation for Activity:

- Gather materials. If possible, better material may be used to produce longer lasting rubber band cars.

Instructions:

- Cut out the balsa wood parts of the roadster's frame and glue them together. (see Appendix pages T28 - T29).
- When the glue is dry, use a thick needle to make a hole in the frame for the propeller shaft.
- Unbend a paper clip and slip the model propeller onto it. Add a small bead on each side of the propeller.
- Push the paper clip through the hole in the frame, and bend both ends back. Hook one end of the rubber band over the paper clip and staple the other end to the front of the roadster's frame.
- Make the wheels (plastic wheels may be used). Cut out four disks of corrugated cardboard and four slices of cork. Glue a slice of cork to the center of each cardboard disk.

- Poke a small hole through the middle of each wheel and reinforce it with a very short length of metal tube (refer to illustrations).
- Loop a rubber band around the rim of each wheel to make a tire.
- Fix a wheel to the end of each axle with a piece of bent wire or a thin nail. Put a bead on either side of each wheel so it can spin freely.
- Wind up the propeller and let your roadster go.

Assessment:

- At what points did the roadster not move on its own? (When the rubber band was not wound up and when the rubber band was wound, but not turned loose.)
- When did it move? (When the rubber band was turned loose.)
- At what point was there potential energy? (When the rubber band is wound up, but not turned loose.)
- Why isn't there any potential energy when the roadster is not moving, but the rubber band is loose. (Because the roadster has no "source" of energy.)
- When does the roadster have kinetic energy? (When it is moving from one position to another.)
- Which of Newton's laws are shown here?

Extensions:

- Design and build a boat using the roadster as a model.
- Go to a theme park and talk about how the rides have potential and kinetic energy.
- Make catapults (see Appendix pages T30 - T31).

Sound Energy

MAKING MUSIC

Approximate Time Needed:

- One class period

Materials:

- 8-12 large plastic straws
- 8-12 flexible plastic straws to fit just inside the larger straws
- Meter sticks
- Marking pens
- Scissors
- Tape
- A recorder - the instrument
- Possibly a clarinet
- Rubber bands
- Coffee cans
- Rubber sheets
- Pencils
- Piece of wood
- Clamps
- Drum mallet - this can be made also

Student Grouping

- Individuals

Background:

- Compression waves
- Pitch
- Amplification
- Sound is a disturbance of the molecules in a solid, liquid, or gas.
- Different kinds of instruments: woodwind, percussion, string, or brass.

Preparation for Activity:

- Provide four straws for each student to make a
- Make available materials for putting flute together

Instructions:

- Pan Flute
    - Demonstrate how a recorder works.
    - Distribute materials to each student.
    - Students then measure and mark different lengths on four straws - 9 cm, 7 cm, 5 cm, and 3 cm.
    - Have students bend straw back on itself at the mark, closing the end.
    - Students then blow gently into the end opposite the bent end until it whistles.

- Repeat for each length of straw.
- Students or instructor should record data on relationship of pitch and length of the straw.
- Tape the straws together and they will have a pan flute.

□ Woodwind Straws
- Student should mark a straw 3 cm and flatten that end of it.
- Cut the flattened ends to make a protruding V-shape about 1 cm in length
- Open the straw slightly.
- Students should place their lips loosely over the cut end of the straw (reed) and blow. This clarinet sounds like a duck call.
- A pan flute can be made out of this woodwind.

□ Piano
- Arrange rulers hanging over the edge of a table at 8, 10, 12, 14, 17, 20, 23, and 26 centimeters.
- Secure them with a piece of wood clamped on them.
- Pluck the extending part of the meter stick.

□ Drums
- coffee cans can be covered with rubber sheets to produce sound when struck.
- They can be decorated as well in any theme.

□ Guitar
- Place a rubber band on a ruler so that it is tight, but not near breaking.
- Place a pencil under each end of the ruler, under the rubber band. Rest the pencil on modeling clay.
- As the student strums the rubber band, his/her finger can hold the rubber band down at different centimeters.

Assessment:

□ Discuss:
- What made the pitch change in the different types of instrument?
- Which were high notes?
- Which were low notes?
- What pattern do you see? In others words how do the different instruments relate to pitch?
- What causes the sound in the flutes and clarinets? (a vibrating column of air)
- What causes the sound in the string instrument? (Vibrating string)
- What causes the sound in the percussion? (Vibrating drum head)
- What could change the pitch of the drum?

NOTE: It is important to use percussion, string, amplitude, pitch, etc. so students will use correct terminology.

Extensions:

□ This activity leads into a discussion of music. Consult with the music teacher at you school.

□ Discuss type of instruments and select different kinds of music that exemplify the different instrument.

- Use classical and new age music in the classroom during study time or seat work. This actually encourages work and may introduce students to music they would not normally listen to. Discuss the different pieces and the composers, briefly after each study time. A different type of music will then become a part of their lives.
- Have students research a type of music. Have them (probably in teams) do a presentation using the computer, excerpts from the music, videos, etc. Music should be pulled from a hat, so all types are represented. A portfolio piece can be developed using a draw program, integrated package, CD-ROM research, copy and paste, etc.
- Make glass harmonicas (see Appendix pages T32 - T34).

THE POWER OF SONG

Approximate Time Needed:
- 1 class period

Materials:
- A folk singer, singer, band, etc.

Students Grouping
- Any number

Background:
- The energy of people, the earth, emotions, etc., are depicted in many songs old and new.

Preparation for Activity:
- Contact a singer to come to your classroom.

Instructions:
- Singer leads songs. Encourage children to sing along.

Assessment:
- Have words available for students to take to school. Teacher and students can analyze meaning hidden and obvious.
- Talk about the poetry of song. Why does it move us?

Extensions:
- Write poetry that can be made into a song about energy.
- Adapt a song's tune to lyrics you write. Perform it for your class.
- Research other songs that take a position.
- Write a position poem that can use a tune for your portfolio.
- A resource:

  Sue Masse k
  P.O. Box 24708
  Lexington KY 40524-4708
  (606) 245-1529

SOUND DETECTOR

Approximate Time Needed:
- 30 minutes

Materials:
- Rubber bands
- Uncooked rice
- Plastic bowls
- Saucepan (can substitute loud noise maker)
- Large spoon (can substitute loud noise maker)
- Scissors
- Plastic
- Tape

Student Grouping:
- Individuals or groups of 2-3

Background:
- Hearing
- Sound and sound as energy
- Ear anatomy (ear drums)
- Vibrations

Preparation:
- Gather materials.
- Cut the plastic so that it is a few inches bigger than the top of the bowls.

Instructions:
- Stretch the plastic tightly over the bowl and secure it with a rubber band.
- Tape the plastic down to keep it taut. This is your drum.
- Sprinkle a few grains of rice on top of the drum.
- Hold the saucepan near the drum and hit it sharply with the spoon.

Assessment:
- What happens to the rice when you hit the saucepan?
- Which part of your anatomy acts as a sound detector? Specifically.

Extensions:
- "Sympathetic vibration"--using two tuning forks of the same frequency, strike one. What happens to the other? Why?
- Sing a low note. Feel the vibrations in your throat. Do they feel different when the pitch changes?
- Visit the Lexington Children's Museum's oscilloscope.

Solar Energy

SUNDIALS

Approximate time needed:
- 60 minutes

Materials:
- Story books dealing with the sun/sun legends (optional)
- Some ideas:
  - Raven by Gerald McDermott (see bibliography)
  - Welcome Back Sun by Michael Emberley (see bibliography)
- For sundial:
  - Different wood shapes with about 12" diameter
  - One compass for facilitator to mark N/S line
  - Black permanent marker
  - Small hammer
  - Paints
  - One nail for each sundial, to be the pointer or gnomon

Student Grouping:
- Individuals

Background:
- North and South

Instructions:
- Read one or more stories/legends about the sun.
- Discuss:
  - The sun as the earth's main source of energy.
  - What is a sundial? Discuss its use and background.
  - Explain how to tell time with a sundial.
  - Let each child make and decorate their own sundial.
- To make sundial:
  - Have different shapes wood available.
  - Let the children paint/decorate the wood.
- Use the compass to determine north and south, and use a black permanent marker to draw a line from the each to center of the wood.
- Hammer a nail into the center of the wood.
- Add numbers to the dial.
- (See Appendix pages T35 - T37 for alterative directions.)

Assessment:
- Why does it matter which direction your sundial points?
- How is the sun able to create the shadows on the clock, and to move in time?
- Would your sundial function differently in another part of the world?

- If you were in Australia, would your sundial be the same? What direction would it face?

Extensions:

- What are the pros and cons of sundials?

SHADOW SHAPES

Approximate time needed:
- 30 minutes

Materials:
- My Shadow by Robert Louis Stevenson; illustrated by Ted Rand (at Joseph Beth)
- Shadows and Reflections by Tana Hoban.
- Drawing paper
- Strong light to cast a shadow
- objects to trace reflections if want other than the kids themselves

Background:
- Positive and negative shapes
- Silhouettes

Instructions:
- Read about shadows.
- Discuss what makes a shadow. What do you have to have to see a shadow? The sun...
- Discuss the sun as our main source of energy.
- Let the kids make shadow pictures. They may trace each other, their hands/feet, an object etc. They may even trace an object then make a more detailed picture from that base.

Assessment:
- What makes a shadow dark?
- Are shadows black?
- What makes your shadow longer or shorter if you're outside on a sunny day?

Extensions:
- Visit the Lexington Children's Museum Shadow Wall exhibit.
- Make photograms using sun-sensitive paper.
- Do lunar eclipses: using styrofoam balls (baseball size) on sticks, and flashlights, turn out the lights to show moon phases and eclipses.
- Do a puppet show using shadow puppets.

SUNLIGHT, SO BRIGHT!

Introduction:

- With this simple activity, children will be given the opportunity to learn about solar energy and express their creativity in a "solar attractor" construction.

Materials:

- Various materials to allow for construction of "solar attractors" (approx. 12" x 12" each). Good things to have:
  - Dark and light colored material (paper, cloth, paint, etc)
  - Construction paper (easily cut)
  - Aluminum foil
  - Variety! Use different items you want and allow children to choose!

