Earth Watch For A Cleaner & Safer Environment

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Earth Watch
INTRODUCTION

For my grandchildren's
grandchildren.

How we leave this planet for future generations depends on what we do now. Few people today question the fact that our planet Earth is currently in a dangerous state of environmental disrepair. The pollution of our water, the deforestation of our land, the destruction of the ozone layer, acid rain, and the garbage overload are all imprints of mankind. What we inherited from the damage done by those who came before us, and what we are doing now to destroy the earth result in our current environmental problems.

Most of the damage to our planet has taken place during the past 200 years. The Industrial Revolution started a wave of pollution which is still spreading across the world. People were not aware of what was happening until in many cases it was too late. And now, the whole world has been drastically affected. One of the greatest hopes for cleaning up our environment lies in the education of the people who live on this planet.

It is for that reason that I wrote *Earth Watch,* to educate students about these problems and let them know that they can make a difference! Everyone will leave an imprint of their life on the planet Earth, and that single imprint can contribute a great deal toward creating a livable environment for our benefactors.

Earth Watch provides thinking strategies and practical application across the curriculum to help students become observers, explorers, and caretakers of their world. The suggestions in this guide are action-oriented and designed to involve students in the thinking process. All activities relate to real-life examples and information presented in the daily newspaper. Newspapers provide opportunities for students to explore their many interests and extend their knowledge base. To be effective readers, students need to learn how to locate the information or find answers to their many questions. They also need to learn to think about and evaluate the accuracy of any information presented. Finally, they need opportunities to learn the relationship between what they read and the activities in which they apply their new knowledge.

Earth Watch is divided into three sections (Earth Smart: Reduce, Manage, Reuse; Earth Issues: Air, Land, Water; and Earth Life: Plants, Animals, Ecosystems). All three sections were carefully organized to reflect three very different areas of environmental awareness. Every lesson in each section provides the teacher and student with in-depth information relating to a particular topic. Practical application activities follow on the activity page allowing students a hands-on learning experience. They are further challenged with a "think, discuss, react" exercise at the end of each activity page.

It is my hope that the lessons in this book will provide a foundation for the student not only in environmental awareness, but also by opening the door to a lifetime of education through a lifetime of newspaper reading.

CAROLL JORDAN HATCHER

About the Author

Caroll Jordan Hatcher established CJHatcher & Associates, Inc., an educational consulting and publishing company, in 1987 and is now publishing a line of Newspaper in Education curriculum materials designed to focus on the critical needs of today's student. She is well known in the educational community and provides consulting expertise to school districts and newspaper companies nationwide. Prior to publishing, she directed the Educational Services Department for The Houston Chronicle Publishing Company, where she gained national recognition for initiating curriculum materials which addressed the state's educational reform movement. Before joining the Chronicle, she taught high school social studies for ten years in the greater Houston area.

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Section I

EARTH SMART: Reduce, Manage, Reuse

Earth Thoughts

"The Earth does not belong to us, we belong to the Earth."

Chief Seattle to President Franklin Pierce

"Conservation is a state of harmony between men and land."

Aldo Leopold, *A Sand County Almanac*

"There is a sufficiency in the world for man's need but not for man's greed."

Mahatma Mohandas Gandhi

"Recycling is better than disposal, reuse is better than recycling, but reduction is the best of all."

Donella H. Meadows

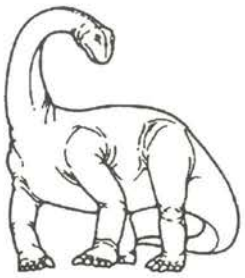
"We believe citizens are ready to do their part to clean up the environment, even if it costs more money and means changes in their life-styles."

U.S. Senators Max Baucus and Joseph Lieberman

"We travel together, passengers on a little spaceship, dependent on its vulnerable reserves of air and soil; all committed for our safety to its security and peace; preserved from annihilation only by the care, the work, and, I will say, the love we give our fragile craft."

Adlai E. Stevenson II

Lesson #1: FOSSIL FUELS



Fuel is a material that provides useful energy. Fuels are used to heat and cool buildings, cook food, power engines, and produce electricity. Some fuels occur naturally and others are artificially created. Such natural fuels as coal, petroleum, and natural gas supply about 90% of the energy used in the world. These natural substances are called fossil fuels because they developed from the fossilized remains of prehistoric plants and animals.

EARTH FACTS

1. *The United States uses more energy per person than any other nation in the world; 90% of which is fossil fuel energy.*
2. *Carbon is a by-product of fossil fuel combustion. Approximately five tons of carbon are pumped into the atmosphere each year for every man, woman, and child in the United States.*
3. *Carbon, when combined with oxygen to form carbon dioxide, is the gas most responsible for global warming.*

The earth has only a limited supply of fossil fuels. The extremely long time needed to change plants into fossil fuels makes them nonrenewable resources, resources that cannot be replaced for millions of years. Since 1900, the use of fossil fuels has almost doubled every 20 years. Causes of this growth include: (1) increased population, (2) the growth of the labor force, (3) increased wealth, (4) energy-using inventions, (5) products that take large amounts of energy to be manufactured, and (6) nonfuel uses of fossil fuels. Scientists estimate that if the world continues to use fossil fuels at the present rate, petroleum will begin to grow scarce in the early 2000s, natural gas is expected to run out in the middle of the next century, and coal should last another 200 years.

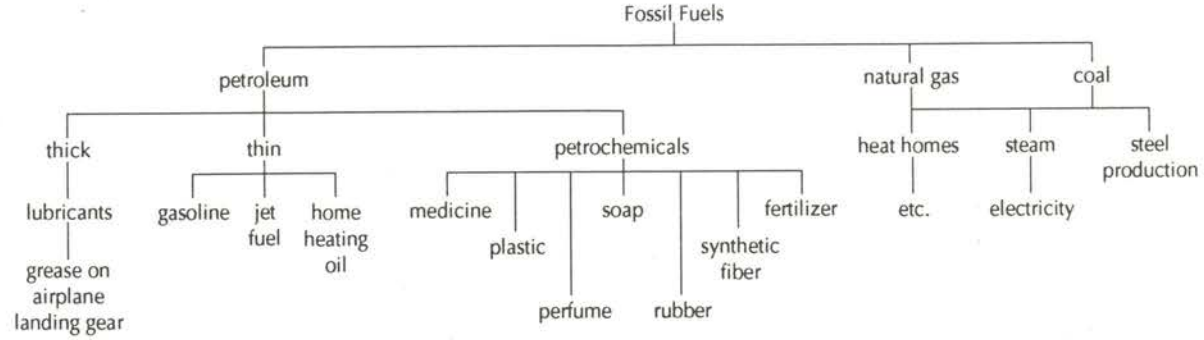
Major new discoveries of fossil fuels are rare. When they are found, such as those off the north coast of Alaska in the Arctic Circle, they are expensive to mine and drill. How well we conserve our remaining nonrenewable resources will determine how long the supply will last.

Petroleum furnishes almost half of the energy used in the world (45%) and in the United States (43%). It provides most of the energy used in the world for transportation. Coal provides about 30% of all the energy used in the world and furnishes about 24% of the energy used in the United States. The major uses of coal include the production of electricity and steel. Natural gas accounts for about 15% of the energy used in the world and about 23% of that used in the United States. Many industries use natural gas for heat and power.

Natural gas is the cleanest and most convenient fossil fuel. It can easily be transported through pipelines, and it causes almost no air pollution. Coal is dangerous to mine, expensive to haul, and when burned releases sulfur and other impurities that pollute the air. Petroleum is easier to get out of the ground than coal is, and pipelines carry it cheaply over long distances. However, like coal, oil contains impurities that cause air pollution.

Bituminous sands and oil shale are lesser known fossil fuels that may form important resources for the future. Wood, also classified as a fossil fuel, accounts for a very small percentage of the world's energy.

Activity #1: FOSSIL FUELS



1. Look through today's newspaper for examples of products that use fossil fuel for energy or pictures of items manufactured from fossil fuels. List these items below.
2. Determine which fossil fuel each product uses, or which fossil fuel is used in the manufacturing process. List it below.
3. If the fossil fuel supply runs out and factories can no longer use fossil fuels to manufacture products, many of the items on your list could not be made or used. Think of a substitute for each item or an alternative energy source. Try to list at least two choices for each.

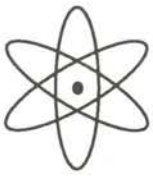
EXAMPLES FROM THE NEWSPAPER	TYPE OF FOSSIL FUEL USED	PRODUCT OR ENERGY SUBSTITUTIONS

THINK, DISCUSS, REACT:

Oil, gasoline, and plastics are probably a large part of your daily life. They are all made from fossil fuels. Describe how your life will be different in the next century if our fossil fuel resources are exhausted.

Write a letter to the editor of your daily newspaper with an action plan for fossil fuel conservation in your community.

Lesson #2: NUCLEAR ENERGY



One alternative energy source currently being used in place of fossil fuels is nuclear energy. This is the most powerful kind of energy known. One way nuclear energy is released is through fission (splitting the nucleus of an atom into two smaller parts). When this energy is freed, it creates large amounts of heat. This heat can then be used to make steam, and the steam can be used to generate electrical energy.

Uranium is the most commonly used nuclear mineral. (Plutonium also provides nuclear energy.) Unlike coal and oil, uranium does not contain a carbon substance. Therefore, its use does not release the same pollutants into the air that fossil fuels do. Also, nuclear fuels can be recycled at least once.

EARTH FACTS

1. *In 1942 scientists at the University of Chicago started up the world's first nuclear reactor. In 1956 Calder Hall in Britain became the first large nuclear station to produce electricity.*
2. *In 1986 a nuclear reactor at Chernobyl (in the former Soviet Union) overheated and caught on fire. Burning for ten days, the reactor began to melt, and radioactive gases escaped into the air. More than 30 people died, and thousands of people have become ill or died since, because they were affected by the radiation. The damaged reactor was sealed in concrete.*

Since all this is true, why don't we use more nuclear energy as fuel? One reason is that the kind of uranium that is needed (U-235) is in limited supply. Another reason is that uranium is hazardous to mine. A third reason is that nuclear power plants are potentially dangerous. This danger was made clear through the incident in 1979 at Three Mile Island (Harrisburg, Pennsylvania) and the disaster at Chernobyl (see above). A fourth reason, and perhaps the most compelling, is that the fission process produces radioactive waste that continues to produce dangerous radiation long after it has been used. It is believed that nuclear waste does not become harmless for approximately 1,000 years.

At the present time, the only way we can dispose of nuclear waste is to store it away from the surface of the earth in deep tunnels. This is a very expensive solution, and in the long run, this waste could be hazardous to our health if any of it escaped into the soil or the air.

Nuclear fusion (or reaction) is another way to produce nuclear energy. It occurs when two lightweight nuclei combine (fuse) and form a heavier nucleus. Any matter that is lost in this process changes into energy. This reaction does not produce any pollution and, if we could control it, we might have an unlimited fuel supply. (The sun has been producing energy by fusion for millions of years.) However, scientists have not yet found a practical way to do this because it is difficult to contain the energy that is released from an energy source this powerful. So far, all the fusion devices developed use much more energy than they create.

Rising costs and fears about the safety of nuclear power have caused many nations to halt or slow down their nuclear programs. A few countries such as France, rely heavily on nuclear power but have found that it is not as cheap as was once hoped. Old nuclear stations are being closed down and not being replaced.

Activity #2: NUCLEAR ENERGY

Although electric power production is by far the most important use of nuclear energy, nuclear energy also powers some submarines and other ships. (These vessels have a reactor to create heat for making steam. The steam is used to turn the ship propellers.) Nuclear energy also has great value because it produces high-energy particles and rays called nuclear radiation. Nuclear radiation has important uses in medicine, industry, and science.

1. Scan your daily newspaper for several weeks to find examples of the many uses today for nuclear energy. Consider nuclear physics and new technology in medicine, industry, and science. Don't forget to include articles and information about nuclear weapons and military uses.
2. Create a clipping file with this information, then complete the chart below.

TODAY'S USES OF NUCLEAR ENERGY	AREA OR FIELD OF EXPERTISE	HOW NUCLEAR ENERGY IS USED	ANY WASTE PRODUCTS?
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

THINK, DISCUSS, REACT:

Careers in nuclear energy cover a wide range of occupations and require widely varying amounts of training. A high percentage of the jobs require a college degree or extensive technical education. Based on the information in this lesson, do you think there will be a greater need in the future for people trained in nuclear energy careers? Explain.

Look in the classified section of your daily newspaper. Prepare a list of jobs available in your community in nuclear energy careers. (The industry employs many workers in various branches of engineering, and in such fields as biology, chemistry, geology, and medicine.)

Lesson #3: ENERGY SOURCES

EARTH FACTS

1. *America's refrigerators consume 7% of the nation's total electricity. This is the equivalent of more than 50% of the power generated by all of our nuclear power plants.*
2. *Water heaters account for about 20% of all the energy we use in our homes.*
3. *A microwave oven uses one-third to one-half as much electricity as a conventional oven.*

WHERE DO WE GET OUR ELECTRICITY?
The chief sources of energy throughout the world are, in order of importance, fossil fuels, water power, and nuclear energy. In addition, solar energy, wind power, tidal energy, and geothermal power provide small amounts of energy. Energy sources in the experimental stage include magneto-hydrodynamic (MHD) generators, fuel cells, solid wastes, and hydrogen.

HOW DOES WATER MAKE ELECTRICITY? The power of moving water can be harnessed to drive generators that make electricity. This is called hydroelectric power. South America gets 75% of its electricity from water power. In places where there are waterfalls or large rivers, the energy from the moving water can be harnessed to power giant turbines. These turbines then turn generators that produce electricity. Water costs nothing and cannot be used up, and it supplies energy without pollution. Because a water power plant can operate only where water flows from a higher place to a lower one, most water power projects require a dam or other expensive structure.

WHAT IS SOLAR ENERGY? Solar energy is energy produced by the sun. Specially designed panels, placed at the proper angle absorb the sun's energy. This energy is converted into heat and then transferred to a storage system. Solar energy is used throughout the world to perform various small jobs: heating buildings and water, and converting light into electricity. Solar energy could provide a clean and almost unlimited supply of power. But solar energy is spread so thinly that large-scale use of the sun's power would require a huge land area. In addition, darkness and bad weather interrupt the supply of sunlight.

HOW CAN WE USE WIND POWER? People have used wind power for hundreds of years. Wind propels sailboats, while airplanes use the power of a high-altitude wind called the jet stream. In the past, windmills have been used to pump water or grind grain. Today windmills can be used to generate electricity. Wind itself costs nothing and creates no pollution. But wind power is practical only in areas that have strong, steady winds.

HOW CAN OCEAN TIDES LIGHT UP OUR HOMES? Tidal energy can be used whenever there are high tides in a bay that can be closed by a dam. During high tide, the bay fills with water. During low tide, the level of the ocean drops below the level of water stored behind the dam. The stored water is then released. As the water falls, it drives turbines that generate electricity. The world's first tidal power plant began to operate in 1966 in France. The chief disadvantage of tidal power is that it can produce electricity only at certain times and for short periods.

Activity #3: ENERGY SOURCES

Government and business officials at the local level (city, county, township, borough) often have the responsibility of making "site" decisions in their communities. They decide, for example, where to locate a garbage dump, a landfill, a hydroelectric plant, a nuclear power plant, an incinerator, a park, a shopping mall, a new school, an airport, or other similar facility. In their analysis of the situation, community officials determine why some sites are more appropriate than others for certain activities. Siting decisions are among the most difficult decisions made in local government. Knowledge of area geography and natural resources is helpful in making such decisions.

1. Site selection decisions often have great economic ramifications for an area and are usually newsworthy events. Scan your local newspaper for several weeks collecting articles about siting decisions made in your city, county, township, or borough.
2. Select and analyze any two news stories from your collection. What are the positive and negative characteristics that may have influenced each situation? (Consider geography, natural resources, price of land, labor, transportation, taxes, water reserves, pollution, waste, etc.) Recreate the chart below in a larger format on your own paper. Then, fill in your information.

