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ABSTRACT

Educators are faced with the task of teaching students to be responsible stewards of the world's natural resources. This curriculum focuses on three interrelated topics in this area: energy, economics, and the environment. The goal of this book is to: (1) teach students basic knowledge and concepts about energy, the environment, and economics; (2) teach students effective decision-making skills; and (3) to engage students in meaningful learning activities. The book is divided into five sections. The first section provides a general economic framework for analyzing environmental and energy issues. The framework is composed of three components: the relationships between production, energy and the environment; economic considerations; and methods such as regulations, taxes, subsidies, and incentives that counteract negative external forces influencing the environment. The next four sections present case studies and learning activities to attain the educational goals of the curriculum. The units investigate: solid waste using a case study of the school cafeteria; air pollution using a case study of burning leaves; energy using a case study of power plants; and natural resources stewardship using a case study about drought conditions in California. A list of 49 additional energy, economics, and environmental resources is provided. (MDH)

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ENERGY, ECONOMICS AND THE ENVIRONMENT

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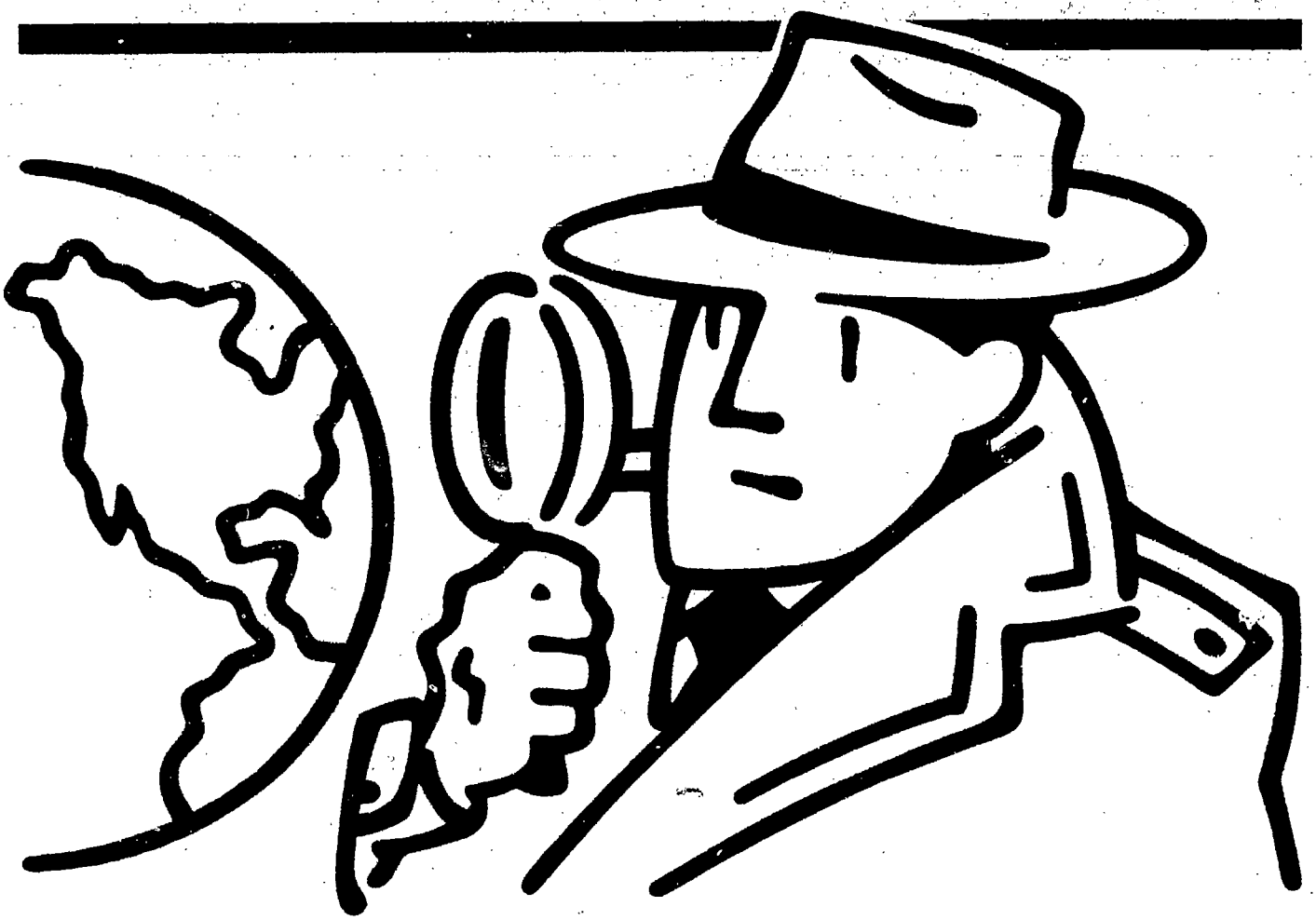

CASE STUDIES AND TEACHING ACTIVITIES FOR MIDDLE SCHOOL

Office of School Assistance
Center for School Improvement and Performance
Indiana Department of Education

SE 052 232

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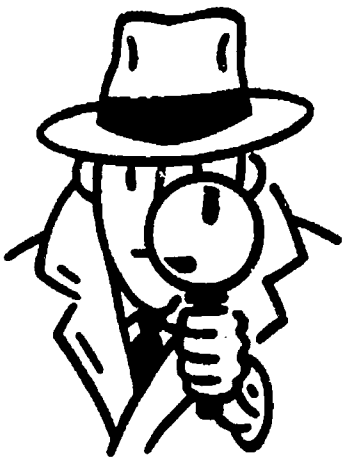
Energy, Economics, and Environment (EEE)

Rationale

One of the great challenges facing educators is to teach students how to be responsible stewards of the natural resources entrusted to them. This is especially true today, as our growing worldwide population inevitably exerts greater strains on our environment and on our fiscal and natural resources. As individuals and as societies, we must be prepared to deal with the problems that will challenge us in the decades ahead. The purpose of this program is to introduce students to some of these problems and to provide students with the knowledge and skills to help solve them.