Background:

- Discuss:
  - Solar energy
  - Solar panels (collectors)
  - light reflecting and absorbing colors and surfaces

Procedure:

- Create two "solar collectors" (approx.. 12" x 12") that you think will collect sunlight the best.
- Predict which collector you think will get the hottest.
- Make two collectors of different shapes and colors. Take them home, put them in the sunlight, and see which collector gets warm the fastest.

Assessment:

- Which of your collectors got the hottest? Why?
- Was your prediction correct?

Extensions:

- Make solar cookers. Have a contest/marshmallow roast.
- Experiment with different colors of liquid and thermometers in them (see Appendix pages T38 - T40 for help).
- Make suncatchers (plastic "stained glass" hanging for a window -- kits available at Michael's Crafts in Lexington)

Conserve and Recycle Energy

ENERGY SAVING ADVICE

Use fans instead of air conditioning.

Block the sun from windows with draperies, blinds, shades or awnings.

Cook during the cooler part of the day and store food for later.

Use a canvas bag when shopping.

Place a small juice bottle, filler with water and capped tight, in your toilet tank. It can save 1-2 gallons per flush.

Use cloth towels instead of paper towels

Ride your bike or walk, instead of driving.

Bring your lunch to school in a lunchbox or canvas sack instead of brown bagging it.

Take short showers, or baths, instead of long showers.

Turn the faucet off while you are brushing your teeth.

Hand wash the dishes instead of using a dishwasher -- but don't leave the water running as you wash.

Buy recycled products.

COMPOST CRITTERS

Approximate time needed:
- 1 hour

Materials:
- Compost Critters by Bianca Lavies (see Bibliography)
- For each compost column use three 2-liter plastic bottles
- Marking pen
- Knife/razor blade
- Scissors
- Hot water
- Needles for poking holes
- Clear tape
- plastic electrical tape
- Netting or mesh fabric
- Rubber bands
- (students can add garden soil (not potting soil) and compost at home)

Instructions:
- Read the book, Compost Critters
- Discuss the idea of composting.
- How does this save energy?
- Make a compost column to take home (see Appendix page T40 for help).

Assessment:
- What works in making a compost column? What doesn't? Why?

Extensions:
- Take a trip to an environmental center to see a large-scale compost operation.
- Make mulch.
- Visit a recycling center.
- Make a compost pile at home.
- Compost your organic garbage, and grow something in it.
- Make a worm farm.

LIKEABLE RECYCLABLES

Synopsis:

- Read Chris Van Alsberg's Just a Dream and let the kids make something out of recyclable materials.

Materials:

- Resource book Likeable Recyclables by Linda Schwartz (at Joseph Beth) lists different things to make and the needed materials for each.

Instructions:

- Go through the Likeable Recyclables book and decide on a few projects to offer and gather the needed materials.
- Read Chris Van Alsberg's Just a Dream.
- Discuss the concept of recycling.
- What are some things that can be recycled?
- Explain the basics of how materials are recycled.
- Let the kids choose something to make out of recyclable materials.

ADAPTATION ART

Approximate Time Needed:
- 1 class period

Materials:
- Paints
- Colored pencils
- Paper
- Various sorts of garbage; plastic bottles, cans, paper, etc.
- Glue
- Art supplies of all sorts

Student Grouping
- Groups of two or singly

Background:
- How garbage is related to energy.
- How garbage or pollution may affect the way an animal has to adapt.
- Why animals are the way they are.
- Art teacher could be included in extensions or assessments.

Preparation for Activity:
- Discussion
- Supplies should be gathered.

Instructions:
- Plan 1 - Child should draw or sculpt their vision of garbage as an energy source, recycling source, or other appropriate theme.
- Plan 2 - Discuss why animals are the way they are (For ideas look at adaptation artistry included in this pack). Children then can create animals according to an energy source or pollution of the earth.
- How would a woodpecker need to adapt if there were no trees? How would they look? (Children must be aware of how a woodpecker feeds, nests, etc.)
- Adapt a bird to a garbage dump.
- Adapt a bird to a oil slick.
- Any situation can be used.

Assessment:
- Oral discussion at school showing their drawing or sculpture to the class, justifying the modifications.
- Write a portfolio piece on the bird or sculpture. Include the picture, picture of sculpture, or drawing. Show the process you went through to your final drawing or sculpture.

Justify with science knowledge of this unit.

Extensions:

- Do computer rendition of activity using a draw program.
- Do a presentation, using a presentation package such as "power point." Possibly take the bird through its life and tell the reasons it had to adapt.
- Adapt another animal or situation to an artistic medium.
- (See Appendix pages T42 - T43 for more information.)

WHAT COULD YOU DO WITHOUT?

Approximate Time Needed:
- 45-60 minutes

Materials:
- Andrew Henry's Meadow by Doris Burns (see Bibliography)
- Drawing Paper
- Drawing Materials (crayons, markers)

Student Grouping:
- Individual

Background:
- Discuss:
  - The different concepts of work (human/mechanical)
  - Kinds of work that take place at home.
  - Who or what does this work?
  - Be thinking of what kind of house you would build.

Preparation for Activity:
- Get book from the library
- Get other materials together

Instructions:
- Read Andrew Henry's Meadow.
- Use the book as a catalyst for discussion on what the children's houses would look like if they could build one.
- Give students the materials to design and "build", on paper, their house.

Assessment:
- What would you really need to live in your house year-round?
- What machines or appliances would you not need or could do without?
- Does that change the picture of your house?
- If you have less machines, who would be working more?
- Discuss the relativity of work; it's still work whether it is being done mechanically or by you.
- Discuss work as a form of energy.

Extensions:
- Write a story to go with their drawing.
- Write about or draw pictures of machines or appliances you could do without.
- Write about or draw pictures of your inventions to help do the work around the house.

- Make your drawing into a floor plan, make it to scale using ratios.
- Make a 3-D model of your house.

WASTE NOT, WANT NOT

Approximate time Needed:
- 45 minutes

Materials:
- large container, labeled "Earth," full of modeling clay
- A small box labeled "BURY"
- A small box labeled "BURN"
- A small box labeled "DUMP/LITTER"

Student Groupings:
- Individuals

Background:
- Discuss:
    - Where do we get the things that we use everyday such as furniture, clothes, toys, etc.?
    - The clay we're using is an example of taking the earth's resources to make things with.
    - What are resources?

Preparation for Activity:
- Fill the container labeled "Earth" with enough modeling clay for each child to be able to make models of several things that they like to use
- Label and place the three boxes around the room

Instructions:
- Discuss the background information
- Have the children come to the "Earth" to get the resources needed to make their model
- After completing their model, the child chooses which box to dispose of the article in and places the model in that box
- After completing one round ask," What happens to our .... after we bury, burn, dump, or throw it away?"
- Let the kids make several more models and dispose of them to show that as we buy and use products we use up the earth's supplies.
- Stop when the earth's resources have been depleted; there is no more clay.

Assessment:
- Discuss as a group
- Can we ever get back the things we threw away? If possible, which ones?
- What is going to happen if we keep taking materials/resources from the earth?
- What will happen when we run out of resources?

- How can we prolong our resources?

Extensions:

- Let students take home one of their models.
- Carry the discussion further by pointing out that all three disposal systems contribute to land, air, and/or water pollution. What are some alternatives?
- Have students research one of their favorite things to use from its inception. (i.e. baseball bat from wood... the process from the tree to the bat)

RECYCLE RELAY

(taken from Environmental Science Activities Kit by Michael L Roa)

Approximate time needed:

- 40-45 minutes

Materials:

- 1 small trash can full of different kinds of recyclable and nonrecyclable items for initial demo
- 1 trash can
- 1 recycling container (box/basket labeled "recycling center")
- 1 "aluminum manufacturing plant" (box/basket or space labeled)
- 40 crushed aluminum cans (make sure there are no jagged edges)
- 40 rocks (to represent bauxite ore)

Student Grouping:

- Two teams of equal numbers:
  - Team A will be the "wasteful" team depicting what happens when we don't recycle.
  - Team B will demonstrate the effects of recycling.

Background:

- Dump a small trash can out on a plastic sheet and have kids analyze the contents.
- Discuss:
  - trash, litter, and wasted resources
  - what can be recycled
- Explain that aluminum is made from bauxite ore (a sample of the ore would enhance the explanation)

Preparation:

- Make a "recycling center" out of a box with the words "**Recycle Here**" printed on the outside
- Label a trash can "**City Dump...Waste Here!**"
- Label a container or space "**Aluminum Can Manufacturing Plant**" with the 40 cans in it

Instructions:

- Have each team choose a "recycling" team name such as "Warped Wasters" for Team A or "Rad Recyclers" for Team B
- Explain the following general rules of the game:
  - **Object of the game:** to produce & have available aluminum cans for as long as you can (four cans are needed for each round of play)
  - Each team gets 20 rocks (these represent bauxite ore and each piece of ore = 1

aluminum can).

- Once a piece of "ore" has been spent it can't be recovered.
- Team A selects one member to be the "Landfill Operator" & Team B assigns one member to be the "Recycling Center Operator"
- If there is an odd number of players one may be the "aluminum-can manufacturing company operator", otherwise the teacher may assume the role.

- Assign a time frame for each round such as a year, decade, or generation etc. (this doesn't affect the overall results of the game but helps to show the finiteness of our resources)
- Before beginning, each team predicts how many rounds it will take until both teams run out of ore (write on data sheet)
- Explain how the game is played:
  - For Round 1 Team A and B both will spend 4 rocks at the aluminum company to make/obtain 4 aluminum cans (each team should have 4 cans & 16 pieces of bauxite)
  - For Round 2 one "waster" from Team A will "Throw away" its 4 cans, and spend 4 ore pieces to get 4 more aluminum cans.
- Team B recycles its 4 cans. It gets 3 of its cans back from the recycling company and then spends 1 ore piece to get the fourth can from the aluminum company to start another round. (Now Team A should have 4 cans/12 pieces of ore & Team B 4 cans/15 pieces of ore)
- The play continues in this relay format until one team runs out of ore. Keep track of how many rounds it takes (time) to run our of resources.

Assessment:

- Discuss as a group:
  - What are the implications of recycling versus not recycling?
  - Whose aluminum supply lasted longer? Why?
  - What happens to the aluminum in the dump?
  - Why where only three cans returned when four were recycled?
  - Do you recycle? Why or why not?