	SUMMARY OF NEWS EVENT	POSITIVE CONSIDERATIONS	NEGATIVE CONSIDERATIONS
NEWS STORY #1			
NEWS STORY #2			

3. Imagine that you are a member of your local government board and you are considering proposals from various utility companies for a new energy plant. Your board must first decide which energy source is best suited for the area. (A hydroelectric plant, for example, would not be feasible in an area where there is no major water source.) Use the information from Lessons 1-3, your daily newspaper, and other community resources to help with your decision.

	FOSSIL FUEL ENERGY	NUCLEAR ENERGY	HYDROELEC. POWER	SOLAR ENERGY	WIND POWER	TIDAL POWER
PROS						
CONS						

THINK, DISCUSS, REACT:

Can you think of any alternate energy sources available to you today? Look through the classified advertisements in the newspaper for homes that offer alternate energy sources, such as solar heating. Look also for new home advertisements that emphasize energy efficiency.

Lesson #4: ALTERNATIVE ENERGY SOURCES

WHAT IS MEANT BY GEOTHERMAL POWER? Geothermal power is generated wherever water comes into contact with heated underground rocks and turns into steam. Power companies drill into areas where underground steam is trapped and direct it into the blades of steam turbines. In areas where underground steam does not exist naturally, engineers can create it by injecting water into hot rock. Geothermal power plants do not burn anything, and so no smoke pollutes the air. Some of these plants produce electricity more cheaply than do conventional power plants.

HOW DO MAGNETOHYDRODYNAMIC GENERATORS WORK? Magnetohydrodynamic (MHD) generators convert fuel directly into electricity. An MHD generator burns coal or other fuel at high temperatures to produce a hot ionized (electrified) gas. The gas shoots through a magnetic field, where it produces an electric current that is drawn off by electrodes. After the gas has passed through the MHD generator, it can drive a turbine to produce more electricity.

EARTH FACTS

1. *Of the electricity generated in the average home, 40% is for heat and 20% is used to keep the lights on.*
2. *If each U.S. household lowered its average heating temperatures by six degrees Fahrenheit over a 24-hour period, we'd save the energy equivalent of 500,000 barrels of oil every day. And conversely, if all consumers raised the settings of their air conditioners by six degrees Fahrenheit, we could save 190,000 barrels of oil every day.*
3. *Americans buy more than one billion incandescent light bulbs a year. A 60-watt incandescent light bulb will last about 750 hours. (However, a 20-watt compact fluorescent bulb will generate the same amount of light as a 60-watt incandescent bulb and burn 7,500 to 10,000 hours.)*

CAN FUEL CELLS GENERATE ELECTRICITY? Fuel cells are batterylike devices in which gas or liquid fuels combine chemically to generate electricity. A reaction of hydrogen and oxygen, for example, in a fuel cell can produce twice as much electricity as ordinary generators can with a given amount of fuel. Nothing burns in fuel cells, so they cause little pollution and lose little energy in waste heat. But fuel cells are expensive to make.

HOW DOES GARBAGE PROVIDE ENERGY? Our huge amount of trash and everyday garbage can also be used as an energy source. About 14% of the garbage produced in the United States is incinerated, or burned. Garbage is shredded and burned in an incinerator which makes the steam that powers a turbine and produces electricity. Also, decaying garbage in landfills produces methane gas. Many landfills are now capturing this gas and selling it as fuel. (See also, Lesson #11.)

COULD HYDROGEN SOMEDAY REPLACE GAS AND OIL AS A FUEL? Hydrogen burns easily, giving off huge amounts of heat and one harmless by-product, water. Chilled to liquid form, hydrogen could flow through pipelines. It could serve as a lightweight, nonpolluting fuel for aircraft and automobiles. Hydrogen can be extracted from ocean water by running an electric current through the water. But this process, called electrolysis, requires enormous quantities of electricity.

Activity #4: ALTERNATIVE ENERGY SOURCES

Whatever the energy source, Americans use a tremendous amount of electricity; 20% of which is used for lighting. Most Americans are unaware of the development of the compact fluorescent lightbulb. It can be used in a standard socket and gives off light that looks just like a traditional (incandescent) bulb. Compact fluorescents are big energy savers. They last longer and use about one-third of the energy of an incandescent bulb. Compact fluorescents are more expensive than incandescents. But they will save you money in the long run. You would need 13 incandescents to last for the same 10,000 hours of normal use (see Earth Facts box). Also, over its lifetime, a compact fluorescent uses about $10 worth of electricity. During the same period, equivalent incandescents use about $30 worth of electricity. An even newer bulb, the E-lamp (electronic lamp) which uses high-frequency radio waves to generate light has recently been developed. It costs about the same as a compact fluorescent, is energy efficient, and produces light for at least 20,000 hours.

1. With energy conservation in mind, use your daily newspaper to shop for lightbulbs. Check the newspaper for hardware and home store advertisements. Select four different stores and do some comparison shopping.
2. Complete the chart below. Then answer the questions following the exercise.

LIGHT BULBS	STORE #1 PRICE	STORE #2 PRICE	STORE #3 PRICE	STORE #4 PRICE
Incandescent 60-watt bulb(s)				
Compact Fluorescent 20-watt bulb(s)				

a. Which store has the best buys?_____

b. If you shopped at that store, how much money would you save by buying two compact fluorescents instead of 26 incandescent bulbs for 20,000 hours of light? _____

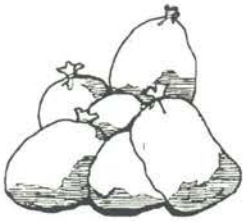
c. There are 100 million households in America. If a single compact fluorescent was installed in each home, the energy equivalent of how many incandescent bulbs would be saved? (Use information from the paragraph above to compute your answer.) _____

THINK, DISCUSS, REACT:

The electricity in your home may be generated from any number of energy sources: fossil fuel, nuclear, hydroelectric, solar, wind, tidal, geothermal, or incinerated garbage. Call your public utility company to find out which energy source is the one most likely providing energy to your neighborhood. Is it the most economical energy source? Is it the cleanest? Is there an alternative energy source available for your community?

Look in the daily newspaper for information regarding your local utility company and your area's energy source. Start a scrapbook of newspaper clippings regarding local energy problems and conservation.

Lesson #5: THE GARBAGE CRISIS



Each year the average American discards about 1,300 pounds of household waste consisting of everything from disposable diapers and paint rollers to throwaway pens and razors. Across the country, most trash is still disposed of the old fashioned way, in landfills. About 73% of the garbage produced in the United States ends up in landfills.

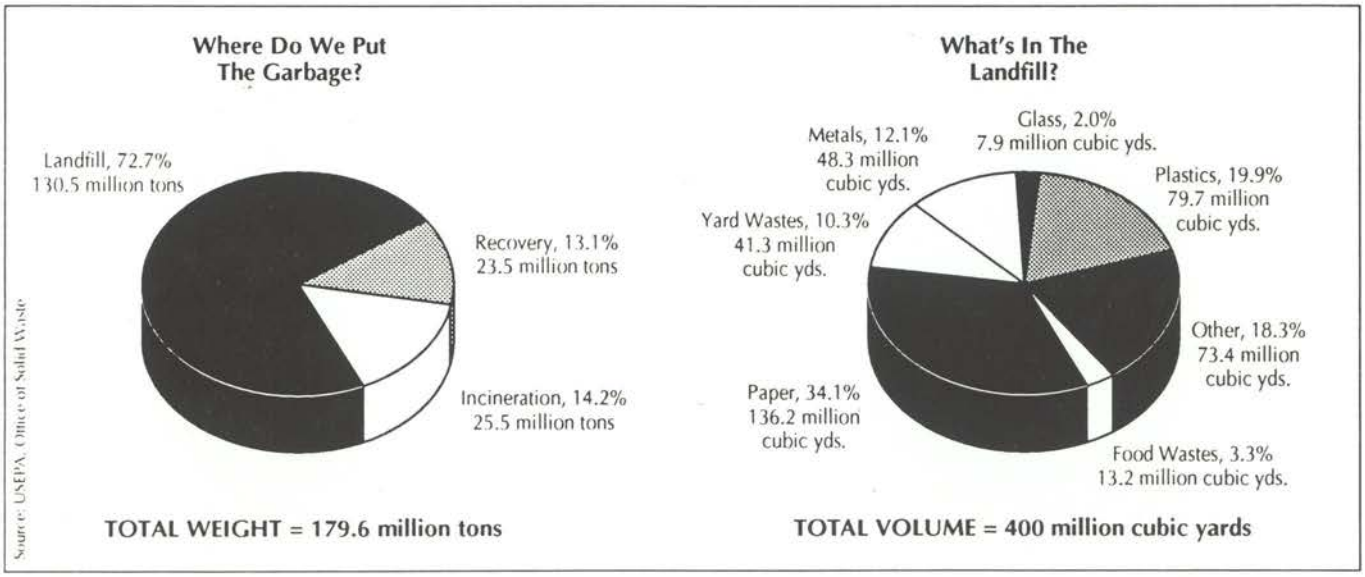
EARTH FACTS

1. *American households and businesses generate about 180 million tons of solid waste, or garbage, each year.*
2. *People in the United States produce enough trash to fill 70,000 garbage trucks each day!*
3. *Other industrial countries produce half as much trash per person as the United States, and recycle a major portion of it.*

A landfill is an enormous hole where garbage is dumped. To create a landfill, public works engineers find a natural pit where low lying land is surrounded by hills. If necessary, they use bulldozers to deepen the bottom and build up the sides of the pit. Usually they line the inside of the pit to prevent the garbage from contaminating groundwater. (A sanitary landfill is a sealed area where solid wastes are buried and the groundwater is monitored for seepage of dangerous chemicals.) Once the pit has been shaped and lined, garbage is trucked in and dumped. Tractors spread the garbage in the landfill and cover each layer of garbage with dirt.

In the United States too little has been done to reduce or recycle solid waste before it reaches landfills. There are about 6,000 landfills in the U.S. By the year 2000, half of all landfills will be filled to capacity. Today, government officials foresee a fast-approaching solid waste crisis and are looking for new solutions to the crisis.

The U.S. Environmental Protection Agency (EPA) has established the following list as a goal for dealing with solid waste: 1. Reduce waste by preventing its creation. 2. Recycle and compost as much waste as possible. 3. Incinerate waste or treat it in other ways to reduce its volume. (Incinerating is also a source of energy.) 4. Landfill waste as a last resort.



Activity #5: THE GARBAGE CRISIS

When you throw away your trash, where does it go? Some of the trash will break down or decompose. This trash is biodegradable and will eventually be absorbed into the environment. Other garbage will not break down and will remain intact in landfills for years to come.

1. Keep a record of each item of trash you throw away during a one-week period. Record every gum wrapper, apple core, soda can, and piece of notebook paper you discard. Use the chart below to list these items. Indicate the type of material each item is made from and whether the trash article could be used again.
2. Next, compile the data from everyone in the class and publish your collective information in the school newspaper or in your own class ecology newsletter.

TRASH ITEM	PLASTIC	GLASS	METAL	PAPER	TEXTILE	FOOD WASTE	YARD WASTE	USED AGAIN?

THINK, DISCUSS, REACT:

When making a purchase, have you ever considered how much garbage it may produce or what happens to a product or package when you are finished with it?

Based on the information in the chart above, write a news story giving the who, what, when, where, why, and how of your own solid waste habits.

Lesson #6: PACKAGING

Reducing solid wastes requires cutting back the number and volume of discarded products. Manufacturers can change product content and packaging. Consumers can help cut trash by changing what they buy.

Consumers can reduce household waste by buying high-quality, long-lasting items that can be repaired, instead of buying short-lived "disposable" alternatives. The consumer typically pays a much higher price per unit for such convenience items.

Disposable packaging and containers take up a great deal of landfill space. According to the most recent EPA (Environmental Protection Agency) figures, packaging makes up 31.6% (56.8 million tons per year) of U.S. solid waste. Of the total container and packaging waste, plastic materials make up 12.8%. Ahead of plastics in terms of volume are paper and cardboard (51%), and glass containers (23%).

EARTH FACTS

1. *Since 1960 the waste generated by packaging in the United States and Canada has increased more than 200%.*
2. *One out of every $11 spent on food in the U.S. goes for packaging. More money was spent on packaging last year than American farmers received in net income.*
3. *During a beach cleanup along 300 miles of Texas shoreline, 15,600 plastic six-pack rings were found in 3 hours.*
4. *More than 25 billion styrofoam cups are discarded each year. If placed in a straight line, the line would circle the earth 436 times!*

Many advocates of waste reduction use the term "precycling." That concept refers to a consumer making environmentally sound choices at the point of purchase. It includes avoiding products with extra packaging (for example, canned or boxed vegetables instead of fresh, unbagged, or bulk items) or products made to satisfy only short-term needs (such as disposable razors and non-refillable pens). Consumer choices can go a long way to influence what manufacturers make, while also preventing some trash from ever entering the waste stream.

In one step toward responding to consumer concern about waste in the entertainment field, the Recording Industry Association of America announced that compact disks will no longer be packaged in the "long box," a cardboard container at least twice as long as the disk itself. Instead, CDs will for the most part be enclosed only in shrink wrap.

Consumers can avoid certain products all together. Polystyrene (styrofoam), for example, is often used for egg cartons, disposable picnic goods, "take-out" containers at fast food restaurants, and packing material. It is completely non-biodegradable; it just won't go away. Even 500 years from now, the foam cup that held coffee this morning will be sitting on the earth's surface. Because of its very structure, containing large amounts of air, styrofoam takes up too much precious landfill space. Styrofoam is actually polystyrene foam, a material made from benzene (a known carcinogen), converted to styrene, and then injected with gases that make it a foam product. The gases often used are chlorofluorocarbons (CFCs), which eat ozone molecules, depleting the earth's vital ozone layer. (See also, Lesson #14.)

Activity #6: PACKAGING

Think about how much aluminum, cardboard, cellophane, foil, paper, plastic, and polystyrene foam is used to package the foods you eat.

1. Using the grocery advertisements in your daily newspaper, go on a packaging scavenger hunt. See how many foods you can find that are packaged with no wrapping, with one wrapping, with two wrappings, and with three or more wrappings. Recreate the chart below on poster board.
2. List the foods you find on your chart and explain how each is packaged.

FOODS WITH NO WRAPPING Example: apples	FOODS WITH ONE WRAPPING Example: bread (a paper or plastic bag)
FOODS WITH TWO WRAPPINGS Example: cereal (a paper bag inside a cardboard box)	FOODS WITH THREE OR MORE WRAPPINGS Example: microwaveable meals (a plastic tray with a foil lid inside a cardboard box)

3. Next, complete the "Smart Shopper's Checklist" below. Place a check beside the things that you and your family do. Then, see how many items from each column you can find advertised in the newspaper. Which products are advertised more, disposable products or reusable products?

WE BUY OR USE.....	INSTEAD OF.....
___ cloth towels	paper towels
___ wax paper	plastic wrap
___ baking soda	air fresheners
___ reusable eating utensils	plastic knives, forks, spoons
___ reusable plates, cups, bowls	disposable plates, cups, bowls
___ food in glass jars / metal lids	food in plastic bottles or jars
___ eggs in cardboard cartons	eggs in polystyrene foam cartons
___ bottled drinks / glass containers	bottled drinks / plastic containers
___ canned drinks / cardboard carriers	canned drinks / plastic rings
___ toothpaste in tubes	toothpaste in pump dispensers
___ bars of hand and bath soap	liquid soap / plastic containers
___ cotton diapers	disposable diapers
___ rechargeable batteries	nonrechargeable batteries

THINK, DISCUSS, REACT:

Both the United States and Canada have been described as "throwaway" societies. Create an editorial cartoon to illustrate your interpretation of this term.

Lesson #7: RECYCLING

EARTH FACTS

1. *Recycling one glass jar saves enough energy to light a 100-watt bulb for four hours.*
2. *Recycling one aluminum can results in 97% less water pollution and 95% less air pollution than creating a new aluminum can from raw materials.*
3. *Recycling and reusing the material in "tin" cans reduces related energy use by 74%; air pollution by 85%; solid waste by 95%; and water pollution by 76%. (Yet, only 5% of tin cans are recycled.)*

Recycling is processing and treating discarded materials so that they can be used again. Recycling helps the environment in three important ways. Recycling saves space, energy, and resources. It also helps to reduce air and water pollution.