This curriculum focuses on three important subjects: energy, economics, and the environment. One of the key assumptions of this booklet is the interrelatedness of these three areas of study. It is virtually impossible to study one of these subjects without encountering the others. Indeed, the failure to consider the interdependence of environmental, energy, and economic issues will result in policy decisions that will be flawed, and that will diminish the potential for maintaining a strong economic system, a healthy and livable environment, and a sustainable energy resource base.

In order to deal with these important and complex issues, students must be trained in three important areas: they must be taught basic knowledge and concepts about energy, the environment, and economics, as well as the fundamental interrelationships of all three; they must learn effective decision-making skills; and they must be involved in meaningful, motivating learning activities. As a result of participating in this program, students will better understand the trade-offs that are involved in insuring a quality environment, the wise use of energy resources, and a sound economy, and will be better equipped to meet the environmental and energy challenges of the future.



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Special Recognition

Indiana Michigan Power for printing this interdisciplinary EEE program.

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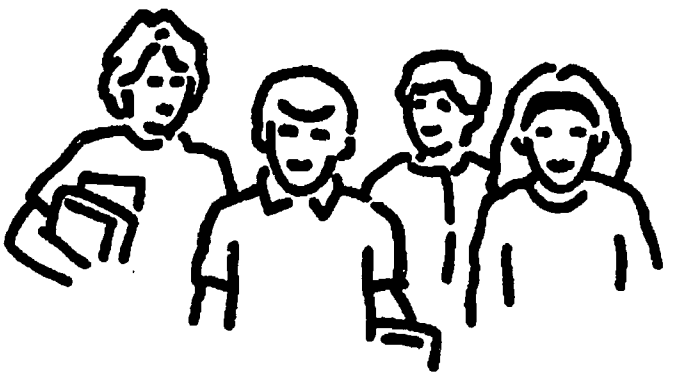
Division of Publications, Indiana Department of Education, for preparing a camera ready EEE module.

As a direct result of this state coordinated program, the EEE program will be promoted and supported by all members through workshops, institutes, and conferences for teachers.

We welcome new EEE members who believe in the EEE process, philosophy, goals, and activities contained in this exciting curriculum.



An Introduction to ENERGY, ECONOMICS, and the ENVIRONMENT

Case Studies and Teaching Activities for Middle School

Nearly every day in the news there are stories dealing with the economic implications of energy and environmental issues. How can middle school students make sense of these complicated issues? What do they need to know in order to make wise decisions as consumers, producers, and voting citizens?

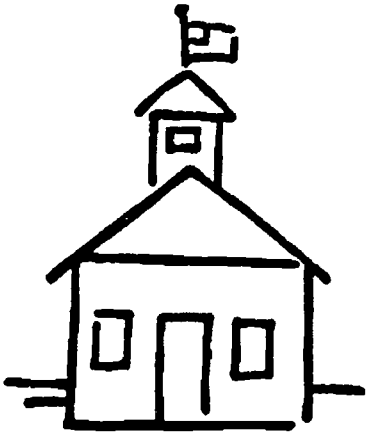
A Conceptual Framework for Analyzing Issues

One purpose of this booklet is to provide teachers and students with a conceptual framework for analyzing these issues, especially, in regards to economics. Teachers will notice that the introductory section to this booklet explains the basic economic concepts that provide this conceptual framework.

Interdisciplinary Teaching Activities

A second purpose of this booklet is to provide teachers with a set of motivating, interdisciplinary teaching units centering on these important issues. Each unit focuses on a particular energy and/or environmental theme and has two basic parts—a case study and a set of classroom activities. In each case study, students use a five step decision-making model to investigate and solve an environmental problem. Each case study is preceded by basic facts and vocabulary about the theme being studied.

The classroom activities are interdisciplinary and thematic in nature, requiring students to apply skills across many areas of the curriculum. These activities also require students to make extensive use of resources in their communities. In each unit, the classroom activities contain special sections titled, "Debating the Issues," "Investigating Your Community," and "EEE Actions—You Can Make a Difference!"



A Framework for Analysis

The introduction to this booklet explains a general economic framework for analyzing environmental and energy issues. Without such a framework, student analysis of these critical issues will be very deficient. Students must understand the basic economic concepts that relate to these issues in order to make wise environmental and energy policy decisions.