Extensions:

- Research bauxite. Where does it come from and where does it o to be made into aluminum?
- Visit a recycling center and/or landfill
- Find out how you can help support or promote recycling in your neighborhood

HOT ON THE TRAIL OF TRICIA TRASH AND WALLY WASTE: A PUPPET SHOW

Approximate Time Needed:
- 5-60 minutes

Materials:
- Puppet show Scripts
- Copies of Puppets
- Crayons, Markers, etc. for coloring puppets and scenery
- Scissors for cutting out puppets
- Glue to glue puppets on paper bags
- Music for the Recyclaroo™ Song
- One paper bag for each puppet
- Poster Board, Scrap Paper, or Chart Paper for Scenery
- Lyrics to "Hop to It and Help" for each student

Student Grouping:
- 7 to 15 students: There are 7 cast members
- Another group may be in charge of designing the set while the cast practices. Additional students may color & make the puppets as the cast practices lines

Background:
- Discuss:
  - Solid Waste (this skit will explain)
  - Solid Waste Problems
  - Possible Solutions/Reductions

Preparation for Activity:
- Taped music for the Recyclaroo Song
- Gather other materials

Instructions:
- Assign or take volunteers for roles
- Separate tasks and give time for each group to complete their preparations for production
- Call together and have cast read through the skit (or may have 7 students act as the puppets while the other 7 read the parts).

Assessment:
- What are some examples of solid waste?
- What do we do with our solid waste?

- How can we reduce the amount of solid waste?
- What are some ways you can help reduce waste?

Extensions:

- Have the puppet theater already complete and have the students concentrate on the content of the skit.
- Tape the production so kids can see themselves in action.
- Have someone from the local landfill come and share about their job.

(see Appendix pages T45 - T62 for help)

"HERE TODAY, STILL HERE TOMORROW": A PLAY

from Browning-Ferris Industries, 1990

Approximate Time Needed:

- 45-60 minutes

Materials:

- An area for the performance (about 10'X20')
- Props:
- For "Before Treasure Existed"
    - Stick for mixing
    - Trash can for cook pot
    - Rulers & yardsticks for bones
    - Stuffed toy for fish
    - Coat to drape over old woman's shoulders

- For "One Maid's Trash is a Princess' Treasure"
    - Two chairs as horses
    - Trash can for the wash bucket
    - Broom for the guard to hold
    - Stone to serve as the spearhead
    - Chair/desk for Brenda to stand on

- For "Treasures Under the Tree House"
    - A shovel
    - Cap for Justin
    - Pillow for Dad's stomach
    - Stone for a spearhead

- The scripts

Student Grouping:

- "Before Treasure Existed" -- 5 parts
- "One Maid's Trash..." -- 5 parts
- "Treasures Under..." -- 4 parts

Background:

- What kind of trash do you think people of the past generated? Cave Dwellers vs Medieval Times vs The Old West
    - How is that different than what we throw away today?
    - How do you think people used to dispose of their trash?
    - Through three short skits we'll see how the handling of trash has evolved through the ages.

Preparation for Activity:

- Find an appropriate area
- Collect all the props
- Make enough scripts for the players

Instructions:

- Cast the parts
- Give each skit group time to practice
- Come together and let each group present their skit to the others

Assessment:

- From "Before Treasure Existed"
  - What does this skit tell us about how people once lived?
  - What did they throw away?
  - How did they use the items they had?
  - What materials didn't the play mention that they probably used regularly? (leaves, grass, teeth, bark, insects, reeds, flowers, herbs, intestines for bowstrings, hemp for rope, logs for boats)
  - What makes it hard for us to use our resources in the same way?
- From "One Maid's Treasure..."
  - Where did the spearhead come from?
  - What would happen if we all threw our trash out the window?
  - Is it healthful to throw trash out the window? Why?
- From "Treasures..."
  - Where did the spearhead come from?
  - What does this tell us?
  - Why would someone throw trash under a tree like that?
  - What should we do with our trash?

Extensions:

- **NOTE:** These skits can be made as elaborate as you want. Given extra days to study and practice, the students could memorize their lines and present the play to younger members of the school.
- Discuss archeology and how archaeologists study trash from the past. What does our trash tell us about ourselves? What does the trash of people in the past tell us about them?
- Visit an archeology dig.

GARBOLOGY

Approximate Time Needed:

- 30 minutes

Materials:

- "Clean" garbage (garbage that has been washed)
- Recycling containers for paper, plastic, glass, metal
- Garbage can

  Descriptions of people who produced the trash, for example:
  - 65 year old woman, grandmother, retired, has a cold, loves chocolate, wears contacts, likes to read...

Students Grouping:

- Groups of 2-3

Background:

- Renewable resources
- Nonrenewable resources
- Recycle sorting
- The study of garbage -- What does it tell us about a person or culture?

Preparation for Activity:

- Have several people save their garbage (and clean it if necessary).
- **NOTE:** It makes the activity much better if the people are diverse -- a child, a college student, a grandmother, etc.
- Gather the other materials.

Instructions:

- Look through your trash.
- Divide it into trash that can be recycle, place into proper category, and trash that cannot.
- Examine your trash.

Assessment:

- Look at the trash as a whole. What does it say about the person?
  - How old do you think the person is?
  - Do you think they are male or female?
  - What kinds of food do they like?
  - Is there anything that appears to be an abnormal amount?
  - Does buy wasteful products?
  - Can you tell what this persons interests or hobbies are?

Extensions:

- Make the garbage into a large sculpture using hot glue and glue guns.
- How does archeology relate to garbology? What can garbage tell us about past cultures? What do you think future cultures will think if they analyze our garbage? Write your opinion.
- Have a private investigator as a guest speaker. What other skills does he/she use to interpret someone's garbage? What else can serve as clues besides garbage?

CLEAN GREEN SOLUTIONS

Approximate Time Needed:
- 1 hour

Materials:
- Borax
- Soap
- Water
- Spray bottles
- Teaspoon
- Commercial cleaning supplies

Students Grouping:
- Individual

Background:
- Hazardous chemicals
- Organic materials

Preparation for Activity:
- Gather materials.

Instructions:
- Mix two teaspoons of borax and one teaspoon of soap in a quart of water in a rinsed-out spray bottle.

Assessment:
- Test your cleaner against the commercial products. Which works better?
- Why do you think companies sell products with strong and hazardous chemicals in them?
- How do you think these chemicals harm the environment?

Extensions:
- Try some other recipes using lemon juice, vinegar, salt, and linseed oil.
- Test your recipes first on scraps of things.
- Try your cleaning supplies out at home.
- Read labels at the grocery store. Can you find a trend in the type of supply with the chemicals on the ingredient list? Make a chart.
- Sell your Clean Green Cleaning Solutions as a class fundraiser.

GREEN AUDIT

Approximate Time Needed:

- 1 week (homework assignment)

Materials:

- A Green Audit checklist
- A notebook (logbook)

Students Groupings:

- Individual

Background:

- Recyclables
- Wasteful packaging
- Hazardous wastes

Preparation for Activity:

- It is important to do lessons relating to recycling and conserving energy before this lesson.
- Green Audit checklists.

Instructions:

Complete the following checklist:

- Take a look at your kitchen shelves. How many examples of over-packaging can you spot? Are there items wrapped in several layers? Make a list of the products you think would be just as good with less packaging.
- Take a look at the shopping. How many grocery bags are brought to your home over course of the week? How can this be eliminated?
- Take a look at the trash. Over the course of the week, go through two bags of garbage and determine if how much trash is recyclable or could be reused.
- Take a look at the food. Is there any food that has been shipped from other countries? Why would this waste energy? Ask at the supermarket how their fruits and vegetables are grown. Do farmers use "organic" methods? What states and countries do the produce come from? Find out if there are markets that sell produce grown locally, using a minimum of chemicals.
- Is your tuna "dolphin friendly"?
- Take a look at the beverage containers you and your family buy during the week. How many of them can be recycled easily? Of those that are recyclable, how many of them are actually being recycled by members of your family?
- Take a look at food wraps and paper towels. Are there reusable products that can be used instead?
- Examine the laundry detergent your family buys. Note whether it contains

phosphates or other harmful ingredients and whether it comes in a plastic or cardboard container.

- Using the table found in the fun facts listed in this section, determine how much water your family uses in showers and baths over the week. Determine if there are ways to reduce the amount of water you use, including installing low-flow shower heads.
- Find out if members of your family keep the water running when they brush, and whether they use toothpaste pumps instead of tubes.
- Check all the faucets and toilets in your home -- including those that are outside the house -- to see if there are any leaks. Make a list of possible leaks for later action.
- Is your family's toilet paper made from recycled paper?
-

Assessment:

- Write your findings in your logbook.
- Rate your family's "green" factor.

Extensions:

- Implement your suggestions.
- Do a green audit of your school.

Food Chains

BEARLY ENOUGH ENERGY

Approximate Time Needed:
- 1 class period for activity and one for writing
- 1 - 2 weeks with extensions

Materials:
- Five Colors of construction paper or poster board (Lamination allows reuse)
- Black felt pen
- One envelope per student
- One blindfold

Students Grouping
- Individual during activity
- Group discussion
- Individual writing pieces

Background:
- Limiting factors
- Food chain
- Food groups ... animal and people
- Energy -pyramid
- Omnivores, herbivores, carnivores

Preparation for Activity:
- Make up a set of 2" x 2" cards from the colored construction paper for a group of 31-35 students. Make 30 cards of each of five colors to represent food as follow:
    - orange nuts; mark five pieces N-20; 25 pieces N-10
    - blue berries and fruit: mark five pieces B-20; mark 25 pieces B-10
    - yellow insects; mark five pieces I-25; mark 25 pieces I-6
    - red meat; mark five pieces M-8; mark 25 pieces M-4
    - green plants; mark five pieces P-20; mark 25 pieces P-10

Instructions:
- There should be less than 80 pounds of food per student so that there is not actually enough food in the area for all the "bears" to survive.
- In a fairly large open area, scatter the colored pieces of paper.
- Have each student write his or her name on an envelope. This will represent the student's den sight and should be left on the ground at the starting line on the perimeter of the field area.
- Have the students line up on the starting line, leaving their envelopes between their feet on the ground.
- Give the following instructions:

- *"All bears are not alike, just as you and I are not exactly alike. Among you is a young male bear who has not yet found his own territory. Last week he met up with a larger male bear in the big bear's territory, and before he could get away, he was hurt. (Assign one student as the crippled bear. He must hunt by hopping on one leg.) Another bear is a young female who investigated a porcupine too closely and was blinded by the quills. (Assign one student as the blind bear. She must hunt blindfolded.) The third special bear is a mother bear with two fairly small cubs. She must gather twice as much food as the other bears. (Assign one student as the mother bear.)."*

- Do not tell the students what the colors, initials, and numbers on the pieces of paper represent. Tell them only that the pieces of paper represent various kinds of bear food. Since bears are omnivores, they like a wide assortment of food, so they should gather different colored squares to represent a variety of food.
- Students must walk into the "forest." Bears do not run down their food; they gather it. When the students find a colored square, they should pick it up (one at a time) and return it to their "den" before picking up another colored square. (Bears would not actually return to their den to ear;. they would eat food as they find it.)
- When all the "food" has been picked up, the food gathering is over. Have the students pick up their den and return to the class.
- Explain the different foods and record data on the board. Which bears survived, which didn't? Why?