When we recycle, we save space. Things that would have been thrown away are kept and reused. Fewer discards find their way into the crowded city dumps and bulging landfills.

When we recycle, we save energy. Of course, some energy is needed for the recycling process: to melt aluminum, to crush glass, or to convert newsprint into clean paper that can be used again; but, recycling requires less energy than making new products from raw materials.

When we recycle, we save natural resources. In the recycling process, old materials are made into new products so fewer raw materials are used. Also, some of the coal, natural gas, water, or oil that might have been used to produce energy for the manufacturing process is not needed.

There are four simple steps to recycling:

1. *COLLECTING* - gathering used materials like glass, metal, paper, and plastic.
2. *SORTING* - separating these materials by type. Sorting is necessary because each of these materials must be recycled in a different way.
3. *RECLAIMING* - doing something to collected materials to separate what is reusable from what is not. For example, metals are often melted during the reclamation process; paper is soaked and washed.
4. *REUSING* - using reclaimed materials in new products.

Over 80% of general household waste, including food scraps, can be recycled. Although newspapers, glass, and aluminum are the most commonly recycled items, they aren't the only ones you can recycle. Other items, such as tin cans (99% steel), plastic soda bottles or milk cartons, telephone books, and corrugated cardboard are all recyclable.

Yard wastes (lawn clippings, leaves, and twigs) are also recyclable. Yard waste makes up 31.6 tons of the country's municipal solid waste. Yard wastes, as well as food wastes, can be recycled by "composting." This is the process of turning organic material into a rich mixture that can be used to condition soil and feed plants. In a compost heap, billions of tiny organisms break down the organic wastes so that they can be used to add nutrients to soil and improve its ability to hold both air and water. By using compost in your garden (as you would use fertilizer), you return organic matter to its source, the soil, in a form that is beneficial to plant life.

Activity #7: RECYCLING

Conduct a survey to learn more about the recycling habits of your relatives, friends, neighbors, and classmates. Create sample questions and make up your own survey scoring system after completing the activity below. Begin a newspaper clipping file on "recycling" with the information you find for this activity.

1. Look through the newspaper for items you currently reuse and/or recycle. List them on the chart below.
2. Next, look for pictures or advertisements of items that you know you should reuse and/or recycle, but do not. List these also on the chart.
3. Finally, find photos, cartoons, editorials, advertisements, illustrations, or articles in the newspaper that reflect the most important reasons for recycling. List them in the third column below.

ITEMS YOU CURRENTLY REUSE AND/OR RECYCLE	ITEMS YOU SHOULD REUSE AND/OR RECYCLE	REASONS FOR RECYCLING

4. Based on the information you have gathered, develop a "Recycling Survey." After you have created your sample questions, interview your relatives, friends, neighbors, and classmates. Summarize your results and share your findings with survey participants.

THINK, DISCUSS, REACT:

The recycling and solid waste industry today is a growth industry, generating over $30 billion per year. Investment brokers are paying a lot of attention to waste management and recycling companies. You can too!

Follow the stock market pages in your daily newspaper to keep track of local recycling and waste management companies. How do these companies compare to others?

Lesson #8: ALL ABOUT PLASTIC & GLASS

Plastic is the name given to any of a large group of substances made chemically from such materials as coal or oil mixed with water and limestone. Nylon, vinyl, and many cellulose products are plastics. Plastic can be hard or soft, solid or clear. It can be molded by means of heat and pressure into a wide variety of forms. Because of its versatility, plastic is often used instead of glass, metal, or paper.

EARTH FACTS

1. *Americans go through 2.5 million plastic bottles every hour.*
2. *Every American uses about 190 pounds of plastic per year (60 pounds of which is packaging that is discarded as soon as the package is opened).*
3. *Each year Americans throw away 28 billion glass bottles and jars (enough to fill the twin towers of New York's World Trade Center every two weeks).*

As a packaging material, plastic offers some definite advantages. Plastic preserves freshness better than paper. It is sturdy and resists breaking better than glass. Also, containers made of plastic weigh less than same-size containers made of glass, so they are easier to carry and cost less to transport.

There are some disadvantages associated with plastic. It is made from fossil fuels, which are nonrenewable resources. Plastic is very difficult to recycle. Currently, only about 1% of all discarded plastic is recycled. Before plastics can be recycled, they must be separated according to the type of resin used to make them. Recycled plastic is used to make toys, carpet backing, and fiber filling for ski jackets and sleeping bags. The remaining 99% of our discarded plastics are not recycled. When placed in landfills, plastics become a permanent part of the landscape because they take hundreds of years to decompose.

Glass is made by melting sand with certain chemicals. While glass is very hot, it can be shaped into a variety of useful objects. Glass is used to make a variety of products including eyeglasses, windows, and all sorts of containers (bottles and jars). Glass containers hold many different liquid products, such as food, drinks, and cosmetics.

The glass containers used to hold food products are of two types, refundable and nonrefundable. Refundable glass containers can be reused commercially. Bottles and jars of this type are made of thick, heavy glass. They can be washed, dried, and refilled many times. Water and other beverages are often sold in refundable glass bottles. When you buy products in refundable glass containers, you are charged a deposit on each container. When you return these containers to a point of purchase, the deposit is refunded.

Nonrefundable glass containers cannot be reused commercially. They are made of thinner glass, which is not strong enough to withstand the thorough cleaning needed to make them safe for reuse. You can reuse them in your home for mixing liquids or storing leftovers. Or you can take them to a glass recycling center where they will be melted down and made into new glass products. Crushed glass called "cullet" melts at a lower temperature than the raw materials and thus requires less energy for the production of new glass containers.

Activity #8: ALL ABOUT PLASTIC & GLASS

Recycling of plastic does not solve the plastic waste issue, as does recycling for glass. Unlike glass, plastic cannot yet be recycled back to its original uses. So that recycling plastic does not reduce the manufacture of plastic nor the volume of plastic waste. In fact, it creates more and new uses for plastic as the recycled plastics industry finds new markets for its product. By the end of the 20th century, it is estimated that the use of plastics in our country will double, and so will the waste.

1. Look through your daily newspaper for photos, illustrations, or advertisements of products made from plastic or products that generate plastic waste. Clip these for your file, then list them below. Do the same for glass products. Which product list is longer, plastic or glass?
2. Indicate whether or not you use these products. Many consumers use plastic products for convenience or because of the benefits offered by the product. Determine the benefits or advantages for using each plastic product on your list. How do you dispose of these plastic products? Is that the best method of disposal?

PLASTIC PRODUCTS	DO YOU USE THE PRODUCT?	BENEFITS OR ADVANTAGES	WASTE DISPOSAL	GLASS PRODUCTS	DO YOU USE THE PRODUCT?

THINK, DISCUSS, REACT:

The Glass Packaging Institute reports that 25% of any given glass container is made from recycled glass. How might the plastics industry be just as successful? What are some solutions or suggestions for the future? Use newspaper articles and other reference materials to support your hypothesis.

Lesson #9: RECYCLING METALS & RUBBER

EARTH FACTS:

1. *Aluminum, the most abundant metal on earth, was only discovered in the 1820s. At that time it was worth $1,200 a kilogram, more than gold.*
2. *A recycled aluminum can is typically re-melted and back in use at the store within 6 weeks. The energy saved from one recycled aluminum can will operate a television for 3 hours.*
3. *Some 240-260 million tires are discarded annually in the U.S.*

The most commonly used metals are iron, copper, and aluminum. Most metals used in industry today are alloys, or mixtures, such as bronze and steel. These alloys are stronger than the pure metals from which they are made.

ALUMINUM is light, easily shaped, not magnetic, and does not corrode when exposed to rain and wind. Aluminum is the most plentiful metallic element on earth, but is never found on its own (pure). It is always combined with other elements. The aluminum we use is obtained from bauxite, an ore that is processed for extraction of aluminum. Processing bauxite to make aluminum uses a lot of energy. It takes 95% less energy to produce an aluminum can from an existing one than from bauxite. The Aluminum Association reports that aluminum can recycling in one year (1988) saved eleven (11) billion kilowatt hours of electricity, enough energy to supply the residential electric needs of New York City for over six months. Sixty percent of all aluminum cans produced are recycled by consumers. The industry has the capacity to purchase and process all of the aluminum in the country. Although cans are the most common form of recyclable aluminum, aluminum foil, containers, siding, gutters, downspouts, storm doors, window frames, lawn furniture frames, and the like are also recyclable.

IRON and STEEL are the most recycled materials used today. Scrap metal dealers have been the most visible recyclers, doing business many years before recent comprehensive recycling programs. In whatever form we use steel—pipes, automobiles, or tin food cans—it is recyclable.

TIN food containers are recycled by separating the tin, an expensive imported metal, from the steel in the can. High-grade tin is recovered for new tin products, and steel is sold for reprocessing as new steel for manufacturing.

RUBBER is one of our most interesting and most important raw materials. About 60% of the rubber used in the U.S. goes into tires and tubes used on automobiles, airplanes, buses, trucks, tractors, and construction machinery. Over a billion scrap tires are stockpiled around the country. Landfilling is prohibited in many states because tires have a tendency to rise to the surface in a landfill and crack the landfill cap. Abandoned tires collect water and become a breeding ground for mosquitoes. Tire recycling is a fairly untapped area. Producing one pound of recycled rubber saves 71% of the energy required to produce new rubber. Recycled rubber can be used for tires and other rubber products. Ground rubber "crumbs" can be added to asphalt for paving roads, runways, playgrounds, and running tracks. Rubber added to asphalt increases pavement life by 4 or 5 times, and reduces the amount of resurfacing materials required.

Activity #9: RECYCLING METALS & RUBBER

Natural resources are materials supplied by nature (minerals, fossil fuels, forests, water). Aluminum, tin, and rubber are all classified as natural resources. Aluminum (bauxite ore) makes up 8% of the Earth's crust. Tin makes up only about 0.001% of the Earth's crust. Australia produces about a third of the world's aluminum and the biggest tin producer is Malaysia. Natural rubber is an elastic substance obtained from the milky juice of certain tropical trees. Although rubber tree plantations were first discovered in Brazil, the largest natural rubber producer today is Malaysia. What about some of our other natural resources?

1. Go on a newspaper treasure hunt for natural resources! The object of the treasure hunt game is to accumulate the most points so that you can be the winner! To do so, find as many newspaper articles pertaining to natural resources as you can, and score yourself according to the point system outlined below.
2. For 5 additional points per article, locate the origin of the news story (dateline) on an outline map of the world.
3. Double your points per item by finding the current price of the resource in the market pages of the newspaper.
4. If you can find the world's largest producer of that resource, award yourself another 6 points. (Use an encyclopedia, world almanac, or other source to find this information.)

TREASURE HUNT POINT SYSTEM

SAND, GRAVEL, and BUILDING STONE = 3 points
PETROLEUM = 5 points
NATURAL GAS = 5 points
COAL = 5 points
WATER = 5 points
TIMBER/RUBBER = 5 points
METALS: Iron, Aluminum, Copper, Tin, Etc. = 7 points
PRECIOUS METALS: Gold, Silver, Platinum, Etc. = 10 points
PRECIOUS JEWELS: Diamonds, Rubies, Emeralds, Etc. = 10 points

(Play the game during a specified time period.
All players should start and stop at the same time.)

THINK, DISCUSS, REACT:

Most natural resources are nonrenewable, so it is very important to recycle them. Consumers recycle 60% of all aluminum cans produced. How can consumers achieve the same success recycling other metals? Think of some conservation techniques for preserving our natural resources. Use your collection of newspaper clippings to help with this activity.

Lesson #10: PAPER WASTE & RECYCLING

EARTH FACTS:

1. *The average American uses about 580 pounds of paper annually.*
2. *The average office worker throws away about 180 pounds of recyclable paper every year.*
3. *Each ton of recycled paper saves more than three cubic yards of landfill space and 380 gallons of oil.*
4. *Making new paper from old paper uses 30% to 55% less energy than making paper from trees, and reduces related air pollution by 95%.*

The entire American paper industry was actually built on recycling. Beginning in 1690, when the first U.S. paper mill was established near Philadelphia, paper was made exclusively of fiber taken from cotton and linen rags. It wasn't until the 1860s, when the growing demand for paper products created shortages, that techniques were developed to use wood fiber in papermaking. Then the composition of paper began to change rapidly. By 1904, 60% of American paper was made with wood pulp (although 40% was still recycled rags and waste paper). But by the 1930s, paper was made primarily with wood pulp. Even during the recycling drives of World War II, the highest level of recycled material used in paper manufacturing was just 35%. Americans are now recycling 28 of the 72 million tons of paper they use: a 39% recovery rate.

Paper is the largest component of our waste stream, comprising about 40% of our garbage. Five broad grades of waste paper are recycled: newspaper, corrugated cardboard, office paper, high-grade waste paper, and mixed paper.

Newspapers constitute the majority of recycled used paper. About 30% of all used newsprint is recovered for recycling, mainly for new newsprint. In 1992 recycling newspaper reached a record 6.6 million tons (an increase of 90% since 1983). In the last decade the newspaper industry has worked hard to promote recycling. Many new newspaper de-inking plants are in the planning stages all across the United States and Canada. (Ink must be removed before newsprint can be recycled.) Also, technology has finally made it easier for the newspaper industry to use its own recycled newsprint. Most newspaper companies are now using recycled paper as a fixed percentage of their newsprint.

The largest single source of waste paper is corrugated boxes. Every industry uses and discards cardboard. Recycled cardboard is used again for boxboard, insulation, packaging material, and many other products.

Office paper represents a relatively new grade of waste paper as offices implement recycling programs. Ledger and computer paper are higher grades of paper fiber and can be recycled to manufacture new paper products, such as writing paper, computer paper, and paper towels. High-grade waste paper is generated by commercial printers in clipping waste. Mixed paper is one of the largest components of residential waste, including cereal boxes, junk mail, telephone books, paper packaging, and grocery bags.

Recycled paper could easily be substituted for virgin paper in many products without any loss of quality. But, because the demand for it has been low, recycled paper prices tend to be higher, which in turn makes it harder to get. For that reason, many manufacturers that could use recycled paper do not.

Activity #10: PAPER WASTE & RECYCLING

Mixed paper is one of the largest components of residential waste. Mixed paper includes all paper packaging for products, as well as junk mail, telephone books, and numerous other household paper items. Because it is made of a mix of low-grade papers, many paper recycling programs do not accept mixed paper.

1. What paper products are used in each room of your home? List those products below.
2. Scan your newspaper advertisements to find a purchase price for each paper product. Write the price in the designated column. How much money would you spend for paper products in your home? How often would you need to make these purchases? How much money might you spend per month on paper products for your household?
3. If possible, suggest alternatives for each paper product. How much money could you save per month if some of these paper products were eliminated?

ROOM	PAPER PRODUCT	PRICE	ALTERNATIVE TO PAPER
KITCHEN			
DINING ROOM			
BEDROOM			
BATHROOM			
BASEMENT/GARAGE			
	TOTAL		

THINK, DISCUSS, REACT:

Shredded newspapers have been put to use in place of hay for barns and other farmyard needs. Farmers and agricultural specialists are pleased with this newly discovered use for newspapers. It saves farmers and ranchers a lot of money. Suggest another new method for recycling newspapers. Explain who will benefit and how.

Lesson #11: INCINERATION: THE BURNING ISSUE

EARTH FACTS:

1. *Presently, we incinerate more garbage (14.2%, 25.5 million tons) than we recycle (13.1%, 23.5 million tons).*
2. *Incineration produces particulates which pollute the air, if not filtered properly. The ash which results from the process must be landfilled.*

The public knows them as "incinerators." The waste management industry uses the term "combustors." What are they referring to? There are a number of types of facilities that burn municipal trash, but in different mixes and for different results.

INCINERATORS have been around for years. The basic incinerator takes unsorted mixed trash, burns it, and the resulting ash is landfilled. There are just a few basic incinerators still in operation. This is because the Environmental Protection Agency (EPA) has called for the development of waste-to-energy facilities, a method of waste management where non-recyclable solid waste is used as fuel for incineration. The energy released in the process produces electricity.