Fundamental Ideas and Relationships

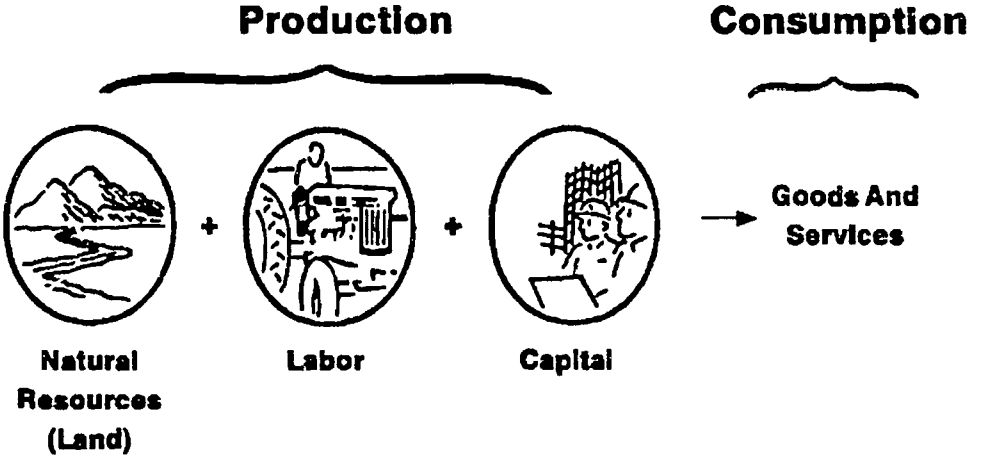
The Necessity of Production

In every society, people require goods and services that will enable them to survive and prosper. **A fundamental principle of economics is that these goods and services must be produced.** Without production of some sort, survival would be difficult indeed.

Fortunately, every society is endowed with resources which can be used to produce goods and services. These resources, called **productive resources (factors of production)**, can be classified into three groups: natural resources (land), labor resources, and capital resources. **Natural resources**, both renewable and nonrenewable, come from nature. Examples include coal, water, trees, air, and the land itself. **Labor resources** refer to the mental and physical work effort, expended in production, and to the entrepreneurial skills needed to guide production. **Capital resources** are physical goods used to produce other goods and services, such as buildings, tools, equipment, and machinery. Figure 1 illustrates how the productive resources are combined to produce goods and services.

FIGURE 1

Using Productive Resources To Produce Goods And Services



The goods and services are scarce because there are not enough productive resources to satisfy all of society's wants.

The problem for individuals and society is that the desire for goods and services is **unlimited;** whereas, the productive resources needed for production are limited. This tension between unlimited wants and the limited productive resources available for satisfying these wants is what economists refer to as **scarcity. Every society, rich or poor, confronts the basic economic problem of scarcity.**

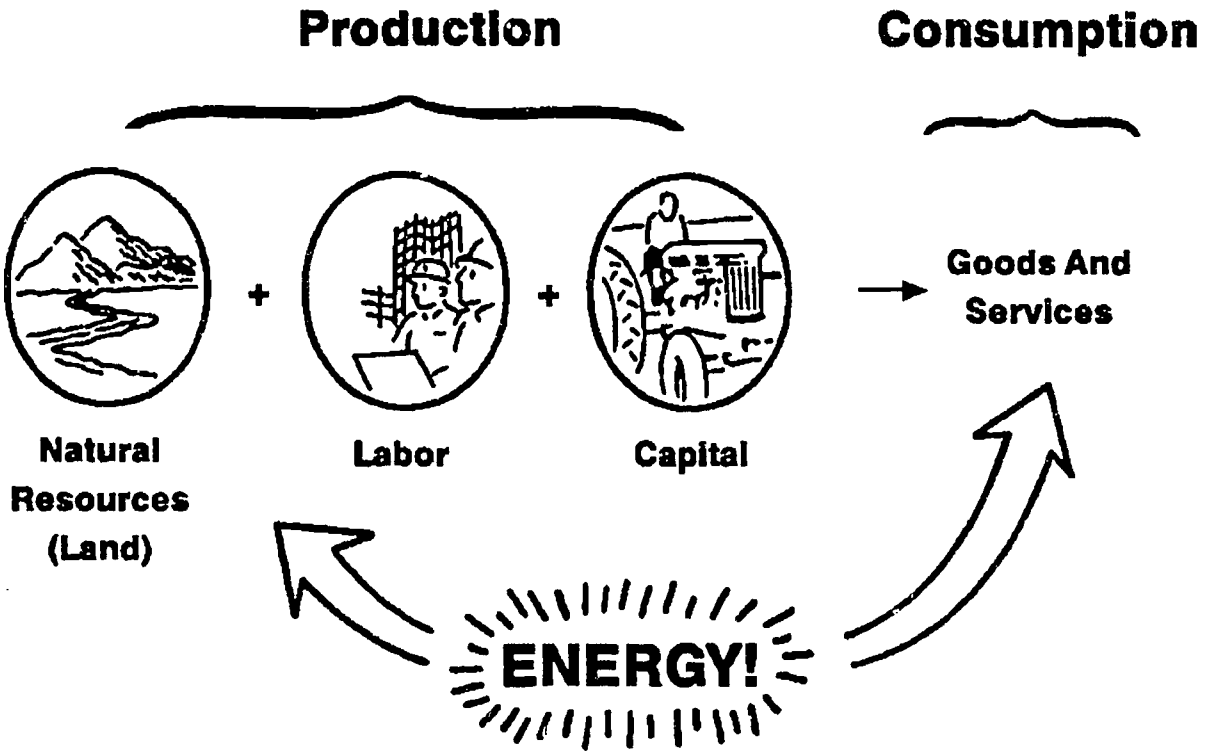
Production and Energy

So where does energy fit into our discussion? First, **energy is something that consumers desire.** All of us consume energy in some way or another—to heat our homes, cook our food, or power our cars.