Assessment:

- Discuss:
  - Ask the students to arrive at a class total for all the pounds of food they gathered as bears. (Math - if possible, allow students to devise way of getting data together)
  - Divide the total by the 80 pounds needed by an individual bear in order survive in a ten-day period.
  - How many bears could the habitat support?
  - Why didn't all the bears survive?
  - What fraction/percentage survived or didn't? (Math)
  - What limiting factors, cultural and natural, would be likely to actually in influence the survival of individual bears and populations of bears in an area?
  - Be able the explain all vocabulary
  - Write a portfolio piece explaining the problems of all our bears. To be effective, activity data needs to be written down for use at the school.
  - Students should create charts and graphs for the bears and explain them in the portfolio pieces.

Extensions:

- Show the movie "The Bear." Compare the experiences of the bears in the activity to the cub in the movie.
- Show "The Lion King."

- Explain the food chain in the movie.
- What causes the animals to begin to starve? (drought, overgrazing, too many predators, etc.)
- Compare the habitat of lions to the habitat of bears.
- What other kind of "vores" were there in the movie? How were they like our bears? How were they not like our bears?
- What similar limiting factors did the bears and lions have? How were they different? Could the same ones that happen to the bear happen to the lion?

NOTE - All extensions can be used for open-ended questions and/or portfolio pieces.

OH DEER!

Approximate Time Needed:

- 1 class period

Materials:

- Paper and pencil

Student Grouping

- Whole class

Background:

- Food chain
    - Energy pyramid
    - Habitat
    - Limiting factors
    - Essential components of habitat: food, water, shelter, and space.
    - What is needed for reproduction?

Preparation for Activity:

- This activity requires a sufficient amount of space.

Instructions:

- Read the "Project Wild" activity (see Appendix pages T69 - T72).

Assessment:

- Discuss what happen to the deer herd from season to season.
- Create a chart and graph to depict to herd's population.
- What sorts of things could have killed to deer?
- What is compost?
- What sorts of creatures feed off of dead animals? (vultures, flies, worms, coyotes, etc.)
- Did the deer need different things from season to season? What could have caused that?

Extensions:

- Using the classes herd, write a story. If the deer needed water one season, make up a story as to why (drought, man, etc.). If the deer needed habitat, what could have happened to the forest? Write it like it is going to be a book or movie. Use lots of details and colorful language.
- Draw a picture showing one of the year's for the herd.
- Draw and cartoon series, depicting your deer.

FOOD? WHAT FOOD?

(taken from Environmental Science Activities Kit by Michael L. Roa)

Approximate Time Needed:
- 45-55 minutes

Materials:
- Popcorn (already popped; about 1 quart per team plus enough to eat some afterwards)
- An area suitable for a relay (at least 40 yards by 30 yards)
- "Cones" or other objects to mark the start and end points of the relay

Student Grouping:
- teams of 5-7 work best

Background:
- Discuss the concept of trophic levels/ food chains and how energy is lost at each level (this is a very complex concept)
- Explain that, to illustrate this idea, we will use popcorn to represent energy and each person will be a part of a food chain.

Preparation for Activity:
- Pop enough popcorn for the activity
- Obtain the other materials listed above

Instructions:
- Divide the teams, with each member representing a member of a food chain.
- Explain the following rules:
    - The first member will be given as much popcorn as they can hold in two hands.
    - They are to run to the cone/marker, circle it, and return to the next person in the food chain.
    - The popcorn is passed on to the next person, who then runs to the marker, circles it, and returns,passing the popcorn to the next person in the chain.
    - This continues until the entire team has completed the relay with the last person holding the popcorn over their head to signify completion.

Assessment:
- Discuss the activity as a group.
- What factor limited how much popcorn could be carried? (the person with the smallest hands)
- Look at the ground. What does the popcorn on the ground represent? (energy lost to the environment)

- When did most of the popcorn spill? (when transferred, unless an accident) What would happen if there were fewer transfers?
- Seeing this loss in energy, how might we conserve?

Extensions:

- To make more complex, you may assign each team member to a trophic level role, such as plant, herbivore, 1st carnivore, second carnivore, scavenger, decomposer, etc. You may also **start** the relay with the person with the largest hands representing the sun, the main source of all our energy.
- Play another round with uneven teams. This helps to simplify the idea that more energy and material is lost at each level. Then have the students explain **why** shorter teams/trophic levels are desirable.

MAKE A FOOD CHAIN!

(taken from Environmental Sciences Activities Kit by Michael L. Roa)

Approximate Time Needed:

- 30-45 minutes

Materials:

- pictures and/or posters depicting food chains
- one set of laminated food chain cards for each team to make a 3-5 length chain beginning with a producer (may use pictures from magazines, calendars, etc.)

Student Grouping:

- Teams of three to five

Background:

- What is a chain?
- What do you think a **food** chain would be?
- Pose a problem such as: "A space shuttle crew on its way to Venus is able to grow wheat and corn on its ship. Would the crew be able to support more of its people by:
  - eating the wheat and corn;
  - feeding the wheat and corn to chickens, then eating the chickens;
  - feeding the wheat and corn to the chickens, then eating the chicken eggs?"
- The above problem should lead into a discussion of food chains and their components.

Preparation for Activity:

- Prepare food chain cards. (You may consider simplifying the task by color coding the cards, either by coloring the margins differently or by mounting each chain on a different color of paper).
- Familiarize yourself with the sequences.

Instructions:

- Explain that the team's task is to arrange themselves into a logical food chain by lining up in order, from the producer to the last member of the food chain. (You could make this a race)
- Give out the food chain cards to each team so that each team has enough cards to form a complete chain.
- Give the teams time to arrange themselves.
- When all chains are formed, have each team member explain why they placed themselves where they did.

Assessment:

- Discuss the benefits of eating things that are found lower on the food chain to conserve energy. Include health benefits as well as environmental.

- Where do humans fit into most food chains?
- Discuss the effects of removing a link in the food chain (extinction). Relate this to the interconnectedness of organisms.

Extensions:

- Have students investigate and report on other food chains.
- Make a collage or bulletin board illustrating food chains.
- Form a food **web** with students representing the parts and showing the linkage with a piece of string. Hold the string taut. What happens when one part of the web is removed? Have one person drop their piece.
- Discuss the concept of vegetarianism.

Water Energy

WATER WHEELS

Synopsis:

- Read Come a Tide by George Ella Lyon or other book with water as its theme and make a waterwheel to demonstrate hydroelectric power.

Materials:

- Picture book/s related to water.
- For each waterwheel:
  - cardboard
  - toothpicks
  - thread
  - paper clips
- For further exploration:
  - gallon plastic milk container
  - one-hole stopper
  - 2" length of glass tubing
  - 2' piece of rubber tubing
  - medicine dropper

Instructions:

- Read picture books relating to moving water.
- Discuss the force of water and how moving water can be used to make electrical energy.
- Make water wheels and test them under a stream of water (see instructions Appendix pg. T73)

Assessment:

- If you pour the water into the water wheel from higher up, does the water wheel spin faster?
- Do the speed of the water wheel spinning and the energy produced by the water wheel relate? How?

Extensions:

- Visit water falls.
- Visit a damn and study steam turbines.

(For more information, see the appendix, pg. T 73)

SURF ENERGY

Approximate Time Needed:
- Stand alone
- A smaller tank may be used for extensions

Materials:
- Large fish tank
- Enough of the following recipe to fill the tank:
    - 1 kg corn starch
    - 750 ml water
- Light source to make waves visible
- A paddle, possible a mechanical way to keep paddle in motion
- Different size pebbles or marbles to drop in see concentric waves
- Water wheel

Students Grouping
- 1-3 students

Background:
- Transverse wave
- Crest
- Trough
- Refraction (angle of refraction)
- Reflection
- Lunar tides

Preparation for Activity:
- Make wave tank
- Place marbles and paddle where waves can be made by children
- Explanation and pictures demonstrating wave action

Instructions:
- Allow students to experiment with wave action.
- Boats (maybe one from steam engine exhibit) or rubber ducks to see how waves move things.
- Suggest other ways to produce waves: blowing in it, a piece of wood, Styrofoam, etc.

Assessment:
- Discuss:
    - Are waves the same shape, height, and direction? Why or why not.
    - Where did the waves get their energy?
    - Where do ocean waves get their energy?

- What other ways can waves get energy to move?
- How did the floating object move? Draw this action.
- What different things cause waves?

Extensions:

- Repeat the experiment at school. Drop food dye into the pan.
- How does it move?
- Do the drops spread equally in all directions?
- What does the front of a wave look like? Is it like a wall, or does it slide or roll along?
- Where else have you seen waves like this?
- What might a wave do to the air? (breeze)
- What might a wave do to sand?
- What might a wave do to rocks?
- Design a useful mechanical device that could harness wave energy. Draw it and then explain it in detail.
- You live on a beach and the waves are starting the harm your house. How would you protect you house and use this energy?

(For more information, see the appendix pp. 74-76)

STEAM ENERGY

Approximate Time Needed:

- Demonstration
- Workshop, if greatly supervised

Materials:

- Toothpick
- Small candle
- Cardboard
- Glue
- Balsa wood
- A wooden dowel
- Piece of soft brass or copper tubing
- Length of flexible plastic tubing that will fit over the metal tubing
- Pattern for boat

Students Grouping

- Varies

Background:

- Newton's Laws, particularly the 3rd law
- Archimedes Law
- Different forms of matter
- Boiling point
- Condensation point

Preparation for Activity:

- Gather materials for boat.

