Exploring Your Environment
Teacher's Guide

Introduction
Exploring Your Environment shows students the links among energy, environment, and energy efficiency. This booklet illustrates some basic environmental principles and actions that can change the impact of our energy use on the environment. If they spend 30 minutes a day, students can work through *Exploring Your Environment* in 8 to 10 days. This teacher's guide gives you information you will need to help your students.

Opening Questions
1. What is the environment? Where is it?
2. Does the environment change? How?
3. How does using energy affect the environment?
4. How is the environment different now than it used to be?

Lesson Plan 1: Pages 2, 3

Objectives
Students will be able to:
1. Define the word "environment."
2. Use their senses to make observations about the environment.

Background
The environment is varied and pervasive. Students may think that the word "environment" refers only to the natural world, but it refers to anything that surrounds or affects an organism. Environments change constantly. There are natural changes, like the seasons, and changes made by organisms in order to survive.

Lesson Development
1. *Explore Your Environment - page 2:*
   Send students to their observation sites in cooperative work teams. When they return, have each team meet for 10 minutes to share their findings. Then write a group poem from the words they used to answer the questions on page 2. Each group should present their poem to the class.
2. *What If? - page 3:*
   Help students think about what elements of the environment have been added or made by human beings; list on the board. Then ask them to speculate what their school grounds and the surrounding community was like before modern times; before any human civilization in the area. You may have to supply some of this information, but answers can be imaginative—then, they can make their drawings.

Questions and Answers:
1. *Why did people make these changes?*
   To accommodate many people in a small space, to accommodate automotive travel, to give themselves shelter/food/clothing or to fill other basic needs.

2. *How have these changes been helpful?*
   Provide comfortable places for people to live, easier ways to travel, etc.
3. *How have they been harmful?*
   Less land for farms and forests, pollution of air and water, disruptive of habitats, overcrowding, traffic jams, litter, etc.

Lesson Plan 2: Pages 4, 5

Objectives
Students will be able to:
1. Explain why plants, people, and other animals have to adapt to their changing environment.
2. Give examples of several species that change the environment to suit their own needs.

Background
Habitats change over time. Survival depends on an organism's ability to adapt to change. An example of adaptation would be the markings of deer fawns that make them almost perfectly invisible even at close range.

Organisms also alter the environment in order to survive; the beaver is a good example. Beavers are adapted to the water, and they build dams in order to make a habitat most suitable to their bodies. Human beings alter the environment, too, in many ways, but it is important for students to understand that many species change the environment.

Lesson Development
1. *Explore - page 4:*
   Before students begin reading, ask how many know what a beaver is or if anyone has seen a beaver. Talk about their impressions. Then answer the questions.

   Questions and Answers:
   - *In what ways is a beaver's body adapted to fit the environment?*
     Fur for warmth, webbed hind feet for swimming, tail for balance and as a rudder when swimming, front teeth for cutting trees.
   - *How do these features help the beaver survive?*
     Physical adaptations let them change the environment in order to live in safety.

2. *Hydroelectric Dam - page 5:*
   Ask students to identify the differences between beaver dams and hydroelectric dams; list on the board, then answer the questions on the left side of the page as a class.

   Questions and Answers:
   - *How does a dam change the river it is built on?*
     Decreases the flow of water downstream. Creates a reservoir upstream. Floods land that was dry. Can cause silting and threaten the survival of fish downstream.

   - *What is necessary to get the electricity from the dam to you?*
     From the generator, electricity flows through wires to a transformer outside the turbine building. This step-up transformer raises the push behind the current (called voltage). Electricity leaves the transformer and travels long distances over large transmission lines. When electricity reaches its destination, it passes through step-down transformers in a substation to lower the voltage. The electricity flows through small distribution lines to all the places we use it.

- *How does that change the environment?*
  Land is needed for the equipment at the dam site, for transmission and distribution lines. The presence of electric lines can pose a danger to people that come in contact with them, etc.