Second, **energy is necessary for production**. Without some form of energy, the production of goods and services would virtually cease. Energy is, therefore, a crucial component of both the production and consumption side of the diagram (Figure 2).

FIGURE 2

Energy Is Required For Production And Consumption



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Third, **energy, like all goods and services and like all productive resources, is scarce.** It is not a free good, available in unlimited quantities at a zero price. Quite the contrary, energy sources are natural resources and are very costly to develop and produce. Because energy is scarce, its value is reflected in our market system by prices. **The price of an energy resource gives an indication of how scarce the resource is.**

Sometimes an energy shortage may occur, as in the 1970s when there were long gas lines. A shortage is caused when a government fixes the price of a good or service below its natural, market level. Teachers should recognize that even when there is no energy shortage (when supply needs are balanced with demand needs), energy is still a **scarce** resource. One must still pay to obtain it.

Production and the Environment

Now, we can examine how the environment affects our simple model of production and energy use. First, **all production and consumption must take place within the context of the environment.** As such, the environment affects and is affected by production and consumption. This is evident when examining three basic services provided by the environment.

Services Provided by the Environment

First, the environment provides us with the natural resources, including energy resources, needed to produce goods and services. As we learned above, natural resources (land) are among the basic productive resources.

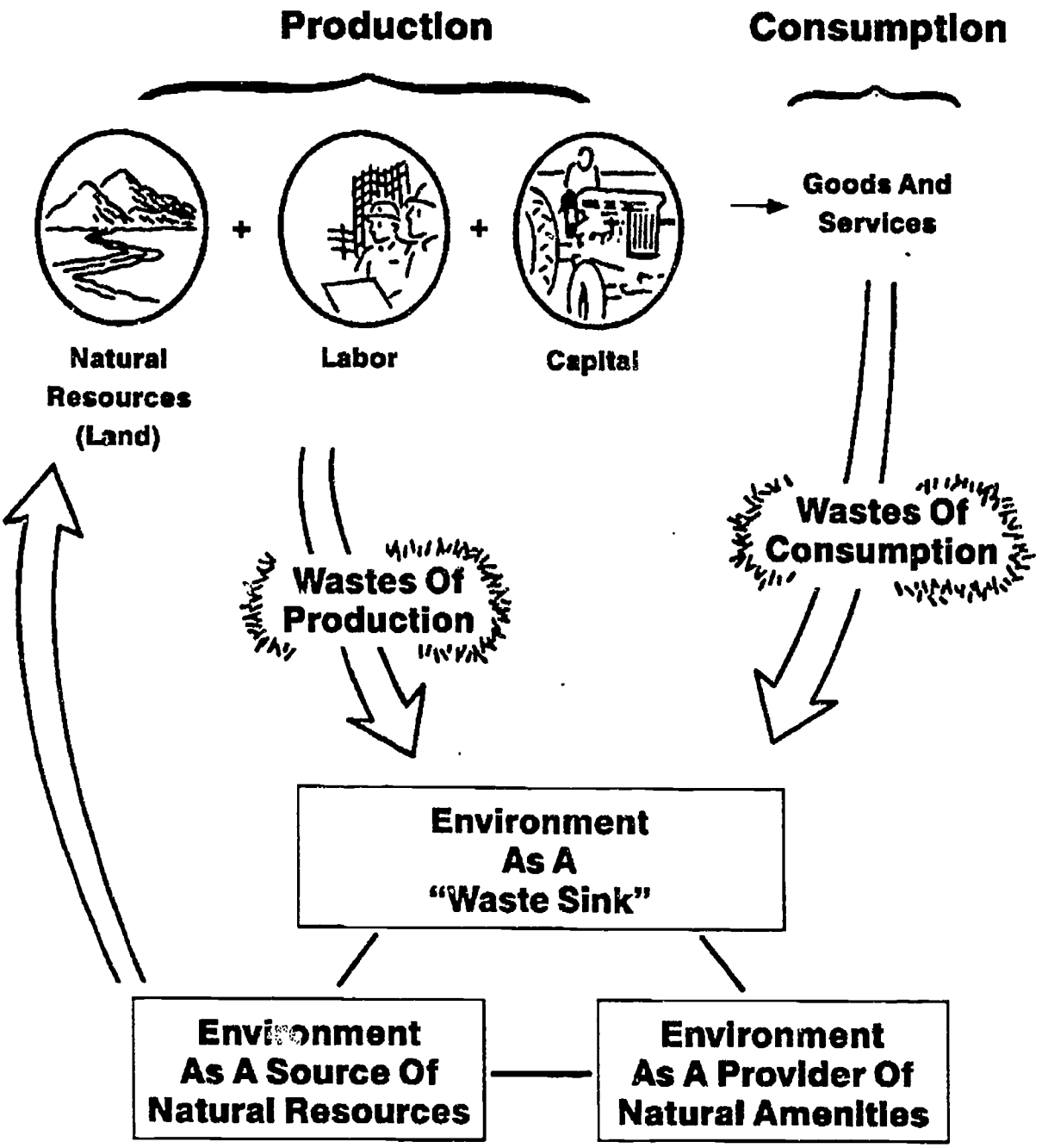
Second, the environment is a natural "waste sink" for the inevitable by-products/wastes of both production and consumption. In earlier times, organic wastes were more common, and were more easily degraded by the environment. However, in modern times, many wastes are not easily degraded by the environment and are present in larger quantities, resulting in a more serious problem for society.