MASS BURN COMBUSTORS are one of three systems for burning waste in which the heat generated from the burning material is converted into usable electricity. Mixed garbage burns in a single combustion chamber where the temperature reaches 2,000 degrees Fahrenheit. The by-products are ash, which is typically sent to a landfill, and combustion gases. As the hot gases rise from the burning waste, they heat water held in tubes around the combustion chamber. The boiling water is used to generate steam and/or electricity. The gases pass through a spray dryer and a fabric air filter to remove contaminants before they are released from a stack into the air.

MODULAR COMBUSTION SYSTEMS typically have two combustion chambers, a lower one for the burning of mixed trash and an upper one for the heating of gases. A burner in the second, or higher, chamber heats gases at least momentarily to 1,800 degrees Fahrenheit to destroy dioxins. As in mass burn systems, the gases are put through air filters before they are released. In modular units, energy is recovered with a heat recovery steam generator. These incinerator units are called "modular" because the newer versions can be built from prefabricated units. They are often much smaller than mass burn plants.

REFUSE-DERIVED FUEL COMBUSTORS burn presorted waste and convert the resulting heat into energy. Bulky wastes, such as appliances, are removed in the "tipping area," where trucks dump the mixed garbage. The remaining waste travels on a system of conveyor belts, through a series of magnets, screens, and other devices that shred and separate the trash. The best burning material, or that which generates the most amount of heat, is saved for combustion, and the remainder is either landfilled or recycled. Often, the waste saved for burning is mixed with coal or another hot-burning fuel to produce energy.

In combustion systems employing the most modern techniques and environmental controls, only garbage that cannot be reused, recycled, or composted is burned; air contaminant systems filter out pollutants; and ash is transported in covered, leak-proof containers and disposed of in landfills designed and monitored exclusively for ash.

Activity #11: INCINERATION: THE BURNING ISSUE

Any form of waste removal or treatment has some advantages and some disadvantages. Even incineration in the form of waste-to-energy has its disadvantages and by-products. Modern combustion facilities must have equipment to filter or collect ash and other hazardous airborne particles. This presents a waste disposal problem: a need for specially designed landfills for the ash or an alternative solution.

1. Accumulate a newspaper clipping file about waste products. The waste products may be industrial or municipal, garbage or sewage. Classify the articles according to type of waste and method of disposal.
2. Pick an article from your clipping file and complete the chart below, listing advantages and disadvantages of one particular waste management system.

ADVANTAGES	DISADVANTAGES

3. Write a letter to the editor of your daily newspaper about one of the problems related to the waste management system you analyzed above. Use the following outline.

I. Introduction (State the problem.)
II. Proposed Solution
III. Support for the Solution
- **A. Benefit #1**
- **B. Benefit #2**
- **C. Benefit #3**

IV. Conclusion

THINK, DISCUSS, REACT:

Watch for stories in the newspaper about incineration (combustion) plants. Is one proposed for a community near you? Interview local government officials and citizen's groups. Determine the advantages and the disadvantages of having a combustion system in a nearby community.

Write an editorial voicing your opinion on the subject. (Look in today's newspaper to review other editorials before beginning your own essay.) Exchange editorials with a classmate. Differentiate between fact and opinion in your classmate's editorial.

MORE EARTH ACTIVITIES USING THE NEWSPAPER

Clip newspaper articles and photographs for an energy notebook. What are our energy problems? What resources do we have? What forms of energy will we be using in fifty years?

Some businesses and legislators are working to reduce excess packaging. Find newspaper stories that refer to business and legislative efforts in the area of packaging.

Landfills contribute to air and water pollution. They destroy acres of land that could be put to better use. State legislators are looking for new solutions to the garbage crisis. Using the newspaper as your resource, research and evaluate the options available.

Create a newspaper clipping file for alternative energy sources such as solar energy, wind power, water power, and more efficient combustion.

Look at the comics section in the newspaper. Collect comic strips related to pollution, recycling, or ecology. Draw your own comic strip reflecting your feelings about one of the topics.

Look in the newspaper for articles and information about the pollution and ecological destruction caused by nuclear weapons. What are preventative measures that can be taken?

Write a letter to the editor of your daily newspaper encouraging local businesses to use recyclable containers for product packaging.

Look in the business section of the newspaper for articles and graphs relating to the overall money savings or costs (to a community or to the state) that result from recycling programs.

Develop a newspaper clipping file about the environmental nightmare created by disposable diapers. (Americans throw away enough disposable diapers to fill a barge every 6 hours.) Collect, also, articles about the disposable diaper industry's creation of an "earth-safe" product.

Read your newspaper's gardening section for information on composting. Are there any ideas you can use at home or at school?

Plan a recycling "show and tell" day. Bring an item from home that is normally thrown away. Show the item to your classmates and describe a new use for it. Write a newspaper classified advertisement to market your item.

Create a recycling box. Decorate it with pictures clipped from the newspaper. Use it at home to save your newspapers after they are read. Make an extra box for the classroom.

To save paper, begin using the colorful Sunday comics to wrap gifts.

Plastic rings used to hold six-packs of soda, beer, and oil are extremely dangerous to birds and marine life. When these are left on the beach or in the water, wildlife often get their beaks or throats stuck in the plastic rings. Because of the danger, some products are no longer packaged in rings. Notice how many products advertised in the newspaper are still packaged in plastic rings.

Section II

EARTH ISSUES: Air, Land, Water

Earth Thoughts

"When the well's dry, we know the worth of water."

Benjamin Franklin, *Poor Richard's Almanac*

"Government cannot close its eyes to the pollution of waters, to the erosion of soil, to the slashing of forests any more than it can close its eyes to the need for slum clearance and schools."

President Franklin D. Roosevelt

"As in a quiet backwater, pollution collects in the stratosphere and no rain washes it away."

Louise Young, *Earth's Aura*

"The overwhelming tragedy of planet Earth is man's contempt for nature."

Robert van den Bosch, *The Pesticide Conspiracy*

"We know enough right now to justify moving as quickly as possible to change the practices that are causing the worst environmental destruction in history."

Vice President Albert Gore, Jr.

"If the greenhouse effect is so serious, why are we doing so little about it?"

Lewis Steel

Lesson #12: AIR POLLUTION

WHAT CAUSES AIR POLLUTION?
Most air pollution is caused by the combustion process (burning), which releases gases and smoke. Clear air becomes murky and smelly and can become poisonous. Car engines give off the waste gases carbon monoxide and nitrogen dioxide. These gases damage vegetation and people's lungs. Factory smokestacks pour out gas, smoke, and tiny particles of solid waste.

EARTH FACTS:

1. *In December of 1952, a four-day smog in London killed more than 4,000 people. It remains one of the greatest air pollution disasters the world has ever seen.*
2. *Lung damage from ozone polluted air is a risk faced by roughly 3 out of 5 Americans.*
3. *Breathing smoggy air is said to be as harmful as smoking 40 cigarettes a day.*

WHAT IS SMOG? Smog is a mixture of pollutants that causes a fog-like haze over a city. Ozone, the primary component of smog, is a gas formed when nitrogen oxide and hydrocarbons combine in sunlight. Warm air traps the cool air beneath it. The cool air becomes polluted with exhaust fumes, which react with sunlight to form harmful chemical compounds. In the atmosphere, ozone occurs naturally as a thin layer that protects us from the sun's ultraviolet rays. But when it's formed at ground level, it is deadly.

WHAT DIRTIES THE AIR? Air is made dirty by a mixture of things. These pollutants include sulfur and nitrogen dioxide from power stations and factories. Vehicle exhausts and oil refineries give off hydrocarbons. Heavy metals such as lead come from cars, smelters, and factories, while chemicals are given off as waste by chemical industries.

CAN WE BEAT AIR POLLUTION? Since the 1970s new cars have been equipped with catalytic converters which scrub clean the exhaust gases from the engine. Also, lead-free gasoline has been available to motorists since the 1970s. Cars are now designed to run only on unleaded gasoline, and in most states leaded gasoline is no longer available or illegal.

Governmental agencies such as the Environmental Protection Agency (EPA) and many private organizations have been created to regulate and enforce laws governing industry's participation in air pollution. Different industries are required by law to comply with specific regulations regarding air emissions. Restrictions have also been placed on the use of certain materials which produce environmental pollution.

WHAT IS INDOOR AIR POLLUTION? As harmful as outdoor pollution is, the air we breathe indoors—at home, at work, in the car—may pose an even greater threat to our health. With no winds to disperse them, indoor contaminants (chemicals used in consumer and building products, and the by-products of cigarette smoking, cooking, natural gas appliances, and poorly vented furnaces) can build up. The move toward more airtight, energy-efficient houses aggravates the problem. Concentrations of some toxic and cancer-causing pollutants are up to 100 times greater indoors than outdoors.

Activity #12: AIR POLLUTION

Perfume and after-shave lotion seem harmless enough until you splash them on. When the alcohol evaporates, it eventually meets up with sunlight, where it reacts with nitrogen oxides and helps produce smog. It is difficult to imagine how a splash or two can cause much harm, but when the action is performed by millions of people each day, the effects add up. In California, for example, where 30 million people splash, spray, and clean their homes on a regular basis, emissions of volatile organic compounds (VOCs) from consumer products like spray starch, charcoal lighter fluid, automotive brake cleaner, and disinfectant make up 10% of the state's total VOC emissions (or about 200 tons a day). How do VOC emissions affect your state?

1. Thumb through your newspaper for consumer product advertisements. List two examples for each category below. Then, complete the chart.
2. Use an almanac to find out the population for your county and your state. Based on your family's use, calculate the approximate usage of these consumer products in your county and state.

CATEGORY	CONSUMER PRODUCTS	AEROSOL OR NON-AEROSOL?	DO YOU USE THIS ITEM?	HOW OFTEN?
COOKING PRODUCTS				
CLEANING PRODUCTS				
PERSONAL PRODUCTS				
INSECTICIDES				
AUTOMOTIVE PRODUCTS				
HOUSEHOLD ADHESIVES				

THINK, DISCUSS, REACT:

The cost to clean-up the consumer product industry is likely to be passed on to the end user. However, consumers may receive a greater percentage of the real product (less pollutant) as more products are water-based or as solid forms are substituted for aerosols. How do you feel about this? Is the cost worth the cost? Explain.

Watch the daily newspaper for information regarding VOC emissions and/or articles concerning state or federal regulation of the consumer product industry.

Lesson #13: ACID RAIN

EARTH FACTS:

1. *The basic fuel of eastern Europe is a high-sulfur coal called lignite.*
2. *Acid rain has damaged as much as 80% of the lush forests that once flourished in former East Germany (now eastern Germany).*
3. *Over time, acid precipitation can increase the acidity of lakes, streams, and soils to the point that they change entire local ecosystems.*

All rain contains some weak acids. This is because it reacts with the gases which occur naturally in the air, such as carbon dioxide and sulphur dioxide. Since about 1960, however, people have noticed that rain has become more and more acidic, to the point where it is damaging buildings, crops, trees, and marine life.

Acid rain has been blamed on industrial air pollution. When fossil fuels are burned, they produce sulphur and nitrogen, which react with damp air to make sulfuric and nitric acids. If the air is dry, the reaction takes place very slowly. The rain might not fall until the fumes have drifted into damp air far away from the place where they were produced.

This has created international problems, since fumes from industries in the United States, for example, blow northward and may fall as acid rain over Canada. In Great Britain, fumes are blown across Europe or Scandinavia. There, lakes and rivers have become acidic, damaging plant life and killing fish. In the 1900s, anglers in Norway caught more than 66,000 pounds of salmon, but since 1970, they have caught none. In the northwest corner of the United States and in Canada where the trout and salmon fisheries are a major industry, many of the lakes and rivers no longer have fish because of the acid rain.

Large areas of soil also have been affected, so that forests are dying. Acid rain may damage forests by removing vital elements from the soil, so that the trees cannot take these nutrients up into their roots. The acid may also affect the leaves of some trees, reducing their ability to make food by photosynthesis. As a result, the trees starve. At the same time, they become more at-risk from severe frosts and pests. The latest research into the death of trees suggests that there is no single cause. Scientists believe that the trees may be dying from a mixture of tens or even hundreds of chemicals which are released into the air.

Acid rain damages many man-made structures also. Limestone and marble rock is used to create many buildings, bridges, statues, and other structures. These rocks react with sulfuric acid by dissolving. After many seasons of acid rain, these structures can become pitted, change shape, or be weakened.

Acid rain can be reduced by limiting the amount of sulfur and nitrogen compounds released into the air. Several types of devices have been developed to remove these compounds from substances that pass through industrial smokestacks. Scientists have also found ways of decreasing the effects of acid rain. For instance, lime or other neutralizing substances can be added to lake water periodically.

Activity #13: ACID RAIN

How much acid is in your rainwater? Conduct the following experiment to find out.

WHAT YOU NEED	WHAT YOU DO
a. a clean widemouthed jar b. litmus paper and a "pH" color chart (available from stores that sell pets and/or topical fish) c. a rainy day	a. Set the jar out in the open, away from eaves, gutters, and trees, where rainwater will fall directly into it. b. Wait patiently for rainwater to collect in the jar. c. When the rain stops, dip a strip of litmus paper into the collected rainwater. d. Determine whether rainwater in your area is acid, alkaline, or neither ("pH balanced") by comparing the color of the dampened litmus paper to the colors shown on the chart.

1. Does acid rain affect the area where you live? What did you learn from your experiment? Look through your daily newspaper for examples of ways that acid rain might be affecting your community.
2. Next, locate the weather information in today's newspaper. Find the information about yesterday's precipitation. List it (in inches) on the chart below next to the number that corresponds with yesterday's date. Continue your precipitation records each day for a month (or for the next several months).
3. At the end of the month, transfer your information to a graph. How does the graph help you understand patterns of precipitation in your community? Combine this information with your acid rain experiment findings. Formulate your own hypothesis regarding rain and rainwater in your community.

DATE	PRECIPITATION	DATE	PRECIPITATION	DATE	PRECIPITATION
1		11		21	
2		12		22	
3		13		23	
4		14		24	
5		15		25	
6		16		26	
7		17		27	
8		18		28	
9		19		29	
10		20		30	
				31	

THINK, DISCUSS, REACT:

Based on your hypothesis from the activity above, write a science news story about acid rain in your community. (Be sure to include the who, what, when, where, why, and how.)

Lesson #14: THE OZONE LAYER

The ozone layer is a region in the earth's stratosphere, between 7 and 30 miles above the surface. Ozone is a form of oxygen which is created by the action of sunlight. Ozone absorbs much of the harmful ultraviolet (UV) radiation from the sun. Ultraviolet radiation is one of the causes of skin cancer.

EARTH FACTS:

1. *Once freed, a single atom of chlorine destroys about 100,000 molecules of ozone before settling to the earth's surface years later.*
2. *Up to 5% of the global ozone layer has already been destroyed by CFCs.*
3. *CFCs are put to hundreds of uses because they are relatively nontoxic, nonflammable, and do not decompose easily. Because they are so stable, they will last for up to 150 years.*

Since 1979, scientists have noticed that the ozone layer is becoming thinner in places. The thinning is believed to be caused by a group of chemicals called chlorofluorocarbons (CFCs), which are used in aerosol spray cans, air conditioners, refrigerators, insulation and foam, industrial cleaning agents, and many other common articles, including the polystyrene food containers used for fast foods. When they are released, CFCs rise to the stratosphere, where sunlight converts them into chlorine monoxide. The chlorine monoxide reacts with ozone, removing it from the air.

The seriousness of this effect was first realized in the autumn of 1985 when a hole appeared in the ozone layer over Antarctica. The hole has been seen every summer since then, and some scientists fear that it will spread to lower latitudes, nearer to the equator.

If more UV radiation reaches the earth, the increase of skin cancer may not be the only result. Grain crops could become less productive and the UV could warm the atmosphere, adding to the "greenhouse effect" caused by rising amounts of other pollutants such as carbon dioxide and methane. (See also, Lesson #15).

In the interest of preserving the ozone layer, the United States banned the use of CFCs in spray cans. Berkeley, California was the first city to ban fast food containers made of polystyrene (in 1987). Since that time, other cities have followed suit. However, even if CFCs were banned immediately all over the world, the effects on the ozone layer would continue for several decades because of the long lifetime of CFCs in the atmosphere (see Earth Facts box). And, as old refrigerators and air conditioners are scrapped, they will release more damaging gases into the stratosphere.