Instructions:

- Cut the balsa wood into the boat shape.
- Twist the metal tube several times around a dowel to produce a coil.
- Push the two ends of the metal tube through the balsa wood.
- Cut the flag, windshield, and number plate out of the cardboard, and fold and glue them in place. Then glue the candle on the boat.
- Push the plastic tubing over one end of the metal tube, and float the boat on the water.
- Such some water into the metal tube through the plastic tube. When the tube is full, pull off the plastic tube, taking care not to lift the boat out of the water.
- Light the candle and watch the boat go!

Assessment:

- Why did the boat continue to move even when bubbles were coming out? (It was taking on more water. As the water became steam, it exited one end of the metal tubing, while the other took on more water.

- Have steam boat races, using different styles of boats.
- What other ways are boats propelled?
- Which way did the steam come out? Which way did the boat move? Why? (Newton's 3rd law, for every action there is an equal and opposite reaction.)
- Were all the boats at the same depth? Why? (Archimedes Rule)

Extensions:

- Design other boats and build them. Why are some faster than others? Draw your design to scale.
- Research Fulton and his steam engine. Why was this so important?
- Study the manufacturing history in your town. Which of the original plants used steam power?

(For more information, see the appendix pp. T 77 - T 78)

Energy of the Earth

TREE POWER

Approximate time needed:
- 45 minutes

Materials:
- Ten Tall Oak Trees by Richard Edwards
- The Tree by Judy Hindley
- Macrame rope
- Instructions on making macrame bracelets (check Michael's crafts)

Instructions:
- Read the books.
- Make macrame bracelets.
- Discuss the importance of trees to the environment.
- How do we use trees as a source of energy? Where do trees get their energy to live?
- Touch on the process of photosynthesis.
- Explain how we get the rope we're using from plants.
- Discuss other uses of trees.
- Demonstrate how to braid the rope into a bracelet and then help the kids to make their own.

Assessment:
- What things come from trees?
- How do trees generate energy?
- What would happen if there were no more trees?

Extensions:
- Make a list of things that come from trees.
- Make homemade paper from newspapers, using a blend, water, and a screen.
- Buy a fire log. Take it apart and see what is inside (paper).
- Plant trees at a public park, or public housing facility.
- Read The Story of Ferdinand by Munro Leaf and make cork creations.

SHAKE BOXES

Approximate Time Needed:
- At least one hour

Materials:
- Various "mortar" materials:
  - peanut butter, syrup, Cool Whip, cake frosting, etc.
- Various reinforcing material:
  - tape, wire, toothpicks.
- Various ground materials:
  - potting soil, aquarium gravel, topsoil, etc.
- Shake box (see pp.T79-T82)

Student Grouping:
- Groups of two or three

Background:
- What causes earthquakes?
- P-waves (slinky)
- S-waves (rope)
- Faults (Silly Putty)
- What makes a good building?
- Energy of the Earth
- Scientific method
- Controlling variables

Preparation for Activity:
- Have shake box as an example. Students can be provided a box or with older students can build their own.
- Have building materials available with example. Students could bring their own from home.

Instructions:
- Instruct groups to use the materials available to construct a building capable of withstanding an earthquake.
- Time of each earthquake should be kept. (controlling variables)
- Pull string down in a rhythmic fashion for S-waves.
- Pull string back and forth for P-waves.
- If done in groups, students should be reminded that controlling variables is part of the scientific process. Should different people pull the string, if we are doing an experiment?

Assessment:

- Discuss:
  - What kind of building held up best? Why?
  - What kind of earthquake wave was the most destructive?
  - What were the variables involved? Which were the dependent variables? What was the independent variable?
  - What made a stronger building?
  - Was it important for the building to "sway"?
  - How important is the use of connectors?
  - How important is the ground that the building sits on?
- Write about how you would design your building differently to withstand an earthquake similar to the one your original building had.
- Draw to scale your new building. List all your materials.
- Research the areas in the United States that have the most earthquakes. Would you build a house there differently than a house in a place that doesn't have earthquakes.
- Describe earthquakes by comparing them to a rubber band or Silly Putty.

Extensions:

- Students can experiment with different building mediums.
- Assign specific materials to each group. Have them do an oral presentation on why their building will hold up better. Have a group test on each. Write a position paper or have a group discussion why it did or did not.
- Use integrated packages and/or a draw program to design an earthquake proof building. Justify your specifications.

NOTE--All questions in extensions and assessment can be used as open-ended questions or portfolio prompts.

(For more information, see pp. T79-T82 in the appendix)

WHOSE FAULT IS IT?

(taken from The Science Teacher, 1993, Vol. 60, #8, pages 28-33)

- **Note:** The following game will be described with orientation to young children (ages 3-8 years approx.). If a more advanced manipulation of the game is desired, please see the article noted above.

Approximate Time Needed:
- 10 - 30 minutes

Materials:
- Watch
- It is suggested to have at least nine participant for this activity.

Materials:
- None, however, it is suggested to have at least nine parti activity.
- The Mediums and Carriers of seismic waves (analogous to the earth's interior).

Student Grouping:
- Entire class

Background:
- Earthquakes
- S Waves
- P Waves
- Seismometers

Preparation for the Activity:
- Gather the materials.

Instructions:
- Have the students line up and hold hands. The person at one end of the pattern will play the role of the Earthquake. The person at the other end will be the Seismometer. All players in between are the Mediums (see appendix pp. T83-T88 for picture).
- Have the person playing the earthquake start a P-wave by squeezing the hand of his/her neighbor. As soon as a player receives a P-wave in one hand, he/she transmits it immediately by squeezing the hand of his/her neighbor. This process continues down the "mediums" until it is received by the "seismometer".
- Once the seismometer receives the P-wave, he/she shouts "P-wave!" (symbolizing the recording and notification by the seismometer).
- Practice the transition of the P-wave several times possibly changing the intervals of the waves given by the earthquake.
- Perform the preceding steps only, this time, instead of a P-wave, the students will

transmit a "S-wave". This type of wave is given by a single shake of the neighbors hand instead of a squeeze. Again, when the wave reaches the seismometer, the student yells "S-wave".

- After the two types of waves have been practiced, the students can now line up again but, this time, have the earthquake role located within the line instead of at the end. With this line, there will be two seismometers (one at each end).
- Have the earthquake give the different types of waves with each hand. Direct the seismometers to, again, call out the type of wave received.
- If this can be done successfully, secretly give the earthquake role to a different student with each trial and have the students try to guess where the earthquake is located.

Assessment:

- How does the location of the earthquake affect the mediums differently? How would this affect cities?
- How do the waves differ? Which causes more damage?

Extensions:

- Study local faults. What type of wave are they likely to produce?
- Make seismographs.
- Study the Richter Scale.

(For more information, see the appendix pp. T83 - T88)

EARTH ON THE MOVE

Introduction:

- Through the use of a paper-and-pencil model, students can explore the theory of plate tectonics and investigate the process of continental drift. They can use their findings to make predictions about how the continents might continue to drift in the future.

Approximate Time Needed:

- 1 hour

Materials:

- One copy of the Earth on the Move activity sheet for each student (see appendix T89)
- A large map or globe of the earth that shows geological features
- Crayons, markers, or colored pencils for each student
- Safety scissors for each student or pair of students
- A large sheet of blue construction paper for each pair of students

Student Grouping:

- Two students

Background:

- Begin by showing the students a map or globe and review the major continents of the earth. Describe and show the different geological features (mountains, rivers, etc.) as well as the different oceans.

Preparation for Activity:

- Gather materials.

Instructions:

- Have students look carefully at the shapes of the continents on their Earth on the Move activity sheet (see pg. T89), and consider if any of the continents seem as if they might fit together like a jigsaw puzzle.
- Distribute scissors, markers or crayons, and a large sheet of blue construction paper to each pair. Have students color each continent in a different color.
- Cut out the continent shapes from one partner's map and place them on the construction paper, using the uncut map as a guide for where to place the continents.
- Slide the continent shapes around on the construction paper; trying to match the edges that seem to fit.

Assessment:

- Based on your observations by moving the pieces together, bow do you think continents used to be located in relation to each other?

Extensions:

- Build a stratification model of the Earth from modeling clay. Create earthquakes by pulling the clay apart. What happens to the layers?
- Do story problems involving the movement of Pangaea (pan-JEE-ah) to now. Predict how far things will move in the next 1,000 years.
- Make jigsaw puzzles by drawing pictures onto posterboard and cutting them into shapes.

(For more information, see pg. T89 of the appendix)

SMASH YOUR CAKE AND EAT IT TOO!

Approximate Time Needed:
- 45 minutes

Materials:
- 4 cakes, iced
- Forks
- Paper plates
- Napkins
- Kitchen shears
- 6-7 foil cake pans
- Aluminum foil

Student Grouping:
- Entire class

Background:
- Discuss:
    - Pangaea
    - Continental drift
    - Platetonics
        - Lateral plate movement
        - Divergent plate movement
        - Convergent plate movement
    - Mountain formation
    - Earthquakes

Preparation for Activity:
- Bake three cakes in disposable foil pans for demonstration and at least one cake for eating.
- Lateral plate movement: Cut one of the foil cake pans diagonally, starting just beneath the reinforced rim. Leave the rim intact. Reinforce the cut pan by covering the outside with a sheet of foil. Place the reinforced pan inside an uncut pan. Lubricate the inside of the second pan liberally with cooking oil or spray.
- Divergent plate movement: Do the same as with the lateral plate movement, but cut the pan across the middle.
- Convergent plate movement: Do the same as with the divergent plate movement, but prepare the pan for this by bending one slide slightly so that it will slide inside the other end when the students apply pressure to both ends of the pan.
- Ice the cakes.
- Cut the rim of the cakes.
- **NOTE:** To make the strata of the earth, try baking two flavors of cake mix each pan. You may also want to add ingredients to represent rocks, etc.