Third, the environment provides us with many natural amenities, such as beautiful wilderness areas, scenic forests, and bodies of water for swimming, boating, and fishing.

Figure 3 expands our production diagram, illustrating the services provided by the environment.

FIGURE 3

Services Provided By The Environment



Summary

The four statements below summarize what we have discussed so far. They provide a starting point for analysis.

A Starting Point for Analysis

1. To survive and prosper, societies must produce goods and services. Every society has productive resources (natural resources, labor resources, and capital resources) that it uses to produce goods and services.

2. Energy is a good/service necessary in both production and consumption. Energy sources originate from natural resources. Because energy is scarce, producers and consumers must pay to obtain it.

3. The production and consumption of goods and services inevitably result in some waste materials, which must be disposed into the environment.

4. Using the environment for production and consumption will affect the amenity providing services of the environment to some extent.

Three Important Economic Considerations

There are three very important economic concepts that students must consider when analyzing environmental and energy issues: opportunity cost and trade-offs, negative externalities (spillover costs), and marginalism. They are discussed below.

Opportunity Cost and Trade-Offs

The basic economic problem of scarcity forces individuals and societies to choose how to use their limited productive resources. Money spent purchasing a bicycle cannot be spent on a new television. Tax monies spent on environmental protection cannot be spent on national defense. Choices must be made.

Any time a choice is made among alternatives, there are specific alternatives that are **not** chosen. The value of the best alternative **not** chosen is called the **opportunity cost**. **Because productive resources are scarce, there is an opportunity cost to every economic decision.**

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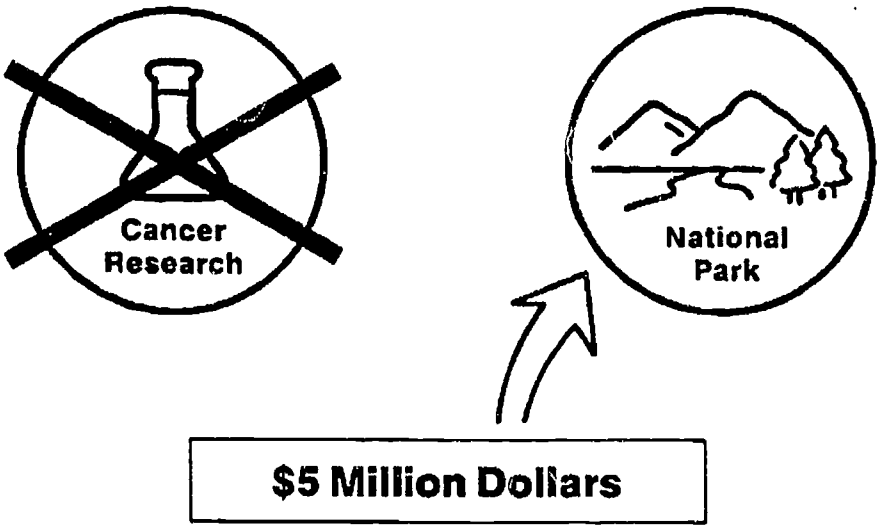
When a person or society decides to produce or consume one good instead of another, they are making a **trade-off**—they are trading off less of one thing for more of something else. For example, when a society decides to spend $5 million less on cancer research, and instead, uses the money to purchase land for a national park, the society is trading off better cancer treatment for its citizens for more environmental protection and recreation.

The value of what is received when making a trade-off is an estimate of the benefit of the decision. The value of what is given up in making a trade-off is a measure of opportunity cost. The opportunity cost is sometimes measured in dollars, as noted above, where the opportunity cost of using $5 million to help purchase land for a national park is the loss of $5 million worth of cancer research (Figure 4).

FIGURE 4

Trade Offs And Opportunity Cost



Society is trading off cancer research for improved environmental protection and recreation. The opportunity cost of choosing a national park is $5 million dollars worth of cancer research.

One major difficulty in analyzing environmental issues is that it is sometimes difficult to measure the monetary value of opportunity costs. For example, what is the money value of clean air, or of a clean river? Not surprisingly, individuals differ greatly in this valuation. One person may easily endure moderate amounts of air pollution in a certain area; whereas, another person would consider even the smallest amounts of pollution to be intolerable. Students should realize that despite the difficulty, many effective techniques have been developed by economists to measure opportunity costs. Such information is vitally important to policymakers when analyzing energy and environmental issues.