3. *Who Can Build the Best Dam?*
   Small teams will work best for this activity. You will need one plastic tub or a window box planter for each team. Before the activity, have students collect materials for building their dams. Be sure they bring in lots of material. Have on hand scrap wood, plastic bags, and soil. Remind students that dams control the flow of water; they do not stop it. Have each team demonstrate their dam to the class. Assign one student to time the holding power of each dam.

   - To conclude, ask: *What have you learned about dams?*
     Answers might include that dams are hard to build, that a dam does not hold back all the water. Students may note the environmental effects or the differences between beaver dams and hydroelectric dams.

Lesson Plan 3: Page 6

Objectives
Students will be able to:
1. Identify the things they need in order to survive.
2. Describe two ways nature adjusts to change.

Background
Nature is balanced, but not static—it is always changing. Any change can affect the survival of any plant or animal species, which will cause reactions in other parts of the environment. These reactions will work toward restoring the balance of nature.

Motivation
Read this story to the class and ask the questions below: "Once upon a time, there was a pond that had a lot of fish. Along the banks of the water, there were a lot of plants that attracted insects. When the insects fell from the plants into the water, the fish ate them. One day a forest fire destroyed the plants." After the forest fire...what do you think happened to the fish? Could any fish survive? If you went there a year later, what would it look like?

*Note to teacher: If there were no plants, no insects would fall into the water. Most fish would die because there was not enough to eat: but a few would probably live. The plants would grow back; insects would fall into the water; and as more food was available, the fish population would grow again.

Lesson Development
1. *What Do You Need to Survive?*
   Have students answer the questions in cooperative groups and report to the class. Check to be sure they have included food, water, and shelter on their lists. Point out the ways energy is involved in survival.

Lesson Plan 4: Page 7

Objectives
Students should be able to:
1. Give examples of the ways we use energy every day.
2. Interpret the information they collected on the chart.

Background
Using energy affects the environment, but before students can look at the effects, they need to be aware of all the ways they use energy. We use energy to breathe and to think, as well as to run cars and computers. Energy comes from fuels—coal, oil, natural gas, water, nuclear, wood, and solar, to name a few. Electricity is made by burning fossil fuels (coal, oil, natural gas), from falling water (hydroelectric), nuclear reactions, solar, wind, wood, and biomass (wood or crop wastes that are used to generate heat or electricity). We get bodily energy from food.

Energy is manifested in the forms of heat, light, and motion. Sound is considered motion because it travels in waves. The energy stored in fuels and in food is potential energy. When that energy is released as heat, light, or motion, it has been changed into kinetic energy.

Lesson Development
1. *Daily Energy Use:*
   Have students keep a diary of their energy use for one day. Include food for physical energy as well as those forms of energy listed on page 7. They could log their activities from the time they get up, to the time they go to bed. Or, you could track energy use during the school day. Set aside time after lunch and/or at the end of the day for students to write down the ways they used energy. Have students compare their charts. Ask, "Is your energy use the same every day?" Students may need help identifying the forms of energy they used.

Lesson Plan 5: Page 8

Objectives
Students will be able to:
1. Explain how acid rain is formed.
2. List at least three sources of sulfur and nitrogen.

Background
Clouds form when water vapor condenses around pieces of dust in the atmosphere. Any pollution in the atmosphere will mix with the condensing water vapor as a cloud forms. When some pollutants, called sulfur dioxide and nitrogen oxides, combine with the water vapor, a weak acid forms. The acid falls to Earth with the rain or snow. It also can be carried in a dry form in dust and smoke. In places where the composition of the soil cannot neutralize the acid, there is concern that acid deposition is damaging forests, lakes, fish, and crops, and man-made structures such as buildings, bridges, and monuments.

Where do the sulfur dioxide and nitrogen oxides come from? Most of the energy we use comes from fossil fuels—coal, oil, and natural gas. We use fossil fuels for transportation, home heating, to make electricity, and other industrial uses. The fossil fuels contain sulfur. When they are burned, the sulfur combines with oxygen and is released. Nitrogen oxides are a product of any high-temperature combustion.