Instructions:

- Have two children, one at each end of the lateral plate movement cake, very slowly move half of the pan to the left while the other student slowly moves the other end to the right, keeping both cake and pan as level as possible.
- Have two children, one at each end of the convergent plate movement cake, pull outward on the ends of the pan and cake, slowly, steadily, and without twisting, until the cake begins to fracture.
- Have two children, one at each end of the divergent plate movement cake, push toward each other with steady, slow pressure.
- During the demonstration, ask assessment questions.
- Afterwards, eat an untouched cake as a treat!

Assessment:

- What happens to the cake with the lateral plate movement? What would this kind of movement do to the Earth?
- What happens to the cake with the divergent plate movement? What would this kind of movement do to the Earth? Does the Earth snap back?
- What happens to the cake with the convergent plate movement? What would this kind of movement do to the Earth? Does the cake look smooth? Where in the United States could you find an example of this kind of movement?

Extensions:

- Make a cake to teach about magma flows. (see appendix article)
- Create environments on top of the cakes.
- Study maps to find examples of these different plate movements in the world. What kind of topography is in these areas?
- Study your local faults. How often do they cause earthquakes?

(For more information, see pp. T90-94 in the appendix.)

RAIN GAUGES

Approximate Time Needed:

- 45 minutes

Materials:

- Empty and clean 2-liter bottles
- Paint markers (**warning:** these are permanent!)
- Markers
- Drawing paper
- Exacto knife
- Rulers
- Tape
- Hot glue and glue gun

Students Grouping:

- Individual

Background:

- Discuss:
    - Weather as energy
    - Causes of rain
    - Benefits of rain
    - Weather stations
    - Affects of rain

Preparation for Activity:

- Gather materials.
- Cut the tops of the 2-liter bottles for the students using an exacto knife. Cut the tops horizontally at the highest part where the bottle's sides are still straight vertical. (see picture on p. T95 for more clarity)

Instructions:

- Draw a picture that you would like to have on your rain gauge using markers and drawing paper.
- Tape your picture inside the bottle so that you can see your picture through the plastic.
- Trace your picture using the paint markers.
- Place a ruler inside your bottle with the lower numbers at the bottom of the bottle and the higher numbers at the top.
- Trace the measurements of the ruler onto your rain gauge with a paint marker. Mark each 1/2". Number each inch starting at the bottom.
- Invert the top of the bottle so that it is a funnel and place it inside the top rim of your rain gauge. Have your teacher help you glue the funnel in place.
- Teacher: Place a few drops of hot glue around the rim of the bottle. Tape will work,

but won't withstand the rain.

Assessment:

- Why do you think that it is important to measure rain?
- Make a list of reasons why rainfall information would be helpful, and to whom.
- What are the pros and cons of rain? Make a list.

Extensions:

- Create a weather station with a weather vane, wind sock, and barometer.
- Make tornado tubes.
- Study rainfall around the world. Is there a pattern in what countries look like with similar rainfall? What kind of animals like dry or wet areas? Do different plants grow in these areas?
- Have a weather forecaster visit from a local TV station.

(For more information, see p. T95 of the appendix.)

PHOTOSYNTHESIS

Approximate Time Needed:
- Set up time, 45 minutes
- Allow time to grow (1 week)

Materials:
- Radish seeds
- A large box
- Paper towels
- Water
- Scissors
- Vinegar
- Two spray bottles
- White carnations
- Food coloring
- Jars to hold carnations
- Two identical house plants

Student Grouping:
- Divide the class into three groups:
  - Light for Growth
  - Acid Rain
  - Funny Flowers

Background:
- Discuss:
  - What do plants need to live?
  - How can the environment affect growth?
  - How do plants get what they need?
  - Photosynthesis

Preparation for Activity:
- Gather the materials.
- Divide the box into thirds. Cut the top of the box out on one of the end sections. Cut the side of the box out of the other end section. Leave the middle section completely intact.

Instructions:
- Light for Growth
  - Sprinkle radish seeds onto wet paper towels. Place the paper towels in the bottom of the box. Place the box in front of a window in your classroom. Observe growth daily.
- Acid Rain

- Place the two identical house plants next to a window so that they both receive the same amount of light. Spray each plant daily. Spray one with water, and the other with water containing vinegar. Observe the growth daily.

- Funny Flowers
  - Place several white carnations each into separate jars with water in them. Place several drops of food coloring into each jar. Observe daily.

Assessment:

- What happens to each of the experiments? What do they show about how plants grow? What do they need? Which experiments show examples of plants that are lacking what they need?
- Which experiment best illustrates the effects of pollution on the environment?

Extensions:

- Visit a greenhouse. Tour the grounds. Do all plants require the same amount of water and light?
- Study leaves. Make a collection.
- Make Leaf Impression T-shirts by cutting sponges to the shapes of leaves that you study. Dip the sponges into fabric paint and make into a design on a T-shirt.

(For more information, see pp. T96-100 in the appendix.)

Fossil Fuels

PEANUT MINING MAGIC

(taken from "The Mine to My Home," Science Scope Magazine, May 1994, pages 28-29)

Approximate Time Needed:
- 1 1/2 hours

Materials:
- Five large bags of peanuts in the shell
- Two large bowls
- Eight to ten small paper bowls
- Blender (or peanut butter maker)
- Salt
- Vegetable oil
- Foods to eat peanut butter with; e.g. crackers, celery, apples, etc.

Student Grouping:
- 2 - 3 students

Instructions:
- Find all the peanuts hidden in the classroom (explore).
- Collect the peanuts into two large bowls (mine).
- Take a small supply of peanuts in a small bowl and shell them (process).
- The shelled peanuts (representing the mineral resource) must be made into a product or form that is consumable. With the help of your teacher, use a blender or peanut butter maker to make peanut butter by crushing the peanuts and adding vegetable oil and salt as needed (process).
- Eat the peanut butter with crackers, celery, or apples, or use the peanut butter to make candy or cookies (consume).
- Create as many different ways to use the peanut shells as possible (recycle).

Assessment:
- How does this activity relate to the exploring, mining, processing, consuming, and recycling involved in mineral resource development?
- Think of other examples that could illustrate the "mine to my home" concept.

Extensions:
- Visit a coal mine.
- Locate mining areas on a map and study industrial geography.

(For more information, see pp. T100 - T101 in the appendix.)

RESEARCHING KENTUCKY'S RESOURCES

Approximate Time Needed:
- 1 class period

Introduction:
- This workshop will emphasize the natural resources of the state of Kentucky. The information will be presented mostly from a guest speaker from Kentucky Geological Survey located at the University of Kentucky.

Materials:
- Will be provided by the guest speaker in most cases.

Student Grouping:
- The entire class

Background:
- Fossil fuels
- Coring
- Geology

Preparation for Activity:
- Contact:

  Steve Greb
  Kentucky Geological Survey
  University of Kentucky
  Lexington, KY 40506
  (606)257-5500
- Arrange a time for someone to come you your classroom. Choose which artifacts and/or activities you would like in your classroom:
  - Geological survey mapping for natural oil, gas, and coal
  - Example of oil well devices
  - Core samples for geological surveys
  - Coal mining exhibit
  - Photographs dealing with the above items
  - Display of various items dealing with water
  - Games: "Find the Oil"

Instructions:
- This part of the lesson will be planned by the guest speaker.

Assessment:
- These questions will be asked by the guest speaker.

Extensions:

- Make an edible coring game with straws and jello.

FOSSIL FUEL EXTRACTION

(taken from Environmental Science Activities Kit by Michael L. Roa and "Science and Children" magazine, 1991)

Approximate Time Needed:
- 45-55 minutes

Materials:
- Per individual or team:
  - 1 brownie containing chocolate chips (or M & Ms), raisins, and walnut pieces
  - 1 toothpick
  - 1 paper plate
- Worksheets (see appendix p. T102)

Student Grouping:
- Individual, or teams of 2-3

Background:
- Discuss:
  - What are fossil fuels?
  - What do we use them for?
  - Why are fossil fuels so important?
  - Why should we work to conserve our fossil fuels?
  - How do you think we get our fossil fuels?
  - The interconnectedness of various resources (land, air, water) and ecosystems
  - By saving/conserving resources, we are reducing land, air, and water pollution
  - The use of models in the lab when we can't bring the experiment inside

Preparation for Activity:
- Bake enough brownies for each individual or team to have a square
- **NOTE:** You may want to bake extra as a treat afterwards since it won't be a good idea to eat the brownie they mined.

Instructions:
- Provide each individual or team with a brownie.
- Explain that this brownie represents an area of land that may contain deposits of coal (raisins), oil (nuts), and/or natural gas (chocolate pieces).
- Give each individual a toothpick which represents the mining and drilling equipment used in obtaining these fossil fuels.
- Inform them that their job is to remove as much of the coal, oil, and natural gas as possible with as little damage to the environment (the brownie) as possible. Pretend the top of the brownie is land on which many kinds of plants and animals live.
- Allow time for the extraction.

- Have students record the amounts of various resources they were able to obtain and the amount of waste.

Assessment:

- What happened to the "land" when you mined for fossil fuels?
- Were any crumbs spilled? What is erosion?
- What would happen to the plants and animals that lived on land that was mined?
- What do you think might be done to reduce the damage done by mining?
- Using less energy requires less fossil fuels. What could you do to reduce energy?

Extensions:

- Have the students determine the percentage of each fossil fuel extracted and the percentage waste (crumbs) from their mining operation.
- Visit a mine and find out what they do to try and reduce the damage to the environment.
- Fine the students based on the amount of damage they do to the land by charging them a portion of their extracted fossil fuels for the damage.
  - Brownie in one piece just holes: 1 chip
  - Brownie in 2-3 pieces: 2 chips
  - Brownie in more than 3 pieces: 3 chips
  - Brownie in crumbs: 5 chips
- Simplify the activity for younger children by using chocolate chip cookies. Mine for chocolate only. If your class is older, they can present this lesson to a younger class.

(For more information, see pg. T102 in the appendix.)