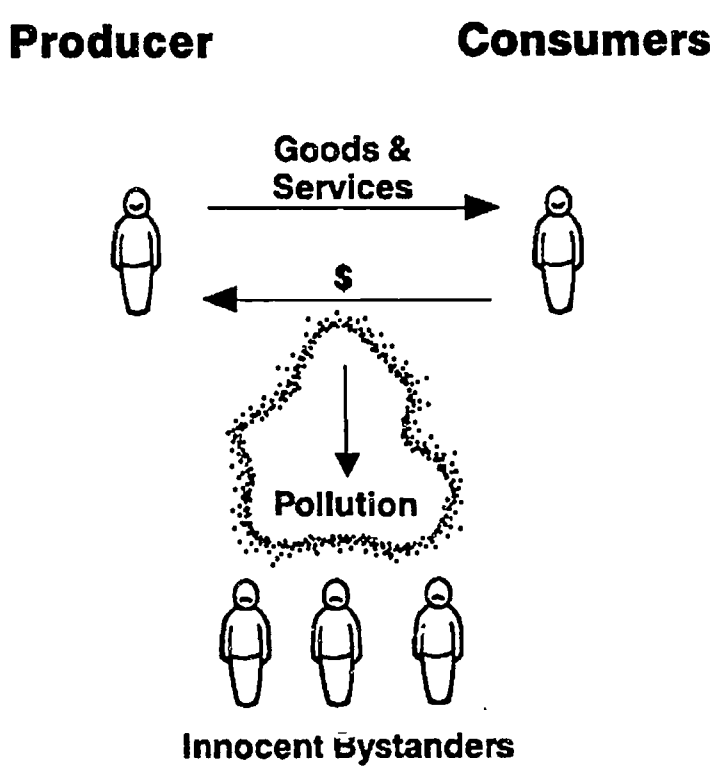
Spillover Costs

We have learned that the production and consumption of goods and services, including energy, will cause some waste to flow into the environment. This is not necessarily bad, because societies must have goods and services in order to survive and prosper.

However, a major problem arises when the negative effects (costs) of waste flows are imposed on individuals not involved in the buying and selling decisions that cause the flows. That is, there are serious problems when the costs of waste flows are imposed on "innocent bystanders" who are **external** to the production and consumption decisions that resulted in the waste flows. Economists refer to these imposed costs as **negative externalities**, or **spillover costs** (Figure 5). In modern times, the problem of negative externalities is compounded by the increasing **volume** of the waste, as well as by the changing **nature** of waste (less biodegradable, more toxic, etc.).

FIGURE 5

Pollution Hurts Innocent Bystanders



The producers and consumers both benefit from the production and consumption of goods and services. However, innocent bystanders sometimes receive the negative effects of the pollution created in production. This especially occurs when natural resources used in production, such as air and water, are commonly owned.

Air and water pollution is an example of a negative externality. When a paper mill produces products, it ejects waste materials into the air and water. Individuals who breathe the air near the paper mill or who use the contaminated water bear the brunt of these external costs, even though these individuals may not benefit from the production or consumption of the paper products made in the mill. **The fundamental problem is that no one owns the air or water, and there is no cost for using these resources.** Because the use of the air and water is free, the mill actually has shifted some of the cost of paper production onto other individuals. The result is that too many paper products are produced, and their price is less than it would be if all the costs were taken into account.

Dealing with Externalities

What do societies do to correct the effects of negative externalities on the environment and on individuals? Three common courses of action are discussed below.

Rules and Regulations

The most typical way used to reduce negative externalities is through rules and regulations. A government may impose regulations which strictly define limits on waste discharge or may set certain standards for air pollution or waste disposal. Examples include the mandated emission standards for automobiles or the required use of "coal-scrubbers" in plants where coal is the source of energy. A government may even ban a certain type of production all together, as in the case of oil drilling in certain wilderness areas.

Rules and regulations are popular, since, they seem to provide a simple and direct solution to spillover problems. The difficulty is that regulations can be very costly to implement and enforce. Regulations also limit individual freedom.

Taxing Production

Another method used by government is to tax the production activity that produced the externality. Taxing a product increases its price, thereby, reducing the quantity of the product that is produced and consumed. This results in fewer spillover costs and raises tax monies that can be used for improving the environment. An example of this method is an excise tax on gasoline, tires, and coal production.

Subsidies

A third method used by government is subsidies. A subsidy is the opposite of a tax. A government **gives** money (directly or in the form of tax breaks) to firms to encourage them to reduce spillovers. For example, monies given to a firm may be used to install modern equipment, to help clean a river, or to revitalize land marred by surface mining. Subsidies may be unpopular because taxpayers may not wish to use public monies to pay for negative externalities caused by private firms, even though taxpayers will benefit generally from less pollution in their communities.

Creating Proper Incentives

In recent years, new methods for reducing the harmful effects of negative externalities have been proposed. These methods are potentially very efficient solutions to spillover problems because they emphasize creating proper incentives for individual action. The goal is to make it more profitable (cost efficient) to act in a socially responsible manner.

Effluent and Emission Taxes

One way to create proper incentives is by imposing effluent and emission taxes. This approach imposes a per unit fee on each unit of pollution discharged. For example, a city might impose a tax on each unit of air pollution discharge. This tax provides an incentive for firms to devise creative ways to reduce emissions and, also, provides tax monies for pollution management. Firms could still choose **not** to reduce emissions, but they would have to bear the cost of this decision. The external costs normally imposed on others would, therefore, be "internalized." Effluent and emission taxes can be a wise course of action because they still provide incentives for legitimate growth and development. This approach taxes the pollution **discharge**, and not the production activity itself.

Better Defined Property Rights

Many economists believe that assigning and enforcing property rights more effectively will create incentives for more responsible social behavior. The logic goes like this. If property is commonly owned, like the air or waterways, it will be overused. In contrast, if property is privately owned, the owner has a strong incentive to maintain or improve the value of the property. For example, a timber company has an incentive to harvest forest areas wisely because they are a valuable source of future income. A commonly owned forest is much more likely to be denuded because no individual owner bears the costs.