Chemical companies and manufacturers are currently seeking practical substitutes for CFCs. However, as they switch to other gases for coolants, propellants, and foaming agents, they are finding these gases less effective and more expensive. Furthermore, equipment (such as air conditioners) that uses replacement chemicals is expected to consume more power and wear out sooner. The cost of environmental protection, say manufacturers, is a step backward in product quality.

Activity #14: THE OZONE LAYER

The use of chlorofluorocarbons (CFCs) is the primary cause of ozone depletion. CFCs are used in aerosol spray cans, air conditioners, refrigerators, insulation, packing foam, industrial cleaning products, and styrofoam fast food containers, just to name a few products. The United States has already banned the use of CFCs in spray cans, but what about other consumer products? Conduct an advertising campaign to educate the public about the dangers of products containing CFCs.

1. Find advertisements in today's newspaper to use for examples. Then, create an advertisement of your own regarding the ozone depletion crisis.

2. Use the space below to sketch your newspaper advertisement. Then, on a separate sheet of paper or poster board, design other promotional items to complement your newspaper ad. Design, for example, a bumper sticker, an outdoor billboard, a radio jingle, and/or a script for a television commercial.

THINK, DISCUSS, REACT:

A few years ago, *TIME* magazine suggested that an Environmental Corps, similar to the Peace Corps, be established. The corps would be sent all over the world to educate and inform people about preserving and protecting the environment. What do you think about this idea?

Imagine that this organization already exists. Create a newspaper advertisement recruiting citizens to join the corps.

Lesson #15: THE GREENHOUSE EFFECT AND GLOBAL WARMING

EARTH FACTS:

1. *The concentration of carbon dioxide and other greenhouse gases in the atmosphere has increased by about 25% since the start of the industrial revolution.*
2. *Every year people add 6 billion tons of carbon dioxide to the atmosphere. (The U.S. is responsible for 1.5 billion.)*

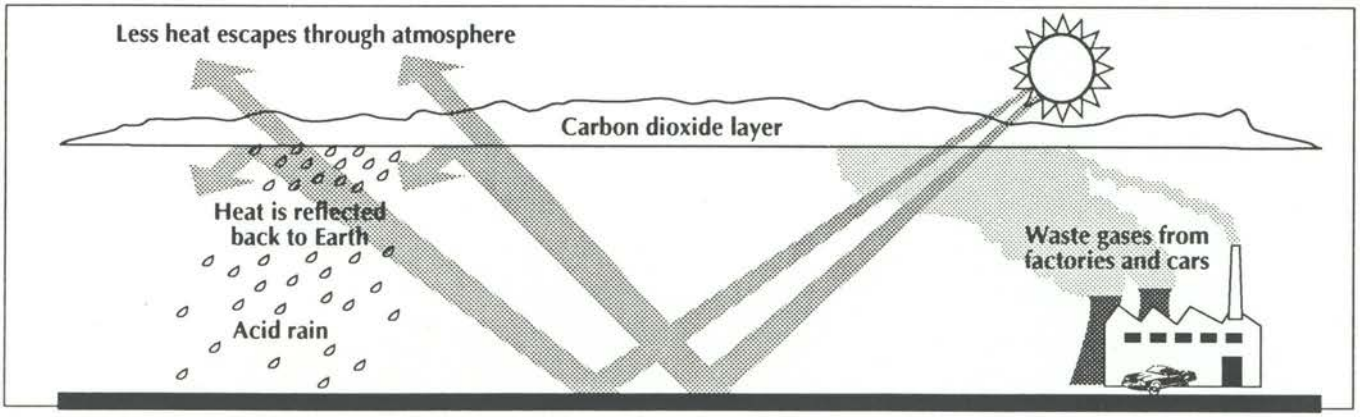
For millions of years the earth's climate warmed and cooled at a certain pace. However, since the industrial revolution of the 1700s, people and industry have affected the earth's atmosphere causing the climate to change more rapidly. The industrial revolution brought factories, railways, fast-growing cities, and motor vehicles, creating worldwide consumption of fossil fuels. When burned, coal, gas, and oil combine with oxygen to form carbon dioxide. The carbon dioxide along with other gases collects in the atmosphere forming "a blanket" around the earth, much like the glass roof on a greenhouse.

The earth's atmospheric concentration of carbon dioxide and other gases traps heat from the sun, like a glass roof. A greenhouse roof lets sunlight in to heat the plants, but it prevents much of the heat from getting out. In a similar way, the atmosphere lets sunlight through to the surface of the earth. The sunlight warms the earth, but the heat that is created cannot easily pass back through the atmosphere into space. The resulting "greenhouse effect" warms the atmosphere.

This could lead to serious global environmental problems. As the world warms up, more of the ice around the North and South Poles will melt. During the next century the sea level could rise by 3 or more feet. Low-lying coastal areas would flood, and low-lying countries such as the Maldive Islands in the Indian Ocean would completely disappear. One third of Bangladesh, for example, would be flooded. This will affect millions of people.

Global warming could have other effects. Lands that presently have cold winters, such as Canada, may well become warmer. Warm countries like Greece would suffer drought. Rainfall will decrease in some areas, leading to crop failure and expanding deserts. Plants and animals will have to adjust to these new conditions, or face extinction.

Scientists predict that world temperatures could increase from 5 to 10 degrees Fahrenheit by the middle of the next century. An Environmental Protection Agency (EPA) report argues that the greenhouse effect is irreversible and has already begun to affect global weather patterns.



Activity #15: THE GREENHOUSE EFFECT & GLOBAL WARMING

During the last decade we have witnessed some very unusual weather. Winters have been milder and summers slightly warmer in most areas of the world. Scientists say this is a result of global warming caused by the "greenhouse effect." How is the weather where you live?

1. Turn to the weather page in your newspaper. What kind of weather is your state having today? Is it "normal" seasonal weather? Or, is it unusually warm or cool? What are the high and low temperatures today? Describe the normal weather for your geographic area this time of year.
2. Notice the high and low temperatures for other cities listed in today's newspaper. Choose six cities in the United States, and six cities in other parts of the world. Select cities that are far apart from each other. Record their high and low temperatures on the chart below.
3. Describe how each city's weather differs from your city's weather today.

CITIES IN THE U.S.	TEMP. HIGH/LOW	HOW IT DIFFERS	CITIES IN THE WORLD	TEMP. HIGH/LOW	HOW IT DIFFERS

4. Next, using the fashion section from your newspaper, find and clip advertisements showing how people would dress for weather in each of these cities.

THINK, DISCUSS, REACT:

Use the weather information in your daily newspaper to keep track of weather patterns over an extended period of time. Graph your data. Note any obvious trends or patterns. Formulate a hypothesis based on your findings. Can you relate your findings in any way to global warming?

Lesson #16: HAZARDOUS WASTE

EARTH FACTS:

1. *Paint and paint products account for 60% of the hazardous waste dumped by individuals.*
2. *In an average city of 100,000 residents, 3.75 tons of toilet bowl cleaner, 13.75 tons of liquid household cleaner, and 3.44 tons of motor oil are discharged into city drains each month.*
3. *A single quart of motor oil poured into the ground can pollute as much as 250,000 gallons of drinking water.*

Advanced nations manufacture some 70,000 different chemicals, most of which have not been thoroughly tested. Careless use and disposal of these substances contaminate our food, soil, water, and air; and seriously threaten the ecosystems on which we depend.

Most of the hazardous waste is generated by industry. In recent years, industry has been held responsible and regulated by laws regarding hazardous waste: from toxic air pollutants released during manufacturing to spills of toxic chemicals. Storing, transporting, and disposing hazardous chemicals are dangerous and important tasks for industry today.

Hazardous waste, however, is not created by industry alone. U.S. households generate more than 2 million tons of hazardous waste each year. This waste is from household products such as:

motor oil	cleaning fluids	spray paint cans	pool chemicals
car batteries	oven cleaner	old paint	photo chemicals
car wax	drain cleaners	solvent cleaners	pharmaceuticals
brake fluid	wood polish	wood strippers	nail polish
antifreeze	floor polish	oil-based paint	mothballs
degreasers	insecticide	paint thinner	air freshener
radiator flushing	weed killer	permanent-ink	asbestos
transmission fluid	pesticides	glue/epoxy	batteries

Although these products do not usually have the word "hazardous" written on them, they are just as hazardous as any industrial waste. Rat poison, for example, is extremely dangerous to humans; oven cleaner is corrosive; and paint thinner is ignitable and toxic.

The average household stores from 3 to 10 gallons of hazardous waste. Current statistics indicate that as much as 25% of all toxic waste originates in individual households. Much of it goes out with the trash to a landfill or incinerator, down the sink or sewer, or into the yard or woods. Changing our household practices can make a significant difference to the environment!

Toxic waste comes from toxic products. One simple way to reduce toxic waste and protect the environment and drinking water from these wastes is to substitute safe, natural, inexpensive products for hazardous products. A mix of one part lemon to two parts olive oil makes a furniture polish, for example. Similar ecological "recipes" for house products, including oven cleaner, window washer, drain cleaner, and all-purpose cleaners have been developed by environmental groups.

Activity #16: HAZARDOUS WASTE

Don't assume a product is toxic-free just because there are no toxics listed on the label. The government does not require manufacturers to list every ingredient if the product does not violate federal safety standards. Baby powder, for example, often contains asbestos. And traces of pesticides have been found in certain brands of shampoo. You can help the environment by becoming a cautious and informed consumer, especially where it concerns the products you use everyday.

Take toilet paper, for example! Some of the dyes used to color toilet paper produce toxins. These substances are poisonous to the environment when the paper decomposes. Some of the perfumes used to scent toilet paper also produce toxins. Conduct your own "Toilet Paper Study."

1. Begin with your daily newspaper. Find advertisements for five different brands of toilet paper. List the brands below. What is the cost of a package of each brand? Compute the price per roll for each brand and list these below in the last column.
2. Take the chart with you to the supermarket. Examine all five brands of toilet paper. Check the package labels to see if dyes and perfumes are listed. How is each brand packaged? Is it packaged in paper rather than plastic? Is the toilet paper made from recycled paper?

BRAND NAME	PAPER WRAPPER	USES DYES	USES PERFUMES	IS MADE FROM RECYCLED PAPER	PRICE PER ROLL

3. Based on the results of your study, which brand is the best buy for the consumer? Which brand is the best buy for the environment? Are these two "best buys" the same? Why or why not?

THINK, DISCUSS, REACT:

There are a surprising amount of toxics in your home, hidden in everything from oven cleaner to toilet paper. They are a hazard, not only to you and your family when they are used, but to the environment when they are first manufactured, and when they are finally disposed of.

Billions of dollars are spent every year in advertising to convince consumers that these products are necessary and will enhance their lives, when in fact they are dangerous. What can be done about this? (Notice how many of these products are advertised in your daily newspaper, on the radio, and on television.)

Lesson #17: SOIL EROSION & POLLUTION

EARTH FACTS:

1. *Each year millions of acres of farmland in the world are destroyed because of improper farming methods.*
2. *Lawn fertilizers and pesticides are just as lethal as agricultural ones. According to the EPA, at least 74 different pesticides have been found in the groundwater of 38 U.S. states.*

Most of the damage to soil is due to erosion. Erosion alters landscapes, reshaping the earth's surface. Erosion is the wearing away of rocks and soil by wind, water, ice, and frost. It can happen quickly in just a few years, or very slowly over thousands of years. The word erosion means "gnawing away." Natural erosion happens all the time. It can be done by glaciers, by the sun's heat, or by the scouring action of wind, rain, snow, river currents, or ocean waves.

Soil erosion can also be caused by "unnatural" methods. Farming, for example, can place a great strain on the soil. Wise farmers work hard at preventing soil erosion. Planting trees and shrubs checks erosion by binding the loose soil. Sowing grass is another way to stop erosion. Grass helps build up new organic matter which binds together the soil crumbs and so prevents them from being blown away. Farmers can also prevent erosion by: (a) rotating crops, (b) "resting" the soil between crops, and (c) using animal manure for fertilizer.

As the world population increases, so does the demand for food. This places pressure on farmers to produce more from the land. Farmland can be destroyed by overwork, careless irrigation, poor plowing, and chemicals (fertilizers and pesticides).

Modern farming is based on adding artificial fertilizers to the soil. These chemical fertilizers make it possible to grow very large crops and to use the land every year. Besides overworking the soil, it causes problems when the chemicals run off the land and upset the balance of life in the streams and waterways. Also, chemicals seep into groundwater and contaminate drinking water.

Modern farmers spray their crops with weed killers and pesticides. When the pesticide DDT (dichloro-diphenyl-trichloro-ethane) was first discovered, it was regarded as a "miracle." Scientists believed they had finally discovered a safe and effective way to kill pests while making farmland more productive. But, that is not what happened. DDT proved to be toxic not only to pests, but to all life. It stayed in the soil, killing insects other than the pests. Eventually, it worked its way up the food chain, killing birds of prey and other harmless creatures. DDT also accumulated in fish, wildlife, and humans. In 1972, DDT was banned in the United States. Pesticides destroy the soil itself by killing essential organisms (like microbes and earthworms). Once pesticides seemed ideal; today the evidence is mounting that they are an ecological disaster.

Other "unnatural" or man-made methods of soil erosion are the construction of roads and highways, and the development of homes and buildings. Clearing the land for any kind of construction alters the earth's landscape.

Activity #17: SOIL EROSION & POLLUTION

Farmland can be destroyed by overwork, careless irrigation, poor plowing, and chemicals (fertilizers and pesticides). When farmland is destroyed or polluted the value of the land is likely to change dramatically. Although it seems logical that it would be valued at a much lower price, that may not be true. Often other factors play a role in land values. Sometimes the passing of time can cause land to change value, sometimes location. If the farmland was located in the middle of Manhattan, for example, it would be worth a fortune, no matter how poorly the soil was eroded.

1. Geographic, economic, and ecological factors can cause land to change value. Group the following hypothetical situations into one or more of those categories. Then, explain why each would cause some value change in the land.
   a. population growth or decline of an area
   b. drainage improvements
   c. completion of a new transportation system
   d. discovery or depletion of a natural resource
   e. passage or rejection of zoning regulations
   f. creation of an enhancing or obnoxious economic activity in the area
2. Consider the following hypothetical newspaper headlines. Determine whether each would indicate a change in land value. And if so, would it increase or decrease the value? Explain.
   City Chooses New Waste Disposal Site
   Natural Gas Discovered in Chester County
   Oil Spill Off Florida Coast, Worst This Century
   City Council Approves Horse Racing Track
   New Dam Slated for South Texas
   Unemployment Rate Soars to 8%
   New Commuter Rail Line to Link Four Counties
   Drought Leaves Farmers Dry
3. Look in today's newspaper for articles similar to these hypothetical examples. Recreate the chart below in a larger format on your own paper. Then, complete the chart.

NEWSPAPER ARTICLE	BRIEF SUMMARY OF NEWS STORY	HOW LAND VALUES WOULD BE AFFECTED
#1		
#2		

THINK, DISCUSS, REACT:

How have land values in your city, county, and state changed in recent years? Is farmland valued the same as it was 20 or 30 years ago? Use the classified advertising section of your newspaper to find current real estate prices.

Lesson #18: OIL POLLUTION

EARTH FACTS:

1. *While tanker spills make the headlines, more than 50% of the oil that pollutes the oceans comes from landbased sources.*
2. *About 40% of the pollution in America's rivers and streams is from used motor oil.*

Every year more than three million tons of oil is spilled into the sea. About a third of this is washed out of the tanks of oil tankers before they reload. Sometimes oil tankers tear their hulls on anchors or rocks and spill their contents into the sea. Some of these spills are small and do little damage, but other spills are large. Each forms a widespread film of oil atop the water. This floating film is called an oil slick.

The slicks created by large spills have a devastating effect on the ocean and on beaches and shores. The oil seeps into eggs laid at the water's edge and kills the tiny organisms and animals growing inside. The oil clogs the gills of fish, making it impossible for them to breathe. The oil coats the feathers of birds. In doing so, it eliminates the air layer that insulates them from the cold. It also reduces their buoyancy in water, leaving them unable to dive for food or to swim away from predators. The oil kills the marine life that eat food or drink water poisoned by the oil.