SURFACE MINING

(taken from Environmental Science Activities Kit by Michael L. Roa, 1993)

Approximate Time Needed:
- 45 minutes

Materials:
- One watch with a second hand
- For each team of students:
  - One plastic pan (approximately 30cmx35cmx15cm deep)
  - Sand or fine gravel to fill pan to about 10 cm deep soil to form a "topsoil" layer About 1cm thick on top of the sand
  - Peanuts in the shell (may substitute sunflower seeds or acorns to represent "ore")
  - Enough small leaves or grass to cover the "topsoil"
  - 1 probe, pencil, or long thin stick
  - 1 forceps
  - 1 teaspoon
  - 1 tablespoon
  - 1 small scoop
  - 1 small kitchen strainer (opening diameter of about 5-8 cm)
  - 1 clean container to hold the peanuts
  - 1 nutcracker or pliers
- Small brooms/dustpans to clean up
- Data tables (see appendix pg. T104)

Student Grouping:
- 2-5 students per group to allow for modifications

Background:
- Discuss:
  - How scientists use models to simulate real life especially in studying things that can't be brought into the lab the physical process of strip mining
  - Vocabulary terms as needed:

overburden	refine
infinite	reclaim/reclamation
strip mining	tailings
open pit mine	surface mining
nonrenewable resource	ore
	spoil

Preparation for activity:

- Prepare each mining site as follows:
  - Place about 5cm (2") of sand in the bottom of the plastic pan
  - Place the peanuts on top of the layer of sand (**note**: some sites should have the "ore" spread evenly and others should have the ore in clusters; also, keep count of each site's number)
  - Add more sand, to a depth of about 10cm (4")
  - Cover the top of the sand with about 1 cm soil
  - Cover the top of the soil with small leaves or grass (**note**: you may want to have some extra "sites" set up for those who mine all of theirs before the activity is over)

Instructions:

- Form the teams. There are roles for up to five on a team. Below are descriptions of each role. Decide which roles you will have the students assume. Either let each child choose their part, assign it, or have a random drawing.
  - **FIELD GEOLOGIST-** uses the probe to try to locate where to mine for the minerals. Since mining is expensive, try to find the most minerals that can be recovered with the least movement of the soil (overburden).
  - **MINE OPERATOR-** uses the forceps or other equipment to remove ore from the ground. After acquiring some ore, the company may choose to buy more advanced equipment for this job such as a spoon or strainer.
  - **PROCESSING PLANT OPERATOR-** removes the mineral from the ore (peanut from shell). Must start with fingers until company can afford and chooses to buy a nutcracker or pliers. The peanut shells represent poisonous mining and processing wastes so...**don't use teeth to remove the nuts!**
  - **ACCOUNTANT-** keeps track of the amount of mineral mined and refined; may use peanuts to buy new equipment if you want to get that involved.
  - **ENVIRONMENTAL ENGINEER-** in charge of cleaning up any spillage, disposing of waste products (such as peanut shells), and reclaiming the land. The companies will be fined for improperly disposed wastes.
- Have each team give their company a name.
- Explain the following instructions to the companies:
  - Round 1 or 1 "day" of mining lasts for 15 seconds.
  - Round 2 of processing lasts for 15 seconds.
  - After these 2 rounds each company has 30 seconds to clean up, plot data, and discuss plans
- Distribute and explain instructions and data sheets. With younger students you may want to read the instructions together.
- Depending on available time, conduct rounds. You have up to 16 on the data sheet.
- After the last round have each company report on its final accumulated wealth.

Assessment:

- Discuss:
  - Did all mining companies recover the same amount of ore? Why or Why not?
  - Do all states or countries have the same mineral wealth? If different, how should this wealth be shared among countries and people?
  - If minerals can't be mined profitably without harming the environment, should they be mined?
  - Who should pay to repair the damage to the land?
  - Do we have an infinite amount of minerals on earth?
  - What usually happens to the price of a mineral as its supply diminishes?
  - What does this statement mean: "We do not inherit the Earth from our ancestors. We borrow it from our children."

Extensions:

- Have students graph their mining data. Production rate (#peanuts/round) vs time (mining round number).
- Try to think of future inventions that could make mining less destructive. Scientist now use geological survey maps and equipment that lets them find pockets of a resource without coring first.
- Make maps of the mining sites to scale with a compass, or plot onto graph paper by marking site into plots as with archeological surveys.
- Visit an archeological or geological survey.

(For more information, see pg. T103 in the appendix.)

OIL SPILL!

(taken from Environmental Science Activities Kit by Michael L. Roa)

Approximate Time Needed:

- 45 minutes

Materials:

- Pre-made habitats (if time allows, the kids may take more ownership if they make their own habitat)
- For each habitat, you will need:
  - 10x14 pan
  - Water to fill pan to 2-5cm (1-2")
  - Items to put in your habitat such as:
  - rocks, sticks, plastic animals, feathers (preferably waterfowl, untreated), pieces of animal skin with fur attached (may find old fur at a flea market, biological supply house, leatherworking/hobby shop)
- For each team you will need:
  - 4-8ml oil (cooking or other light oil will work)
  - Small paper cups/plastic boats to use as "oil tankers"
  - Cleaning materials such as:
  - dishwashing detergents/soaps, laundry detergents/soaps, baking soda, sponges,
  - pieces of cloth, borax, gauze, cotton balls, mineral oil, paper towels, cotton swabs, medicine droppers
  - newspaper to work on

- **Note:** This activity can be done without a "habitat". Simply have the students take the fur and feather dip them in water to see water-repelling properties and then dip them in oil. Note the differences and then go on to the various clean-up materials.

Student Grouping:

- 2-4 students

Background:

- Introduce with current news article on a recent oil spill or magazine article on oil spills and their effects on wildlife and/or water. If none available, explain what an oil spill is.
- Discuss habitats and their importance to the ecosystem.

Preparation for Activity

- Either prepare enough diverse habitats for each team or place the habitat building materials in sets for each team
- Set up a clean-up supply station with all the possible cleaning materials.
- Prepare your "fleet" of tankers for the "accident"

Instructions:

- Provide the students with the pre-made habitats or give them the materials and instructions to build their own (allow 5-10 minutes to build).
- Add water (about 1-2") to each island habitat
- Allow students to use the medicine droppers to test the feathers and fur for water-repellant properties.
- Explain that there is a shipping lane that passes near the island and then explain that oil supertankers use this shipping lane.
- Either give each team a supertanker or you bring the tanker to each team and, as you explain that an oil affects the island and its inhabitants, you "spill" oil onto their habitat.
- Discuss possible approaches to cleaning up the spills as you introduce them to the clean-up station.
- Allow them time (10-30 minutes) to try several different cleaning agents to try & clean the rocks, animals, feathers, and fur.
- The students may want to retest the fur and feathers for water-repellant abilities after the spill.

Assessment:

- Compare the feather and fur before and after the oil spill, and before and after cleaning
- What are the effects of oil spills? How can we reduce the need to transport?
- If we didn't use/waste so much oil we wouldn't need to ship so much.
- What clean-up method(s) worked best for removing the oil?
- How would the various clean-up methods affect the wildlife?
- What are you willing to do to help prevent spills?
- What are you willing to do to save energy?

Extensions:

- Design an experiment to determine whether oil can pass through and eggshell. If it does, what might the effects be on developing bird embryos? What about animals that don't produce shells?
- Try the same experiment, but with different types of oils.
- Visit a facility that deals with waste oil.
- Do research to find out more about specific oil spills.
- Make wax resist paintings using crayons (oil) and tempera paint (water).
- Do experiments with liquid levels and density. (see pp. T105-T106 in the appendix)

Thermal Energy

WHAT MAKES HOT HOT?

Approximate Time Needed:
- 1 hour

Materials:
- Safety goggles
- wire coat hanger
- large wood block
- small wood block
- sandpaper
- small jar with lid
- coarse dry sand(salt can be substituted)
- thermometer
- masking tape

- **Note: Make sure to wear safety goggles throughout this activity!**

Student Grouping:
- 2 - 3 students

Background:
- Objects become warmer with increasing motion
- Energy can be transferred but not lost

Preparation for Activity:
- Collect the materials.

Instructions:
- Hold the wire coat hanger at both sides and bend it in and out 15 times. Carefully touch the hanger at the bend. What did it feel like? How do you think it go that way?
- Wrap the sandpaper around the small wood block. Pressing hard, rub the sandpaper against the surface of the big block 50 times. Immediately feel the surface of the wood. What did it feel like? How did it happen? How is this like the coat hanger?
- Fill the jar about 3/4 full with course sand or salt. Insert the thermometer about halfway into the sand through the hole. What was the temperature?
- Put the lid on the jar. Shake the jar vigorously for 3 minutes. After the three min. of shaking, remove the jar lid and quickly insert the thermometer. Now what is the temperature? Where do you think the change came from?
- All these activities required you to use energy. What happened to the energy you used? What was the effect on the materials?

Assessment:

- Included in the instructions.

Extensions:

- Use dark and light colored liquid with thermometers in them to illustrate this effect.

CHILL STOPPERS!

Approximate Time Needed:

- 45 minutes

Materials:

- Brave Irene by William Steig
- Pieces of fabric 6"wide by 39" long (may want patterned & plain)
- sand and/or beans for stuffing
- Needle & thread for the facilitator to sew up end when filled
- Decorations such as:
    - eyes
    - glitter
    - felt
    - animal pom poms
    - puff paints
    - pipe cleaner
    - permanent markers
    - beads

Student Grouping:

- Individual

Background:

- Read Brave Irene by William Steig
- Discuss:
    - Ways we keep warm in the winter
    - Electricity to keep us warm costs money.
    - Have you been told to not stand with refrigerator door open? Why do you think your parents tell you this?
    - How about, "Don't leave the door open. You're heating the whole outdoors." Again, why are we careful to keep the warm air in and the cold air out?
- Relate this to the use of energy and conservation.
- Explain to participants that they will make a draft guard that is used to cover the cracks under a door to keep the heat in.

Preparation for Activity:

- Collect the necessary materials.
- Have enough tubes for the draft guards sewn so that all the kids need to do is stuff them and decorate. (The facilitator can quickly sew the end of each when stuffed).

Instructions:

- Give each child a tube to fill with either sand or beans. (tubes may be patterned or plain)

- After each has filled tube, quickly tack the end.
- Make available materials for kids to decorate the tube (may draw animal faces, glue on beads, make antennae, etc.)

Assessment:

- There will be no follow-up discussion. All relevant information will be covered before they make their draft guards.

Extensions:

- Bring in utility bills from home. Study how to read them. Compare winter and summer months.
- Walk around your school in the winter. Feel for drafts. Insulate 1/2 of the windows in a drafty area with plastic. Feel the difference. For a more exact comparison, place a thermometer next to the insulated and uninsulated area.