Lesson Development
1. *Water Samples - Page 8:*
   Divide the class into groups. Have each student bring in one small jar in which they have collected water. You may decide to assign a different collection location (as noted on page 8) to each student. Provide coffee filters or strong paper towels for students to strain the samples. Be sure students use only part of each sample so that there is water for the next activity.

   Have groups report to the class. At the end, ask students to name types of pollution with which they are familiar, and classify them as visible or invisible.

2. *Litmus Paper - Page 8:*
   Acid itself is invisible, and this activity helps students identify its presence. Tell students that litmus paper is very sensitive, and the mere presence of acid does not mean that the water is polluted. It is unlikely that any of the samples will be as acidic as vinegar. Vinegar and orange juice are useful for comparison because students know their taste. Help students correlate the acidity of the water with the place it was collected. After it falls, the pH of water may change depending on the soil or rock on which it lands.

Lesson Plan 6: Page 9

Objectives
Students should be able to:
1. Explain the greenhouse effect and why it is important on Earth.
2. Identify at least three reasons for the increase in atmospheric carbon dioxide.

Background
As you know, most of the energy we use comes from fossil fuels—coal, oil, and natural gas. Fossil fuels were formed from the remains of plants and animals that lived millions of years ago; those remains contain carbon. Plants get carbon from carbon dioxide which they use in photosynthesis. Animals get carbon from their food. When the fossil fuels are burned, all that carbon combines with oxygen, which release enormous amounts of energy and tons of carbon dioxide.

The gases in the atmosphere let in sunlight and keep in heat. This function is called the greenhouse effect—it makes life on Earth possible. Carbon dioxide is one of the primary greenhouse gases. Natural sources of greenhouse gases—like volcanoes and animals—used to be in balance with natural absorbers of those gases; especially trees and oceans. But we burn so much fossil fuel now, that we release more carbon dioxide than the natural absorbers can handle. In addition, the great forests that used to be a major carbon sink, are now decreasing rapidly in size.

Lesson Development
1. *How Much Carbon Dioxide Does Your Use of Energy Add to the Atmosphere? - Page 9:*
   It takes about 300 pounds of coal to make 900 kilowatt-hours of electricity.

   Note to teacher: The factor given to find the amount of carbon dioxide released by 900 kilowatt-hours has been updated. Question 3 should say: <u>Multiply kilowatt-hours by 1.5.</u> This figure is closer to the current national average for the mix of fuels used to generate electricity. Answer to Question 3: 900 kWh x 1.5 = 1350 lbs. of carbon dioxide.

   Students may report to the class their ideas about how to use electricity more wisely. Remind them that for every kilowatt-hour they save, they will save <u>1.5</u> pounds of carbon dioxide.

Lesson Plan 7: Pages 10, 11

Objectives
Students will be able to:
1. Use the word "reclaim" accurately in a sentence.
2. Explain the role of trees in absorbing carbon dioxide.

Background

RECLAMATION: A significant amount of the electricity we use in the US is generated from coal. Most of that coal is mined from surface mines. When surface mining first began, no attempt was made to restore the land back to usefulness. One of those areas is shown in Picture A. The Surface Mining Control and Reclamation Act of 1977 requires all operators of surface mines to reclaim the land. Reclaimed land is show in Picture B. In order to be able to reclaim the land, mining companies must study the composition of the soil before mining, and preserve the layers of soil that are removed so that they can be replaced in exactly the same order. Reclaimed areas are used for farming, recreation, wildlife management, and real estate development.

TREES: Trees and other green plants are natural absorbers of carbon dioxide. Trees use carbon dioxide in the process of photosynthesis. Part of that carbon dioxide along with water in the presence of sunlight is converted to oxygen and sugar. Sugar contains carbon. A mature tree takes about 48 pounds of carbon dioxide per year out of the atmosphere on average.