A 1969 leak in an offshore well created an oil slick that stretched 60 miles along the California coast. During the first four months after that spill, 3,000 birds died. In 1989 the oil tanker Exxon Valdez ran aground near Valdez, Alaska. More than 10 million gallons of crude oil spilled from the tanker's torn hull into Alaska's Prince William Sound. As a result, in the first year following the accident, at least 33,000 seabirds, 980 sea otters, and 136 bald eagles died.

Transporting oil on land from where it is found to where it is refined and used can also prove hazardous to the environment. Sometimes pipelines leak. Sometimes oil trucks are involved in accidents. Drilling for oil can be dangerous too. Sometimes natural gas trapped underground causes wells to "blow out," or explode with tremendous force. Thus, oil shoots high into the air, and workers must struggle to control the gusher.

Oil wells can catch on fire and burn for days. Because oil fires cannot be put out with streams of water, experts must be called in to fight these fires. As an act of hostility during the Persian Gulf War, Saddam Hussein authorized his troops to set Kuwaiti oil fields on fire. It took specialists more than a year to extinguish these massive fires. Millions of barrels of Kuwaiti oil were also spilled into the Gulf. Kuwait became an environmental disaster, with serious degradation of its air, soil, and marine resources.

Oil pollution is not limited to war destruction or accidents that happen on wells or while oil is being moved from place to place. One of the biggest causes of oil pollution is motor oil that is improperly discarded after its use (see Earth Facts box). Used motor oil should be recycled or disposed of in a way that is safe for the environment.

Activity #18: OIL POLLUTION

Many of the oil pollution disasters are a result of transportation mishaps or accidents: tankers run aground or tear their hulls at sea, pipelines leak or burst, and oil trucks on the roads and highways are involved in motor accidents. How many other environmental disasters result from transportation problems or accidents?

1. Look through today's newspaper to locate and clip articles having to do with commerce and transportation. Find articles for each mode of transportation listed on the chart.
2. Complete the data retrieval chart. Using your collection of newspapers, an almanac, and other sources, list recent environmental disasters that have resulted from transportation accidents.

MODE OF TRANSPORTATION	KIND OF CARGO	SPEED (Rank)	COST (Rank)	SPECIAL REQUIREMENTS	ECOLOGICAL DISASTERS
AIRPLANE					
SHIP					
PIPELINE					
RAILROAD					
TRUCK					
BUS					

THINK, DISCUSS, REACT:

Conduct an analysis of your data retrieval chart. Draw conclusions and generalizations from the information in the chart. Ask yourself questions such as: (a) Which is the fastest means of transportation? The slowest? (b) Which is the most expensive form of transportation? Least expensive? (c) Which is the most flexible method? Least flexible? (d) Why are some forms of transportation appropriate for some products and not for others? (e) Do any of these factors make accidents more likely? (f) What mode of transportation is more often involved in environmental accidents? What type of cargo?

Lesson #19: THE WATER CYCLE

EARTH FACTS:

1. *The water we drink is at least 3 billion years old. The same rain water has been recycled over and over again.*
2. *The U.S. uses 450 billion gallons of water every day.*
3. *Only 3% of the earth's water is fresh water, and 99.5% of all the fresh water is in icecaps and glaciers.*

Water is essential to all living things. Plants, animals, and people need it to survive. We draw our drinking water from surface sources: lakes, rivers, and springs; and from underground sources: aquifers composed of waterbearing sand, gravel, or rock formations.

More than half of all U.S. citizens drink water drawn from aquifers. Groundwater supplies most rural households, approximately 75% of all major cities, and most of Florida. The rest of the population drinks water that is diverted from rivers and lakes and stored in reservoirs.

The world's supply of fresh water comes almost entirely from precipitation. Local precipitation is part of a global water cycle that moves water from sea to land and back to sea again. Moisture evaporates from the sea, and air masses carry the vapor over the continents. When the vapor cools to its dew point, it condenses to visible water droplets that form clouds or fog. Favorable atmospheric conditions cause tiny droplets to enlarge and fall to earth as rain, snow, sleet, and hail.

The underground aquifers and the surface lakes and rivers are constantly fed by the volumes of water lifted from the sea, moved by wind over land, and redeposited on land as rain, snow, or ice. About two-thirds of what reaches land returns to the atmosphere by evaporation from land surfaces and soil, and through transpiration (the giving off of water vapor and photosynthesis by-products from vegetation). The remaining water seeps into the ground, recharging aquifers; or flows overland into downgradient streams, lakes, and rivers, replenishing reservoirs of surface water. Ultimately, water completes its cycle. Underground water seeps into streams and lakes and returns through these surface channels to the sea.

The land from which precipitation drains to a regional river or lake is called a "watershed" or drainage basin. Groundwater flows within a watershed beneath the surface of the ground, fed by precipitation that falls on the watershed and seeps into the soil to the water table. Groundwater exists underground almost everywhere—close to the surface of the earth in some places and thousands of feet deep in others. Like the surface water runoff after a rainstorm that fills streams that feed rivers, groundwater is also interconnected to regional surface water. Moving by the force of gravity away from the "recharge area" where it is fed by surface water, groundwater ultimately empties into a stream, pond, river, or lake. (Coastal watersheds drain to the ocean.)

Groundwater is a critical resource both because it provides drinking water and also because it feeds our lakes, rivers, streams, and oceans. Groundwater is often polluted or contaminated by the tens of thousands of chemicals used daily in industry, in agriculture, and in the home.

Activity #19: THE WATER CYCLE

The world's supply of fresh water results almost entirely from precipitation. The earth's water naturally recycles itself. To understand how this works, conduct your own simple experiment:

WHAT YOU DO:

1. Carry a large metal or plastic mixing bowl outside and place it in the sun.
2. Pour water into the bowl until it is about one-fourth full.
3. Gently place an empty coffee mug in the center of the bowl. Be careful not to splash any water into the mug.
4. Cover the top of the bowl with clear plastic wrap. Make sure the inside of the bowl is completely airtight.
5. Let the bowl sit in the sun while you watch what happens.

WHAT YOU WILL SEE: Heat from the sun will cause the water in the bowl to evaporate. This water will rise as vapor and condense on the plastic wrap, clouding it. As more and more water vapor condenses on the plastic wrap, it will form droplets. These droplets will fall as "rain" back into the bowl and into the mug. The water in the mug will give you a rainfall measurement.

1. Surface water and groundwater play a very important role in the earth's natural water recycling system. Look for articles and photographs in today's newspaper that illustrate different aspects of surface water or groundwater pollution. Select three examples.
2. Determine the long and short range consequences of the pollution described in the article or photograph. Suggest corrective measures for the present problem and preventative methods to preclude future problems.

SURFACE WATER OR GROUNDWATER POLLUTION	LONG/SHORT RANGE CONSEQUENCES	CORRECTIVE MEASURES	PREVENTATIVE METHODS

THINK, DISCUSS, REACT:

Conduct a variation on the simple experiment above. Once vapor has condensed on the plastic wrap clouding it, gently move the bowl from the sun into the shade, being careful not to splash water onto the plastic wrap or into the mug. Let the bowl sit for a while. Then take the plastic wrap off and look inside. What happened to the water on the plastic wrap? Where did it go? Why?

Lesson #20: WATER SOURCES & TREATMENT

EARTH FACTS:

1. *More than 2,000 years ago, the Romans built a system of aqueducts stretching 220 miles. Four of these aqueducts are still in use today.*
2. *In 1902, Belgium was the first country to use chlorine to kill bacteria in its water system.*

Most people in the United States get their water from metropolitan water systems. These systems may rely on one or several sources. For example, they may dam up rivers and create reservoirs to store runoff water for future use (surface water). They may tap natural springs or dig wells to get water from under the ground (aquifers). They may also build aqueducts and lay pipe to carry water in from nearby lakes and rivers. For example, these major U.S. cities get their water from the following sources:

USE SURFACE WATER:	USE UNDERGROUND WATER:	PIPE IN WATER:
Atlanta	Honolulu	Denver
Chicago	Miami	Los Angeles
Dallas	San Antonio	New York

Neither surface water in lakes and rivers nor underground water is pure. Both nature and people deposit substances in this water. Sometimes tiny organisms grow in the water. They carry diseases that can make people sick. For these reasons, water must be treated to make it safe for consumption.

WHAT HAPPENS AT A WATER TREATMENT PLANT?

STEP #1: INTAKE
Large items such as sticks, logs, fish, and plants are screened out of water drawn from rivers, lakes, and other surface sources.

STEP #2: PRETREATMENT
Chemicals, such as chlorine, alum, or lime, are added to remove impurities, and to destroy unpleasant odors and tastes. Chemicals are also added to soften hard water by removing excess minerals. Then the water is mixed rapidly to distribute the chemicals evenly.

STEP #3: COAGULATION
The water is allowed to collect and stand in a large basin. The chemicals that were added during pretreatment cling to any impurities in the water. This process in which chemicals and impurities gather together to form large particles is called coagulation. As the water stands, these larger particles settle to the bottom of the basin and can be removed.

STEP #4: FILTRATION
The water is filtered through layers of sand, gravel, and hard coal (called anthracite) to remove remaining impurities. An additional filter may be used to remove toxic organisms.

STEP #5: CHLORINATION
Chlorine is added to the water to prevent the formation of bacteria. The chlorine is carefully measured so that the smallest effective amount is used. Sometimes fluoride is added to help prevent tooth decay.

STEP #6: DISTRIBUTION
Now pure and ready for use, the water may be stored in a reservoir or tank. It may travel in pipes called mains to the homes or factories where it is needed.

Activity #20: WATER SOURCES & TREATMENT

Where does your town's drinking water supply come from? What percentage of your drinking water comes from aquifers and what percentage comes from surface water? Is any water piped in from nearby lakes or rivers? Conduct an investigation to find out this information.

1. With your information, create a newspaper graphic mapping the aquifers and surface water sources in the geographic area where you live. (Notice the map graphics in today's newspaper. Make your graphic just as easy to read and understand. Be sure to label your map thoroughly.) Sketch your graphic below, then transfer it to poster board.
2. What can you conclude from your investigation and your graphic about the water sources in your area?
3. What role does your state government play in protecting the area's water supply? What legislation is being enacted to protect area aquifers and surface water from pollution? Keep up with current information in your daily newspaper.

THINK, DISCUSS, REACT:

Visit a local water treatment plant. Observe the six steps or stages of water treatment: Intake, Pretreatment, Coagulation, Filtration, Chlorination, and Distribution. Inquire about the quality of the end product and the cost of this treatment to your town. What precautions are taken by area water authorities to conserve water?

Collect stories from the newspaper that relate to the quality of the water supply and/or other information you learned on the plant tour.

Lesson #21: DISTRIBUTION OF WATER & USAGE

EARTH FACTS:

1. *Every American uses an average of 70 gallons of water each day.*
2. *If a family of four takes 5-minute showers each day, they use more than 700 gallons of water every week. This is the equivalent of a 3 year supply of drinking water for one person.*
3. *Up to 40% of the pure water used in every household is flushed down the toilet.*

Distribution of water for most municipal use can be outlined in six basic steps. Water travels:

1. *To the Water Treatment Plant* - Both surface water and groundwater go to a water treatment plant. (See also, Lesson #20.)
2. *By Mains and Service Lines to Water Users* - The treated water travels by distribution pipes, or mains, and by service lines to water users, such as homes, factories, schools, hospitals, and businesses.
3. *Through the Sewer System* - Used water travels through the sanitary sewer system underground to the sewage treatment plant.
4. *To the Sewage Treatment Plant* - First, the water is cleaned. Next, it is carried to streams, where nature cleanses it more. Then, it is captured so that it can be used again.
5. *Into Tanks, Open Reservoirs, and Covered Reservoirs* - The clean, captured water is stored in large, elevated water tanks, in open reservoirs, or in covered reservoirs.
6. *By Mains and Service Lines Back to Users* - The water is either pumped electrically or gravity fed through mains to service lines and back to users.

We use water in so many different ways. For example, we use it for drinking, cooking, cleaning, washing dishes and clothes, bathing, brushing teeth, heating and cooling, generating power, irrigating farms, fighting fires, swimming and sports, washing cars, flushing toilets, and feeding the lawn.

Much of the water we use is wasted. Faucets leak, dishwashers and washing machines run half full, and people leave water running while doing a number of everyday tasks. In fact, a household could save up to 20,000 gallons of water each year by "getting a grip" on its faucets.

DID YOU KNOW.....

.....a running faucet puts 3-5 gallons of water down the drain every minute it is on?
.....you can easily use more than 5 gallons of water if you leave the tap water running while you brush your teeth?
.....washing dishes with the tap running can use an average of 30 gallons of water?
.....if you shave with the water on, you use an estimated 10-20 gallons each time?
.....if you wash your car at home, using a hose, you can use up to 150 gallons of water?
.....a standard shower head uses about 5-7 gallons of water per minute? So, even a 5-minute shower can consume 35 gallons!
.....each time your toilet is flushed it uses 5-7 gallons of water?

Activity #21: DISTRIBUTION OF WATER & USAGE

How many different ways do you use water on a daily basis? Approximately how many gallons of water do you use? Do you waste water? Be a water detective and investigate your own water habits.

1. Review your daily "water" activities from the moment you wake up to the minute you go to bed. List these activities below.
2. Perform each activity or task at your normal speed and see how long it takes to complete each. Approximately how many gallons of water do you use for each activity? (Use the information from Lesson #21 to help you determine those numbers, based on the time it took you to complete each task.)
3. Think of ways to improve each activity to save water. For example, when taking a shower you could turn off the water while you shampoo your hair or lather your skin, then turn it back on when you are ready to rinse off.

DAILY ACTIVITY	TIME IT TAKES TO COMPLETE	APPROXIMATE # OF GALLONS USED	HOW TO IMPROVE TO SAVE WATER

4. Locate the comics section in your daily newspaper and find your favorite comic strip. Cut out the characters. Make up a dialogue for these characters based on your own daily water habits. Create a comic strip using these characters and your new dialogue.

THINK, DISCUSS, REACT:

Think of a new character for a comic strip about water conservation. What would this character look like? What would "its" name be? What kinds of adventures would "it" be involved in? Could such a character and comic strip help water conservation awareness? How?

Lesson #22: PHOSPHATES, LEAD, & ROAD SALT

EARTH FACTS:

1. *Over 50% of the phosphates in our lakes and streams come from detergents.*
2. *Lead, inhaled or ingested, interferes with the production of red blood cells and may damage the brain, kidneys, liver, and other organs.*
3. *Road salt contamination of groundwater has significantly increased in the last 30 years.*

Phosphates, chemical compounds containing phosphorus, are found in most detergents and fertilizers. Detergent manufacturers use them because they soften water and prevent dirt particles from being redeposited on clothes. Phosphates have other effects. For example, they encourage plant growth by enabling plant leaves to make food. While small amounts of phosphate are good for the environment, large amounts are harmful to it.

Phosphates biodegrade very slowly, so their effects are felt for a long time. As phosphates empty into the streams and lakes, they increase the acidity of the water. They also speed up the growth of plants called algae. They fertilize the algae to a point where it grows out of control. Algae block out light and choke off water flow. Algae rob other plants of the fresh water and nourishment they need to survive. When the algae dies (in its natural cycle), the bacteria that cause it to decay pollutes the water and poisons the fish and other animals that live in it or drink from it. In time, lakes and streams are eliminated.

Lead is a toxic metal that was once used in many consumer products and is still found in some products. Young children and infants are especially vulnerable to lead poisoning. It can irreversibly affect both their mental and physical development. Unlike the other sources of contamination, lead in drinking water most often comes from within the water system. Typically lead gets into water after the water leaves the municipal water plant or well. The source of lead is most likely lead pipe or lead solder in the plumbing of your home that corrodes and dissolves into water. Some conditions increase the amount of lead that concentrates in your water from lead pipes or lead solder, for instance, water standing in the pipes for many hours, hot tap water, and "soft" water.

Lead contaminated drinking water is most often a problem in very old and very new houses. Plumbing installed before 1930, including interior plumbing and service connections that join house pipes to public water supplies, most likely contain lead. Copper pipes have replaced lead pipes in most residential plumbing. Until 1988, however, lead solder was used with copper pipes. The Environmental Protection Agency (EPA) estimates that lead solder in new pipes dissolves into water for a period of about five years.