DON'T LET THE ICE MELT!

Approximate Time Needed:
- 45-60 minutes

Materials:
- ice cubes
- plastic bag for each cube
- masking tape
- string
- containers to put some of the insulating material in (i.e.sand) that cannot be "wrapped" around the cube
- various insulating materials such as:
  - paper (various thicknesses)
  - sawdust
  - sand
  - wool
  - styrofoam
  - feathers
  - construction insulation
  - socks
  - quilting batting
  - plastic
  - cotton balls
  - foam rubber
  - vermiculite
  - other cloth material

Student Grouping:
- 2-3 students per group

Background:
- Discuss:
  - What is insulation?
  - Why do we need insulation?
  - What are some things we use for insulation?
  - Do you think all insulation is the same? How so?
  - How do you think you could test to see which kind of insulation might work the best?

Preparation for Activity:
- Obtain samples of as many insulation types as possible.
- Put one ice cube in each plastic bag and seal with masking tape (make enough for each child to test several materials).
- As the timer, set up several ice cube bags with tape to hang with string (round is up when that cube melts).

Instructions:
- Each team receives one ice cube in a plastic bag taped shut.
- The goal of the activity is to prevent the ice cube from melting for the longest period

- The goal of the activity is to prevent the ice cube from melting for the longest period of time.
- Students choose one insulation type to test in a round.
- Students surround the ice cube with the chosen insulation.
- Hang up the timer ice cube.
- As you are waiting and watching the melting, make predictions based on the insulation chosen. Which insulation do you predict will work best. Why?
- The round ends when the timer cube melts.
- Complete enough rounds so that each insulation type gets tested at least twice (this could lead into short discussion about scientific methods of testing).

Assessment:

- Which insulation material(s) preserved the ice cube the longest?
- What properties does this material(s) have that might account for its superiority?
- Which materials didn't work well? Why do you think this is so?
- Why do you want a good insulator in your house?

Extensions:

- To be more scientific, the students could use coffee cans and warm water, taking the temperature of the water when the cans are covered in different insulation. Record the data and compare.
- Have the students graph the data.
- Arrange for a guest speaker on the topic of insulation and/or energy conservation.

Bibliography

ENERGYQUEST BIBLIOGRAPHY

Altman, Paula. Energy Education Resources. Department of Energy, Washington, DC, 1994.

Ardley, Neil. The Science Book of Light. Gulliver Books, New York, NY, 1991.

Ardley, Neil. The Science Book of Sound. Gulliver Books, New York, NY, 1991.

Ardley, Neil. The Science Book of Water. Gulliver Books, New York, NY, 1991.

Ballooning Interest, Mebane & Rector, Science and Children, October 1992, pp. 16-18.

Berger, Melvin. Switch on, Switch Off. Harper Collins, New York, NY, 1989.

Boorstin, Michael. The Discoverers. Vintage Books, New York, NY, 1985.

Brown, Ruth. The World that Jack Built. Dutton Children's Books, New York, NY, 1991.

Burnes, Doris. Andrew Henry's Meadow. Coward-McCann, New York, NY, 1965.

Calmenson, Stephanie. Zip, Whiz, Zoom!. Little, Brown, and Company, Boston, MA, 1992.

Challoner, Jack. Eyewitness Science: Energy. Dorling Kindersley, New York, NY, 1993.

The Class Project, The National Wildlife Federation.

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Coiley, John. Eyewitness Books: Train. Alfred A. Knopf, New York, NY, 1992.

Daitz, Myrna. Crafty Ideas from Science. Exley, Mt. Kisco, NY, 1991.

Dorros, Arthur. Feel the Wind. Crowell, New York, NY, 1989.

Elkington, John, et. al. Going Green: A Kid's Handbook to Saving the Planet. Tilden Press, New York, NY, 1990.

Emberley, Michael. Welcome Back Sun. Little, Brown, Boston, MA, ▫ 1993.

Evans & Williams. *Let's Explore Science Series: (good for preschool - 1)*

Me and My Body. Dorling Kindersley, Inc., New York, NY, 1992.

Color and Light. Dorling Kindersley, Inc., New York, NY, 1993.
Water and Floating. Dorling Kindersley, Inc., New York, NY, 1993.
Sound and Music. Dorling Kindersley, Inc., New York, NY 1993.

Fife, Dale H. The Empty Lot. Sierra Club/Little Brown, San Francisco, CA, 1991.

50 Simple Things Kids Can Do to Save the Earth. The Earth Works Group, Andrews & McMeel, New York, NY, 1990.

Friedhoffer, Robert. Magic Tricks, Science Facts. Franklin Watts, New York, NY, 1990.

Friedhoffer, Robert. Matter and Energy. Franklin Watts, New York, NY, 1992.

From the Mine to My Home, McBiles, Larry. Science Scope, May 1994, pp. 28, 29.

Greene, Carol. The Old Ladies Who Liked Cats. Harper Collins, New York, NY, 1991.

Hoban, Tana. Shadows and Reflections. Greenwillow Books, New York, NY, 1990.

James & Granovetter. Waterworks: A New Book of Waterplay Activities for Children ages 1 to 6. Kaplan Press, Lewisville, NC, 1987.

Kidron, Michael. The State of the World Atlas. Penguin, New York, NY, 1995.

Klein, Herbert Arthur. The Science of Measurement: A Historical Survey. Dover, New York, NY, 1988.

Lavies, Bianca. Compost Critters. Dutton Children's Books, New York, NY, 1993.

Leaf, Munro. The Story of Ferdinand. Viking Press, New York, NY, 1938.

Lyon, George Ella. Come a Tide. Orchard Books, New York, NY, 1990.

MacGill-Callahan, Sheila. And Still the Turtle Watched. Dial Books for Young Readers, New York, NY, 1991.

McDermott, Gerald. The Raven: A Trickster Tale from the Pacific Northwest. Harcourt Brace Jovanovich, San Diego, CA, 1993.

Parker, Steve. Flight and Flying Machines. Dorling Kindersley, Inc., New York, NY, 1993.

Project Wild workbook:

- **In order to obtain this book, you must attend a Project Wild in-service.**
- For more information, call or write:

Melinda Kuhnhenn
Bourbon County Middle School
3343 Lexington Rd.
Paris, KY 40361
(606) 987-2189

Roa, Michael. Environmental Science Activities Kit. 1993.

Rogers, Fred. Going on an Airplane. G.P. Putnam Sons, New York, NY, 1989.

Schwartz, Linda. Earth Book for Kids: Activities to Help Heal the Environment. The Learning Works, Santa Barbara, CA, 1990.

Schwartz, Linda. Likeable Recyclables: Creative Ideas for Reusing Bags, Boxes, Cans and Cartons. The Learning Works, Santa Barbara, CA, 1992.

Science Activity Book: 20 Exciting Experiments for Parents and Kids to Do. Smithsonian Institution. Galison Books, New York, NY, 1987.

Shook-Hazen, Barbara. The Knight Who Was Afraid of the Dark. Dial Books for Young Readers, New York, NY, 1989.

Simons, Robin. Recyclopedia. Houghton Mifflin Company, Boston, MA, 1976.

Steig, William. Brave Irene. Farrar, Straus, Giroux, New York, NY, 1986.

Stevenson, Robert Louis. My Shadow. Putnam, New York, NY, 1990.

Still More Science Activities. Smithsonian Institution. Galison Books, New York, NY, 1989.

A Stroll Through the Solar System, Uslabar, Kenneth. Science Scope, October 1993, pp 41-43.

Seuss, Dr. The Lorax. Random House, New York, NY, 1971.

Tolman & Morton. Earth Science Activities for Grades 2-8. Parker Publishing Company, Inc., West Nyack, NY, 1986.

Van Alsberg, Chris. Just a Dream. Houghton Mifflin, Boston, MA, 1990.

Wasserman & Doyle. Earth Matters.

Whose Fault Is It? Muller, Eric. The Science Teacher, November 1993, pp. 28-33.

Womsak, Francis, ABC of Ecology. Davenport, Los Altos Hill, CA, 1982.

Resource List

RESOURCE LIST

Department of Natural Resources and Environmental Protection
Capitol Plaza Tower
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Western Kentucky University
Bowling Green, KY 42101
502-745-4424

Center for Environmental Education
Department of Elementary and Secondary Education
Murray State University
Murray, KY 42071
502-762-2534

The National Wildlife Federation, "The Class Project"
1412 Sixteenth St., NW
Washington, DC 20036
202-797-6800

National Energy Information Center
U.S. Department of Energy
Washington, DC 20585

American Coal Foundation
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Washington, DC 20036-4604
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Provides materials on coal, some free. Also free, a coal kit with peat, lignite, bituminous coal, and anthracite with a brief description.

American Gas Association
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Natural Gas Education for Kids--free catalog called Natural Gas Teaching Materials.

Bureau of Mines

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Resource for Education
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Salt Lake City, UT 84116

Kids for Saving Earth
P.O. Box 47247
Plymouth, MN 55447-0247

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Washington, DC 20007
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Western Regional Environmental Education Coalition
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Trees for the Future
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Silver Spring, MD 20915

Freshwater Foundation
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612-471-8407
Video available: When the River Runs Dry; K-6 curriculum, water education and brochures.

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Sierra Club
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San Francisco, CA 94109
415-776-2211

U.S. Environmental Protection Agency
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Mail Code A-108 EA
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Washington, DC 20460
202-382-4452
Directory of materials for K-12.

The Aluminum Association
900 19th St., NW
Washington, DC 20006
202-862-5100 or 1-800-243-6877
Video for loan, Recycling: Your Next Assignment, and Call Me a Can. Free catalogs.

National Wildlife Federation
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202-797-6800
Nature Scope, a curriculum guide to resource conservation.

Institute of Scrap Recycling Industries
1627 "K" St., NW
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American Nuclear Society
Public Communications Dept.
555 N. Kensington Ave.

LaGrange Park, IL 60525
708-579-8265
Free and loan publications: science and social studies K-12 (loan), audio visual (loan), newsletter and catalog (free).

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Kits for K-6, 7-12. Also, How to Set up a School Recycling Program for K-3, 4-6, and 7-12.

American Solar Energy Society
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303-443-3130
Sample magazines of Solar Today. For a fee, a science project book.

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122 "C" St., NW
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