Lesson Development

1. *Think!* - Page 10:
   Students compare a coal surface mine before and after reclamation.

   Questions and Answers:
   - *How is Picture A different from Picture B?*
     There is not much growing in Picture A. The bank is eroding, making it hard for anything to grow there. The land in Picture B is supporting grass and trees and probably the animals that live in that environment, etc.
   - *Look at Picture A. Is the environment in balance? How can you tell?*
     No. By how little is growing there and by the erosion marks in the bank.
   - *Look at Picture B. Is the environment in balance? How can you tell?*
     Yes. By the color and amount of vegetation, and by the slope of the land.
   - *How would you reclaim the land in Picture A to make it useful again?*
     Answers will vary. The environment should look like it did before. The slope should be graded into a hill rather than a cliff. The soil should be enriched. Trees and other vegetation should be planted.

2. *Word Search* - Page 11:
   Answers on page 15. To develop this lesson more fully, see Extension Activities below.

Extension Activities

1. Obtain permission to plant or adopt a tree on the school grounds. Draw a picture of the leaf and find out what type of tree it is. Learn how to care for the tree by loosening the soil near its base, making sure it gets enough water, and protecting it from diseases. A tree doctor or an environmentalist from your local utility might speak to the class about trees. Take photos of the project from start to finish, and take pictures of the tree once a month to see how it grows.

Lesson Plan 8: Page 12

Objectives

Students should be able to:

1. Explain why it is important to use energy wisely.
2. List at least four ways to use energy more efficiently.

Background
When we use energy efficiently we help the environment in the following ways. We conserve natural resources; we reduce environmental impacts on land, air, and water (e.g., delaying the need for new power plants, new coal mines); we reduce emissions of sulfur and nitrogen oxides, which are components of acid rain; and we reduce carbon dioxide emissions, which contribute to global warming.

Motivation
Have students look back at the list of energy uses they made on page 7. Where do they use the most energy? Why do they think so? Have them write down their predictions to compare with the chart on page 12.

Lesson Development
1. Divide students into four cooperative groups and assign an area of the graph on page 12 to each one. Have the groups brainstorm ways they can use energy more wisely in each area. Share with the class and add any other student ideas.

   Suggestions:
   - Lighting: Turn off lights when not in use. Install timers for outdoor lights. Use energy efficient-light bulbs.
   - Heating and Cooling: First, find and seal leaks around windows and doors. Then, be sure insulation is sufficient in the attic, basement, and/or crawl space. Finally, adjust the thermostat to use less energy.
   - Hot Water: Set water heater temperature on the lowest setting. Install a water heater insulation blanket on older water heaters. Wash only full loads in your dishwasher. Use cold or warm water to wash all but the most heavily soiled clothes. Use an efficient low-flow showerhead.
   - Appliances: Don't use your oven to heat the kitchen. Clean clothes dryer lint filter after each load, or better yet, hang dry your clothes. Don't let the refrigerator door stand open while you decide what to eat. Buy energy-efficient appliances.

2. Help students to see that the picture on page 12 is a pie graph. Ask each group to find ways to estimate the size of each section. Compare answers. You may have math manipulatives they could use for this purpose or, you may provide other units of measure, for example, grains of popcorn. Percentages are: Heating/Cooling, 53%; Appliances & Devices, 28%; Hot Water Use, 15%; and Lighting, 4%.

Lesson Plan 9: Page 13

Objectives
Students should be able to:
1. Explain that less energy is used to make recycled products than to make new products.
2. Identify at least three materials that easily can be recycled.

Background
To recycle means using materials over again. The waste and trash we generate is mostly treated as useless garbage. But in nature, everything is recycled. for example, as carbon dioxide is released from the fossil fuels in which it is stored, it is reabsorbed by the trees and oceans of the Earth.

As you can see from the pictograph on page 13, recycling saves a lot of energy. Recycled aluminum is made with 1/10 of the energy needed to manufacture new aluminum. Recycled glass needs only 2/3 as much energy as new glass, and recycled paper needs 45% to 70% of the energy needed to make new paper.