Every winter in snowbelt states, road salt mixed with sand is spread on public roads to melt snow and ice. Most of the salt used is sodium chloride. The water-soluble sodium chloride either runs off roadways dissolved in melted ice and snow to nearby lakes and streams or it percolates into groundwater. In several northeastern states, the sodium contained in public water supplies has at times exceeded the federal and state limits. Excessive sodium intake can contribute to hypertension, and pose a threat to those with heart, liver, or kidney ailments.

Activity #22: PHOSPHATES, LEAD, & ROAD SALT

You may be using a high-phosphate detergent without realizing it. Look on the side of your detergent box. It will list the amount of phosphorus "in the form of phosphates." But that is not the phosphate content. To get the actual amount, multiply the percentage of phosphorus by 3. For example: 8% phosphorus = 24% phosphates. If you use a liquid detergent, you will find that liquid detergents are generally phosphate-free. Conduct your own phosphate study!

1. List the brand of detergent you use at home on the first line below. Record the amount of phosphorus listed on the product label. Then, compute the actual phosphate content.
2. Find and clip detergent advertisements from your daily newspaper for a time period of 3 to 4 weeks. Separate your newspaper advertisements into ads for liquid detergents and ads for powder detergents. Then, sort the powder detergent advertisements into brand names.
3. List five of the most advertised brands on the chart (below your household detergent). Next, take a trip to the supermarket to locate these detergents. Record phosphorus information from the product labels, and compute the actual amount of phosphate in each. Which brand has the highest percent of phosphates? Was it a highly advertised brand? How does your home detergent compare?
4. What other comparisons can you draw from your data? Do you see a relationship between advertising and phosphate content? What can you conclude from this study?

BRAND NAME OF DETERGENT	% OF PHOSPHORUS LISTED ON LABEL	ACTUAL% OF PHOSPHATES	FREQUENCY OF ADVERTISING

THINK, DISCUSS, REACT:

It is difficult, very expensive, and sometimes impossible to correct groundwater or drinking water pollution once the damage is done. Preventing contamination is a much sounder environmental and economic policy. Where lead and road salt are concerned, what are your prevention suggestions? Write an editorial expressing your thoughts.

MORE EARTH ACTIVITIES USING THE NEWSPAPER

Divide the class into three groups representing air, land, and water. Have each group begin an environmental scrapbook of newspaper clippings that relate to their category.

Follow the pollution index reports on the weather page of the newspaper and set up a wall display graph to plot the daily fluctuations. Indicate daily rainfall and other weather conditions on the same graph to see if or how they affect the pollution level.

Start a class ecology bulletin board. Post newspaper photos and stories on ecology problems. Add to it daily.

Collect news or feature stories that show the human impact on the environment. Use these as a springboard for debate or class discussion.

Make a collage of newspaper pictures to illustrate threats to our environment, such as acid rain, soil erosion, toxic waste disposal, strip mining, offshore oil drilling, etc.

Find a newspaper article or photo of a new factory, highway, housing development, or other construction project in the community. Determine the environmental impact of the project on the community.

Select a topic of personal interest related to the environment. Use the newspaper to collect all the information you can find on the topic. Write an article summarizing your findings or participate in a panel discussion. (Suggested topics are acid rain, loss of farmland to urban expansion, and local land use issues.)

Visit a local sewage treatment plant. Where does the water go when it leaves the plant? What happens to the waste material? Write a news story for your school newspaper.

Create a newspaper clipping file about the problems of medical waste disposal (a hazardous waste). Determine the best possible solution to the problem for your state based on the information you have collected.

Locate an example in today's newspaper about how the earth naturally cleans and recycles its water.

Find newspaper photos or articles that show natural resources being used. Determine if they are being used wisely.

Look through the newspaper for articles about waste or abuse of natural resources. Using clippings from the newspaper and other resources, create posters which encourage conservation.

Locate articles in the newspaper about the uses of the forests in your state (or in the United States). Determine how forests are repopulated. List as many products as you can that come from the forests.

Begin a clipping file of newspaper articles and information about the food chain, world food supplies, new methods of agriculture, organic agriculture, etc. How does pollution play a part in the food chain and our world food supply?

Section III

EARTH LIFE: Plants, Animals, Ecosystems

Earth Thoughts

"Woodman, spare that tree! Touch not a single bough! In youth it sheltered me, And I'll protect it now."

George Pope Morris

"When we try to pick out anything by itself, we find it hitched to everything else in the universe."

John Muir

"The three great elemental sounds in nature are the sound of rain, the sound of wind in a primeval wood, and the sound of outer ocean on a beach."

Henry Beston, *The Outermost House*

"Never say there is nothing beautiful in the world any more. There is always something to make you wonder in the shape of a tree, the trembling of a leaf."

Albert Schweitzer

"Let us permit Nature to have her way; she understands her business better than we do."

Michel de Montaigne

"Man shapes himself through decisions that shape his environment."

Rene Dubos

"In wilderness is the preservation of the world."

Henry David Thoreau

Lesson #23: THE BALANCE OF NATURE

EARTH FACTS:

1. *Only the energy stored in body tissue is passed on in a food chain.*
2. *Plants that are native to an area use about 54% less water than imported varieties and survive much better.*
3. *Rabbits from Europe were released in Australia in 1850 by settlers who thought they would be useful for food. Foreigners to the ecosystem, the rabbits had no predators (like fox) to control their population. Today they are still considered farm pests, nibbling grass and crops.*

All living things are united in a web of life. Each strand in this web is important. Every plant and animal has a job to do. Each living thing helps maintain the balance of nature.

All animals (including people) depend on plants for the air they breathe. When animals breathe out, they exhale a gas called carbon dioxide. Plants take the carbon dioxide from the air and use it to make food. In turn, they give off a gas called oxygen which all animals need. In this way, plants and animals are interdependent. Working together, they maintain a balance that enables them both to survive.

Animals also depend on plants for the food they eat. A substance called chlorophyll enables the leaves of green plants to use solar energy, carbon dioxide, water, and organic nutrients from the soil to make sugars and starches. Stored in the leaves and stems of the plant, these sugars and starches nourish the plant so it can grow. They also nourish the many animals that eat plants and the wide variety of roots, leaves, fruits, and seeds that plants produce.

As animals digest their food, they produce wastes, parts of the food their bodies do not need or cannot use. Decomposers like mushrooms, carrion beetles, earthworms, and other insects feed on these wastes and transform them into nitrogen, phosphorus, and other chemicals plants need for food. Thus, decomposers help to replace the nutrients growing plants have taken from the soil.

The energy that supports life on earth comes from sunlight. Plants use this energy, and some animals obtain it by eating the plants. Plant-eating animals (herbivores) are preyed on by meat-eaters (carnivores). The carnivores control the number of herbivores. They prevent the herbivores from becoming so numerous that they eat all the available plant food, and cause mass starvation. This helps maintain the balance of nature. For example, if the bird population rises, the caterpillar population will fall. The birds will therefore die or move on in search of fresh food supplies. The caterpillar population will then increase, and the balance is restored.

A food chain is a simple way to describe how energy passes from one living thing to another. Here is one example: the grass on the North American prairie grows using energy from the sun. Grazing animals such as prairie marmots eat the grass. Coyotes and hawks eat the marmots. These prairie plants and animals make up one ecosystem. An ecosystem is a group of living things (plants and animals) that live together in one particular place making up all levels of a food chain.

Activity #23: THE BALANCE OF NATURE

In today's health conscious world, many diet specialists are advising people to eat "low" on the food chain; in other words, to eat more fruits and vegetables, and less red meat. Many "heart-healthy" diets suggest no more than three servings of beef per week. Whether we eat red meat or not, most of us enjoy eating fruits and vegetables in some form or another. Herbs, leafy greens, fruits, and even corn can be grown in most urban settings and on a very small amount of land. Have you tried your hand at edible gardening?

1. Look in your daily newspaper for the gardening section. Begin a newspaper clipping file for gardening tips and suggestions. Sort your newspaper articles into different categories from yard or lawn information to fruit and vegetable gardening.
2. Plan your garden! With information you have gathered from the newspaper and other sources, decide which fruits or vegetables to grow, select an area in your yard to use, and begin making necessary preparations.
3. Use newspaper advertisements to select the best buys for seed, plant food, fertilizer, and gardening tools. Make a shopping list below. Then, begin to plant your garden!

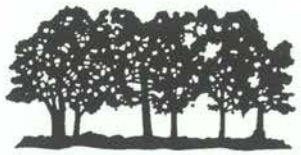
PLANTS/SEEDS TO PURCHASE	TOOLS NEEDED	PLANT FOOD & FERTILIZERS	OTHER ITEMS

THINK, DISCUSS, REACT:

Environmentalists argue that meat production is harder on the environment than grain or vegetable production. To produce 1 pound of beef, for example, one needs 16 pounds of grain and soybeans, 2,500 gallons of water, and the energy equivalent of 1 gallon of gasoline. Land is also a factor. A farmer can feed 20 vegetarians on the land needed to feed one person who eats meat. Find evidence in the newspaper that supports or disputes this point of view.

What would happen to the balance of nature if everyone ate only foods that were "low" on the food chain? Explain your thoughts.

Lesson #24: TREES & DEFORESTATION



EARTH FACTS:

1. *The most massive living thing on earth is a tree in California's Sequoia National Park named "General Sherman." It weighs approximately 6,720 tons.*
2. *About 150,000 trees a year would be saved, if just 100,000 people could stop their junk mail. (Americans receive almost 2 million tons of junk mail every year.)*

Trees play a vital part in keeping the earth's atmosphere fit for animals and people to breathe. Trees take in carbon dioxide from the air and give off oxygen. There are two main kinds of trees. Conifers, such as spruce, pine, and fir, have needlelike leaves. They produce seeds in cones, not flowers. Most conifers are evergreen. They grow best in cooler climates. The other kind of tree is the broad-leaved flowering tree. Many are deciduous, shedding their leaves in the autumn to avoid water loss and frost damage. Others, such as holly, are evergreen. Many tropical trees are evergreen too. Others shed their leaves in the dry season and grow new leaves when the rains fall.

From trees we get wood, which has hundreds of uses. An important use is making paper, such as the newsprint on which the world's newspapers are printed. Most paper is made from wood pulp. Trees are also cut for timber to use in the construction of houses, buildings, and furniture. The world's forests produce two kinds of timber: (a) softwoods from conifer trees (pine, fir, larch, spruce); and (b) hardwoods from broad-leaved trees (maple, oak, walnut) and tropical trees (teak, mahogany, ebony).

Much of our wood still comes from wild forests. Different kinds of forest grow in different areas of the world. Climate determines which kind of forest grows where. The six main kinds of forest are: tropical rainforest; tropical seasonal forest; savanna; temperate deciduous forest; temperate evergreen forest; and boreal forest (taiga).

In prehistoric times about 60% of the earth's land area was forested. Today, about 30% is covered by forest. Only in more recent times have industrialized nations made an effort to replace trees by creating managed forests. A managed forest is one where new young trees are planted to replace those cut. A forest can be managed so that it still looks like a wild forest, with trees growing naturally. Or it can be a plantation, with trees planted in rows—good for producing timber but not very attractive to people or wildlife.

Deforestation is the complete destruction of all forests in an entire region. It is cutting trees with no regard for the land and no effort to replant. Deforestation lowers air quality by substantially reducing the number of trees that are available to replenish the oxygen supply. Deforestation destroys acres of plant and animal habitats. Without habitats, some plants and animals become extinct. Where trees have been cut, rainwater erodes the exposed soil. Nutrient rich topsoil is washed away. Because shade-giving trees and moisture-holding organic matter have been lost, the air becomes hotter and drier. Thus, deforestation may contribute to an overall increase in the earth's temperature.

Activity #24: TREES & DEFORESTATION

The continued logging of old-growth forests in the Pacific Northwest has triggered a national controversy that often is portrayed as pitting people's jobs against environmental protection. Others say, the real issue is how to convert the old-growth industry into a sustainable business and still preserve healthy stands of forests. Loggers will soon run out of old growth to cut, regardless of whether more old-growth forests are protected. Inevitably, jobs will be lost and the industry will have to adapt. The question is, will industry change before or after it has cut down all of the remaining old growth?

1. Look in today's newspaper for articles or information concerning forests, the logging industry, the spotted owl controversy, or any issue dealing with trees and deforestation.
2. Select three news items. Investigate each controversy, determine the issues, and formulate arguments for each side.

CONTROVERSY IN THE NEWS	KEY ISSUES	ARGUMENT FOR	ARGUMENT AGAINST	POPULAR OPINION	YOUR OPINION

THINK, DISCUSS, REACT:

The ecosystem of an old-growth forest is a place of dynamic interaction, where species are dependent on one another. Certain insects are vital to this delicate ecosystem. Endangered insects, often overlooked by laypersons, are of great concern to environmentalists. Think about the importance of an insect to such an ecosystem. Using additional information or library sources, investigate the role of forest insects.

Write an obituary for an old-growth forest insect who has died because of deforestation. (Read the obituaries in your daily newspaper to familiarize yourself with the style, format, and kind of information given in an obituary.)

Lesson #25: RAINFORESTS & WETLANDS

EARTH FACTS:

1. *The Amazon rainforest alone produces 40% of the world's oxygen.*
2. *About 70% of the plants used to make drugs for cancer treatment are found only in rainforests. The source of ingredients used in 25% of all drugs prescribed by U.S. physicians are rainforest plants.*
3. *Throughout the world, rainforests are being destroyed at the alarming rate of 115 square miles a day!*
4. *Of the 213 million acres of wetlands that once existed in the United States, less than half remain.*

Rainforests are tropical woodlands with an annual rainfall of at least 100 inches. These forests grow in the hot, humid areas of the earth, near the equator. In most of these forests, a dense growth of the tallest broad-leafed evergreen trees form a canopy or dense roof shadowing plants lower down. The canopy receives the most sunlight, and it grows thickly. A tropical rainforest is multi-storied, with the different layers supporting their own plant and animal populations. Shrubs and creepers grow in the lower layers, provided the tree cover above is open enough to let sunlight reach them. Even in very dense rainforests, the lower layers get enough sunlight for some plants to grow. Waste, such as animal droppings and leaves, breaks down or decomposes, releasing nutrients to feed the plants. Rainforests grow thickly because there is no cold winter or dry season to halt the growth of the trees and other plants. The sun shines almost every day, and even when it is cloudy the air remains warm and moist. Rain falls every day. In such conditions the forest plants grow amazingly fast.

Rainforests are very important for these reasons: they provide most of the earth's oxygen; they are home to half of all the plant and animal species on earth; and rainforest plants are essential ingredients in herbal medicines and pharmaceutical drugs, especially drugs for cancer treatment. Rainforests contain a huge variety of unknown plants. Among these, are new crops and medicines yet to be discovered.

Rainforests have been commercially exploited at an alarming rate. Vast portions of our earth's rainforests have been completely destroyed and will never be regrown or renewed. Conservation of the remaining rainforests is essential for the health of our planet and environment. If we continue to exploit the rainforests, we must do it in a controlled way, so that they are able to recover. Trees for timber should be selectively felled by choosing the most suitable ones and leaving the rest to grow. Small clearings scattered throughout the forest are much better than large ones. They do not interfere with the rainfall or the fertility of the soil in the same way that large clearings do.

Our earth's wetlands are in as much danger as the rainforests. Wetlands are low-lying areas saturated with moisture such as marshes, deltas, bogs, swamps, and tidal flats. Wetlands help to purify our water, they prevent flooding and loss of valuable top soil through erosion, and they are home to nearly half the animals and a third of the plants on the endangered lists. Once thought to be useless because they were not suitable for farming, wetlands were dredged, drained, or filled in. Today, less than half the wetlands of North America exist. The conservation of all wetlands, like that of rainforests, involves a careful balance between the needs of humanity and the survival of wildlife and the natural environment.

Activity #25: RAINFORESTS & WETLANDS

Rainforests and wetlands are both richly productive areas and extremely valuable habitats for wildlife and plants. In fact, they are home to most of the plants and animals on the endangered lists. Our rainforests and wetlands have been commercially exploited for decades, which is the main reason their wildlife is at-risk.