Established Markets for Pollution Rights

Another way to create incentives for responsible care of the environment, while not discouraging legitimate growth objectives, is to establish markets for pollution rights. For example, a firm that reduces its pollution below the governmental standards could earn "emission reduction credits," which then could be sold to new firms. Under an "offset policy," the new firms would have to buy 1.2 emission credits for each 1.0 units of emissions added by a new plant. Since reductions will be 20 percent greater than additions, the overall air quality would be **improved** every time a new plant entered the area!

The main point to emphasize is that, in some instances, there are creative, practical ways to improve environmental quality instead of imposing rigid regulations that are very expensive to enforce and that completely stifle economic growth. It is encouraging to know that strict environmentalists and those in favor of more growth-oriented policies are beginning to recognize that economic development and environmental protection need not inevitably be seen as conflicting goals.

Marginalism

We have learned that negative externalities are an inevitable by-product of the production and consumption of goods and services. Also, we have examined various ways to minimize the harmful effects of these externalities on the environment. A key question remains unanswered, however. How clean **should** the environment be? It is one thing to agree that action needs to be taken to address a particular environmental problem; it is another to agree t**o what extent** the action needs to be implemented.

A Problem in Centerville

Suppose that industries in Centerville have so polluted the local river that it is now useless for drinking, swimming, or fishing, and is possibly a serious health hazard. While most people would agree that some cleanup is necessary, they will not agree on exactly **how much** cleanup. Fortunately, the concept of **marginalism** can help students analyze these difficult kinds of problems.

In economics, **marginal** simply means "next" or "extra." This rather simple concept can help us solve the river problem. Suppose all citizens in Centerville agree that some cleanup is necessary. They hire an environmental firm to analyze the situation and report back to the city council. Table 1 summarizes the firm's findings.

TABLE 1

Cleaning Up The River

Degree Of Cleanup	Marginal Cost	Total Cost	Marginal Benefit	Total Benefit
20%	$ 10,000	$ 10,000	$100,000	$100,000
40%	$ 15,000	$ 25,000	$ 70,000	$170,000
60%	$ 25,000	$ 50,000	$ 50,000	$220,000
80%	$ 50,000	$100,000	$ 20,000	$240,000
100%	$100,000	$200,000	$ 5,000	$245,000

Common sense tells us that we first should choose the **least** costly cleanup method, whatever that may be. The firm's data show that 20 percent of the pollution problem can be solved at a marginal cost of only $10,000. The resulting marginal benefit is a significant $100,000.

The data also show that additional methods could be used to reduce pollution by another 20 percent giving a total degree of cleanup of 40 percent. However, the cost for this extra (marginal) 20 percent cleanup has increased to $15,000, resulting in a total cost of $25,000. At the same time, the marginal benefit of this extra cleanup has decreased to $70,000, giving us a total benefit of $170,000.

Notice that as the marginal cost for additional cleanup increases, the marginal benefit decreases. This makes intuitive sense. For example, getting the river from 80 percent to a 100 percent pollution-free, pristine condition would be **very** costly—$100,000, possibly, from shutting down some factories altogether and banning the use of power boats. However, the benefit of doing so ($5,000) would not be all that much greater than achieving an 80% degree of cleanliness.

So how clean should the river be? **Economists would say that the citizens of Centerville should continue cleaning up the river as long as the marginal benefits exceed the marginal costs;** in this case, up to a 60 percent degree of cleanliness. After that point, the costs of cleanup are more than the benefits. The scarce productive resources used for cleanup would be better used for some other purpose.

Students tend to look at the **total** amounts in their analysis. They often recommend a 100 percent degree of cleanup, since the total benefit ($245,000) is greater than the total cost ($200,000). However, that would not be the wise choice, as we have seen.

Automobile Pollution

Another common example that illustrates this point is the case of automobile pollution. One sure way of solving this problem would be banning the use of automobiles altogether. Obviously, the cost to society of doing so would be too great. Instead, our government has mandated the use of pollution control equipment, such as catalytic converters. The logic is that the marginal cost of doing so is less than the marginal benefit to the environment.

To summarize, there are trade-offs and opportunity costs associated with all energy and environmental policy decisions. Thus, it is not wise to implement policies mandating the elimination of all negative externalities. Some pollution is inevitable. The key question is **how much,** and that is where marginal analysis is useful.

Summary

So how do we solve the complex environmental problems that face us? Below are three points that have emerged from our discussion.

Ways to Help Improve the Environment

1. **Be more sensitive to how our production and consumption decisions affect the environment.** Marginal cost/benefit analysis demonstrates that, in many cases, steps should be taken to reduce the amount and change the nature of the pollution entering the environment. In production, this means using technologies that create less waste and less toxic waste. It also means treating industrial wastes so they are more easily assimilated by the environment. In consumption and production, this means reusing and recycling to extend the life of resources and developing safe and effective ways to dispose of waste.

2. **Develop wise strategies for dealing with negative externalities.** These strategies must attempt to internalize the costs of production, so that those who benefit from polluting the environment bear the costs. These strategies must protect the environment, yet, not stifle legitimate economic growth and development.

3. **Use marginal analysis when deciding how clean the environment should be, recognizing that insisting on a state of zero pollution is usually not the best policy.**

All three courses of action above depend on a citizenry that is sensitive to the fragile nature of our environment and is willing to act in an environmentally responsible manner. In our schools, homes, and churches, we must create and foster this important sensitivity.