Recycling also lightens other environmental impacts. When paper is recycled, we save the trees that would be cut to make new paper. When glass and aluminum are recycled, the land that would have been mined to get the raw materials for new glass and aluminum is spared. Recycling also saves space in landfills because less garbage is generated.

Lesson Development

1. Ask students to identify the reason we recycle:
   Because it saves energy and helps the environment.
   Then have students look at the chart and answer the questions.

   Questions and Answers:
   - *Which kind of aluminum uses less energy? Which kind of glass? Which kind of paper?*
     In each case, the answer is the recycled product.
   - *Which kind of aluminum, glass, and paper is easier on the environment?*
     The recycled product.
   - *How do you know?*
     Any time energy is saved, environmental impacts are lessened.
   - *What can you tell about recycling from this pictograph?*
     It takes a lot more energy to make new products than recycled ones. Aluminum shows the greatest difference between new and recycled.

2. Vocabulary exercise: Look at each of the four "R" words. (Note that in this case, the word refuse means to say no.) Have students fill in the blanks. Discuss their answers. Brainstorm with the class all the ways we reuse things. Ideas will range from bailing a boat with a cutout plastic gallon jug to having a yard sale.

Lesson Plan 10: Pages 14-16

Objectives

Students should be able to:

1. List at least three ways to reuse paper.
2. Identify alternatives to using paper and other consumer products.

Motivation

Before this lesson begins, save all the paper that would have been thrown out for at least one day. Saving paper trash for a week is even better. Have students predict how much paper there will be. Record their predictions.

Lesson Development

1. *Save All the Paper* - Page 14:
   Divide students into cooperative groups and ask them to answer all the questions on the paper airplane on page 14. Encourage them to create ways to measure the trash; they may use many different kinds of units and weigh it as well as measure its surface area. When groups report to the class, ask them to find ways to compare their units of measure. Also go back to the predictions and see which individual was closest and which group average was closest.

Questions and Answers:

(Note: Answers to first five questions will vary.)

- *How does reusing paper use energy wisely?*
  It requires less energy to reuse paper than to either make new paper or to recycle it.
- *How does it help the environment?*
  Any time energy is saved, impacts on the environment are decreased.

2. *Alternative* - Page 14:
   Have cooperative groups brainstorm ideas and share with the class. Possible answers are given below:

Instead of Using
Paper towels
Plastic trash bags
Disposable diapers
Toothpaste pumps
Incandescent light bulbs
Spray deodorants
Cleansers in plastic packaging

Use
Sponges, cloth towels/napkins
Paper bags or recycled plastic bags
Cloth diapers
Tubes of toothpaste
LEDs or CFLs
Stick or roll-on deodorant
Cleansers in paperboard packaging

3. Take the Energy Pledge! - Page 15:
   - Help students think of ways to save energy at home and school. They may use the tables given on page 15, or refer to their work on energy waste in their home from page 12. Help them remember that the most energy is used for heating/cooling and appliances, so energy savings in those areas will be most visible.
   - Post the energy pledges on a bulletin board. Use the display to help students remember to change their behavior. After two months, redistribute the pledges and ask students to report. Were they successful? How did they know?
   - We suggest using gas and/or electric bills to see what effect the energy pledge had. Energy consumption is given each month along with cost. Students need to compare kilowatt-hours or therms used/month with the same months from the previous year to see if the effect of their savings shows up. If not, it could be that the weather was more severe, that sealing and insulation are inadequate or that the heating/cooling equipment is inefficient. These things will have to be improved in order to see energy savings.

4. Environmental Crossword Challenge! - Page 16:
   - Ask students, "What did you learn?" As each answer is given, have students fill in the word in the puzzle that summarizes that answer. The crossword puzzle also can be used as a pre-unit activity to introduce concepts and definitions to the class. Answers are given on page 15.