1. Pretend that you work for a newspaper called the *Animal Advocate.* It is your job to help rainforest and wetland animals find suitable places to live. You write real estate want ads, describing the homes animals want and the specific neighborhoods (or habitats) they require.
2. Read the sample want ad below. Then, select two rainforest or wetland animals. Do some research to learn more about the needs of the animals you have selected.
3. Finally, write an ad for each of these animals in which you describe both the home and community this animal is seeking.

SAMPLE:

WANTED

A winter hide-away! Must be Gulf Coast marsh land, preferably Louisiana. Need site that offers insects and small water creatures. Farmland nearby with grain crops a must!

(Blue Goose)

WANTED

_____

_____

_____

WANTED

_____

_____

_____

THINK, DISCUSS, REACT:

Visit a forest, rainforest, or wetland in your immediate community, county, or state. Photograph the plants, trees, land, and wildlife. Then, create a photo essay documenting what you saw. Write a caption for each photograph. Identify the who, what, when, where, why, and how of each picture. Evaluate your experience as a photojournalist.

Lesson #26: ENDANGERED SPECIES

EARTH FACTS:

1. *Our planet is now losing up to 3 species per day. That figure is predicted to be 3 species per hour in scarcely a decade.*
2. *Nearly all of Africa's elephants will be gone in 20 years if the present killing rate continues.*
3. *The U.S. Fish and Wildlife service estimates that 8 million fewer ducks migrate south each fall.*

A habitat is the place where a plant or animal naturally lives and grows. For example, a rainforest is the habitat of monkeys. Wetlands are the habitat of alligators, bullfrogs, and wading birds. Oceans are the habitat of dolphins and whales. And deserts are the habitat of lizards, snakes, and desert rats. Habitats provide food, water, space to live, and shelter for an interdependent community of living things, which includes both plants and animals.

When habitats are destroyed or altered by people, pollution, or natural disasters, the animal and plant populations sometimes become endangered or extinct. Endangered species are specific kinds of plants and animals whose total population is becoming steadily smaller, or decreasing. They are called "endangered" because they are in danger of dying out completely, or becoming extinct.

By the year 2050 scientists fear that as many as half of the earth's plant and animal species could be extinct. Yet each species is a storehouse of genetic resources. To lose one species can be a tragedy. For example, drugs made from the rosy periwinkle, a plant of the Madagascar forest, are now used to help children suffering from leukemia. If this one plant had died out, its medical value would never have been known.

Species become endangered for a variety of reasons, for example:

1. *COLLECTION:* The thick-billed parrot is caught and sold to pet shops.
2. *HUNTING:* African bull elephants are hunted and killed for the ivory in their tusks. Hawksbill turtles are killed for their shells.
3. *POISONING:* Many California condors died after eating poisoned meat put out by ranchers to kill coyotes.
4. *HABITAT LOSS:* Every day people move into places on the planet where only plants and animals used to live. Forests are cut down and wetlands are invaded; land is cleared for cattle grazing in order to feed the people.
5. *LIMITED HABITAT:* The Devil's Hole pupfish is found only in one small pool in the middle of the Nevada desert.
6. *IMPORTED PREDATORS:* Rats brought by ship to the Galapagos Islands ate the eggs of the Galapagos tortoise.

According to the Endangered Species Preservation Act, passed in 1966, an animal that has been identified as endangered may not be purchased or sold in interstate or foreign commerce. Also, this animal may not be hunted, shot, pursued, harmed, harassed, trapped, wounded, captured, or collected. Today, more than 300 national wildlife refuges throughout the United States are safe havens for endangered animals, but the threat of extinction remains. Over 100 names appear on the list of endangered native animals.

Activity #26: ENDANGERED SPECIES

In Rwanda, a country on the continent of Africa, tourism is largely responsible for saving that nation's gorillas from extinction. The gorilla was threatened by both poachers and local farmers, whose land clearing practices were destroying the gorilla's natural habitat. Rwanda's Parc des Volcans, created by Dian Fossey as a wildlife preserve, has become an international attraction and the third largest source of revenue for Rwanda. Park entrance fees have allowed the government to create antipoaching patrols and employ local farmers as park guides and guards.

Travelers today see ecotourism as an enjoyable way to give something back to the natural environment. Plan your own ecotour!

1. Locate travel information in your daily newspaper, or begin collecting travel sections from your Sunday newspaper. Clip articles and advertisements pertaining to ecotour activities such as those listed on the chart below.
2. Based on your newspaper information, list possible destinations for each activity and special attractions, if any, for each destination.
3. Locate at least one destination from each category on an outline map. Compare and contrast the similarities and differences between types of vacations and destinations.
4. Plan your ecotour! Make a selection according to personal preference. Then, plan a vacation budget based on the prices advertised in the tour ads.

ECOTOUR ACTIVITY	POSSIBLE DESTINATIONS	SPECIAL ATTRACTIONS
Trekking/hiking		
Bird watching		
Photography safari		
Wildlife safari		
Camping		
Mountain climbing		
Fishing		
River rafting/canoeing		
Botanical study		

THINK, DISCUSS, REACT:

Think about the trip you have planned. What would it be like? What might you do and who might you meet on such a trip? What endangered species might you encounter? Use your imagination to create a travel diary documenting each day's activities.

Lesson #27: WORLD POPULATION

EARTH FACTS:

1. *In 1980 there were 4.4 billion people on this planet; in 1990 there were 5.2 billion. At this rate, imagine the count for the year 2000.*
2. *Overpopulation is the principal cause of all the world's problems of pollution and conservation.*

Scholars estimate that the world's population in the year 1650 totaled 500 million. The population of the world doubled from 1650 to 1850, and has grown five times as much since 1850. Today, the world's population is increasing at the rapid rate of approximately 1.9% per year. This rapid increase has been called the "population explosion."

For thousands of years, birth rates were high, but the population increased slowly because death rates were also high. Then, during the 1700s and 1800s advances in agriculture, communication, and transportation improved living conditions and reduced the occurrence of many diseases. As a result, the death rate began to drop, and the population grew rapidly. In the industrial countries of Europe and North America, many people flocked to the cities. On farms, large families were necessary to help with the work, but in the cities it was difficult to support a large family. As a result, birth rates in the industrial countries began to fall. But in the agricultural countries of Africa, Asia, and Latin America, the drop in death rate did not occur until the mid-1900s. Then the death rate plunged quickly without a corresponding decline in the birth rate. The entire world population grew rapidly, but it increased most rapidly in the newly developing nations which could least afford such increases.

No one knows how many people the earth can support. But many scientists, economists, and other experts fear that food production cannot keep pace with the population explosion for long. They believe the world will soon become overpopulated. In other words, it will have more people than it can support.

In the wild, most animal populations live in balance with their natural environment. If their food supply is limited, the population decreases until the balance is restored. The same applied to human populations before the 1700s. Today, richer industrialized nations hurry to provide international aid to countries in trouble. Worldwide emergency efforts have saved the lives of millions of people who may have died from starvation, malnutrition, or other diseases. Aid to Ethiopia, Bangladesh, and more recently to Somalia, are examples of such emergency efforts. Humanitarian aid, however, does not solve the long-term problem of overpopulation.

Many experts believe disastrous shortages of food and other necessities can be avoided only by halting population growth. They urge that the birth rate be reduced to the level of the death rate. This condition, in which only enough people are born to replace those who die, is called "zero population growth" (ZPG). During the 1970s, the United States achieved its lowest birth rate. However, births still outnumbered deaths by more than a million a year. Nations with higher birth rates have even further to go to reach ZPG.

Activity #27: WORLD POPULATION

The world's population is increasing at the rapid rate of approximately 1.9% per year. At what rate is the population growing in your city, county, and state?

1. Using your state almanac find out what the area populations were in 1990. Assuming the growth rate is the same as that for the world's population, determine the population figures for your city, county, and state for the current year. (Multiply the 1990 figure by 1.9%, then add that number to the 1990 figure to determine the following year's count, and so on.) Project the population figures up to the year 2000.
2. When you arrive at the population number for this year, check it against the actual population numbers reported by your city, county, and state. (You may need to call the offices of each to determine a close approximation.)
3. Did the area's actual population increase, decrease, or stay about the same as it was in 1990, when the last official census was taken? Compute the actual average rate of change for your area's population? Was it 1.9%? Can you determine why it changed in this way?
4. Look in your daily newspaper for clues. Has the local economy improved, offering more jobs through area industry? Has there been a drastic change in the economy, causing industry to flee? Have there been any local problems or natural disasters? Formulate your own hypothesis based on the information you gather from the newspaper.

YEAR	CITY POPULATION PROJECTION/ACTUAL		COUNTY POPULATION PROJECTION/ACTUAL		STATE POPULATION PROJECTION/ACTUAL	
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						

THINK, DISCUSS, REACT:

Use your daily newspaper to keep up with the number of area births and deaths over an extended period of time. How does the birth rate for your community compare to the death rate? What can you conclude? Create a graph to illustrate your findings.

Earth Words GLOSSARY

acid - a water-soluble chemical compound that tastes sour or bitter, irritates skin and eyes, and reddens litmus paper.

acid rain - a harmful type of precipitation which occurs when airborne chemicals like sulfur dioxide and nitrogen dioxide become dissolved in rainwater.

air pollutant - anything that makes air dirty or impure.

algae - simple plants that usually live in water, like seaweed.

aqueduct - a channel build to carry water from where it is to where it is needed.

aquifer - a water bearing stratum of permeable rock, sand, or gravel.

ash - solid material produced from the combustion process.

atmosphere - the blanket of air surrounding the earth.

battery - a container holding materials that produce electrical energy by chemical reaction.

biodegradable - capable of being broken down by the action of bacteria and other microorganisms into products that will not harm the environment.

biomass - the amount of living matter within an ecosystem.

carbon dioxide - a colorless, odorless, tasteless gas that is produced when animals exhale and when fuels burn, and is used by plants to make food.

carcinogen - a substance or agent producing or inciting cancer.

carnivores - animals that eat other animals and are nourished by the plants and smaller creatures these animals have eaten.

chlorofluorocarbons (CFCs) - chemicals that are present in aerosol mixtures, are released when polystyrene is being made, and are believed to thin the atmosphere's ozone layer.

chlorophyll - a green substance that enables the leaves of plants to use solar energy, carbon dioxide, water, and organic nutrients from the soil to make the sugars and starches they use as food.

clear-cutting - an economical method for tree removal that creates a habitat for browsers and grazers, but may also lead to erosion and depletion of soil nutrients.

combustion - a burning process in which solid waste is incinerated.

composting - the process of converting organic wastes into humus, a nutrient-rich mixture that can be used to condition soil and feed plants.

decompose - to rot or decay; to break down into smaller parts or elements.

decomposers - mushrooms, insects, worms, and other organisms that feed on decaying plant and animal matter and break it down into a form that can be used as nutrients by plants.

deforestation - the complete destruction and total clearing of all forests within a region.

deposit - the amount of money that is charged when a product is purchased in a refundable container to encourage return of the container.

detergent - a cleansing agent; a liquid or powder used to wash dishes or clothes.

ecology - the science that studies the relationship between living things and their environment.

ecosystem - a group of living things (plants, animals, and other organisms) that live together in a particular place.

effluent - the liquid discharged as waste, usually from industrial processes or sewage.

emissions - airborne waste by-products from manufacturing or waste management processes.

endangered animals - specific kinds of animals whose total population is becoming steadily smaller, or decreasing, so that they are in danger of becoming extinct.

energy - the capacity to do work or the ability to make things move.

environment - all of the natural and living things with which we are surrounded; the climate and conditions in which any organism lives.

extinct - no longer existing in living or active form.

fission - nuclear reaction in which the nucleus of an atom splits.

fossil fuels - certain natural substances, such as coal, oil, and natural gas, which were created deep within the earth millions of years ago by the decomposing remains of plants and animals and can be burned to release energy.

fusion - nuclear reaction that occurs when two nuclei combine (fuse).

garbage - waste materials; trash.

glass - a very hard substance that is made by melting sand with certain chemicals, breaks easily, and is usually transparent.

global warming - an overall increase in the earth's temperature which may be caused by reduced numbers of trees and increased levels of carbon dioxide.

greenhouse effect - carbon dioxide and other natural gases in the atmosphere form a blanket which allows sunlight to reach the earth's surface, but prevents heat from escaping (much like the glass in a greenhouse). The trapped heat thereby raises the temperature of the earth's atmosphere.

groundwater - water that lies under the ground in natural reservoirs, such as springs, wells, and aquifers.

habitat - the place where any plant or animal naturally lives and

Earth Words GLOSSARY

grows; a place that provides food, water, space to live, and shelter for an interdependent community of living things, including both plants and animals.

hazardous waste - dangerous material (material that can cause harm or injury) that has been thrown away.

herbivores - animals that rely on plants and plant parts for their nourishment.

humus - organic materials resulting from the decay of plant or animal matter; also referred to as compost.

hydroelectricity - electricity generated by water power.

incinerate - to burn.

kilowatt - a unit of measure for electricity which equals one thousand watts.

kinetic energy - the active form of energy that is found in heat, light, sound, and motion.

landfill - permanent waste disposal site for most solid and nonhazardous residential, commercial, and industrial wastes; an enormous pit where trash is buried under shallow layers of dirt.

litter - any unneeded item that has been carelessly discarded instead of being disposed of properly.

mains - large distribution pipes that carry water from the plants where it is treated to the homes, schools, and businesses where it is used.

metal - substances that occur in combination with other elements in minerals known as ores. The ore must be treated, for example, by heating, to rid itself of other elements so as to extract the pure metal.

mineral - a single solid element or compound occurring naturally in the earth's crust.

nonbiodegradable - incapable of being broken down naturally into substances that will not harm the environment.

nonrenewable resource - a resource that cannot be replaced, replenished, or renewed by natural processes or by human planning and practices.

nuclear - about or by an atomic reaction.

organic - related to living things; made by or extracted from plants or animals.

oxygen - a colorless, odorless, tasteless gas that is produced by plants and needed by animals and people.

ozone layer - a layer of oxygen formed naturally, high above the earth, which acts as a screen to protect plants and animals from the sun's ultraviolet rays.

pesticide - a poison that is used to kill pests, such as insects, rodents, or weeds.

pesticide residue - the small amount of poison that may remain on plants long after they have been sprayed with pesticide and may be eaten by animals and/or people.

petroleum - an oily, flammable liquid that ranges in color from clear to black and is found in the rocks which form the earth's crust.

phosphate - a salt or chemical element that is added to fertilizers and detergents; it is necessary for plant and animal growth.

plastic - the name given to a large group of substances made chemically from such materials as coal or oil mixed with water and limestone.

pollutant - any substance that can make air, land, or water dirty or impure.

pollution - the act or process of making air, land, or water unclean or impure.

polystyrene - the main ingredient in styrofoam and foam plastics.

potential energy - the stored form of energy available in resources such as coal, gasoline, oil, and water held behind a dam.

rainforests - tropical woodlands that grow in the hot, humid areas of the earth, near its equator, and receive an annual rainfall of at least 100 inches.

recycle - to process and treat discarded materials so that they can be used again.

reservoirs - natural or man-made structures in which water can be stored for future use.

resources - substances that support life and fulfill human needs, including air, land, water, minerals, fossil fuels, forests, and sunlight.

solar energy - energy produced by the sun.

toxic substance - a chemical or mixture of chemicals whose manufacture, distribution, use, or disposal may present an unreasonable risk to the health of a person and/or the environment.

ultraviolet rays - a form of radiation that is present in sunlight but whose rays have wavelengths too short to be seen (shorter than those of the violet end of the visible spectrum and longer than x-rays). They speed healing, and aid in the formation of vitamins, but are harmful in large amounts.

water cycle - the continuous natural process by which water evaporates from bodies of water, collects in the atmosphere as vapor, condenses in clouds, falls to the ground as precipitation, and evaporates once again.

wetlands - low-lying land areas saturated with moisture, such as bogs, deltas, marshes, lakes, ponds, tidal flats, and swamps. They provide food-rich habitats for a wide variety of animals and vegetation.

windmill - a mechanical device that consists of blades attached to a central pole. It uses wind energy to generate electricity.