A Decision-Making Model—A Tool for Analysis

It is very helpful to teach students a reasoned, systematic way to analyze and solve problems. This gives students a powerful tool to use in their analyses, and helps them to organize their thoughts about issues, instead of merely voicing subjective personal preferences. Using a systematic approach to problem solving clarifies the trade-offs involved in any solution and reveals the sources of disagreement about various policy alternatives.

A Simple Decision-Making Model

Educators have proposed many problem-solving and decision-making models. The model described in this section is similar to the simple, five step model used in many curriculum materials developed by the Joint Council for Economic Education. Teachers may wish to use other, more expanded models; however, this five step model is easy to learn and yet

is powerful enough to help solve most problems. Another great advantage is that video curriculum materials, which teach and use this model (*Trade-Offs* and *Give and Take*) are available from the Indiana Department of Education and the Indiana Council for Economic Education.

The Five Step Decision-Making Model

1. **Define the Problem.** Analyze the situation. Gather important facts. What is the heart of the problem?
2. **List Alternative Solutions.** Taking into account the reality of scarce productive resources, what are some feasible policy alternatives for solving the problem?
3. **List Important Criteria.** What are some of the important values and social goals that will influence the decision? Which of these are most important to you or to the community?
4. **Evaluate the Alternative Solutions.** Use correct economic analysis to evaluate how each alternative "fits" the various criteria.
5. **Choose the Best Alternative (Make a decision!).** Which alternative is the most desirable? What are the trade-offs among the different goals/criteria, (i.e., how much of one goal must be given up to attain more of another)?

Using a Decision-Making Grid

Students use a simple grid (See Decision-Making Grid Answer Key below—"The Case of the Polluted Lake.") to help apply the five step, decision-making model. Alternative solutions are listed vertically on the left side of the grid. Criteria/goals are listed across the top. To complete step four on the model, evaluation marks are placed in each cell of the grid. These marks can vary. For example, a policy alternative can receive a numerical **point** rating which denotes its ability to achieve a certain goal or criterion (for example 1, 2, 3, or 4, with 1 denoting the lowest ability). Or, one can use marks such as "+" (helps meet goal/criterion), "—" (hinders goal/criterion), "0" (neither helps nor hinders, or "?" (unclear). Multiple pluses (+ +) and minuses (— —) also can be used to clarify the extent to which certain alternatives hinder or help attain a goal. It is also helpful to have students write brief comments in each cell, justifying the logic of their marking.

Whatever marking method is used, it will help students get a better "picture" of the problem and will help them determine a solution. Be careful, though! The "highest" score (using points or +/— marks) may not be the students' final decision. It all depends on the importance (weight) attached to each criterion/goal.

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Applying the Five Step Model

Below is a simple scenario about a community concerned about the increasing pollution in the local lake. The five step decision model is used to help solve the pollution problem.

The Case of the Polluted Lake

Middletown had a problem. The town council was receiving more and more complaints from concerned citizens about the pollution in Lake Lemon, on which Middletown was located. For years nobody complained much about the problem; but as the population grew, and as new industries developed near or on the lake, the pollution problem clearly became worse. Fish populations diminished, and swimmers also complained about the dirtiness of the water.

An environmental firm hired to analyze the situation concluded that the waste water ejected into the lake by a local plastics factory was responsible for most of the pollution. Unfortunately, this plastics factory was the main employer in the town. If the factory closed down or was forced to restrict its production, many people would lose their jobs. The economic existence of the town was at stake.

Some citizens, out of a real fear of losing their jobs, suggested doing nothing. Strict environmentalists in town wanted it shut down, regardless of the economic consequences. Some citizens wanted the council to set strict limits on the amount of pollution that could be put into the lake. Still others wanted to levy a tax on the plastic products produced by the factory and use the tax revenues for lake cleanup. Some citizens said it would be better to tax the amount of waste ejected into the lake, not the plastic products. What should the town council do?

Applying the Five Steps:

Step 1: Define the Problem

The problem is that Lake Lemon is becoming increasingly polluted, largely due to the waste water discharges of a local plastics factory, the town's main employer.

Step 2: List Alternative Solutions

Several solutions were proposed in the scenario: do nothing, shut down the factory, set limits on the amount of waste that the factory could put into the lake, tax the plastic products produced and use the revenues for lake cleanup, tax the actual amount of waste ejected into the lake and use revenues for cleanup.

Step 3: List Important Criteria

There are many possibilities. To keep our analysis simple, we will list four: Will clean lake, Fairness (those benefiting from the pollution pay the costs), Job Security, Freedom of Action.

Step 4: Evaluate Alternative Solutions

This is the most challenging part of the problem. In answer grid below, we have used the +, −, ?, marking scheme, with double +'s and −'s to indicate strong help or hindrance. For example, for the Do Nothing alternative, we put a double minus (− −) in the Will Clean Lake cell, since doing nothing will continue to worsen the pollution problem. We put a minus (−) in the Fairness cell, since doing nothing will harm individuals who do not benefit at all from the factory. (Since many people in Middletown do benefit, a double minus (− −) was not used.) The Do Nothing alternative would enhance job security, so a + + was put in that cell. A double plus (+ +) was placed in the Freedom of Action cell, since doing nothing would give individuals the freedom to pollute (or not pollute!) as they pleased, without interference from the town government.

We have completed the other cells and are now ready to make a decision. (You may disagree with how we marked some of the cells. In a class situation, this disagreement forces student discussion and contributes to a more logical solution.)

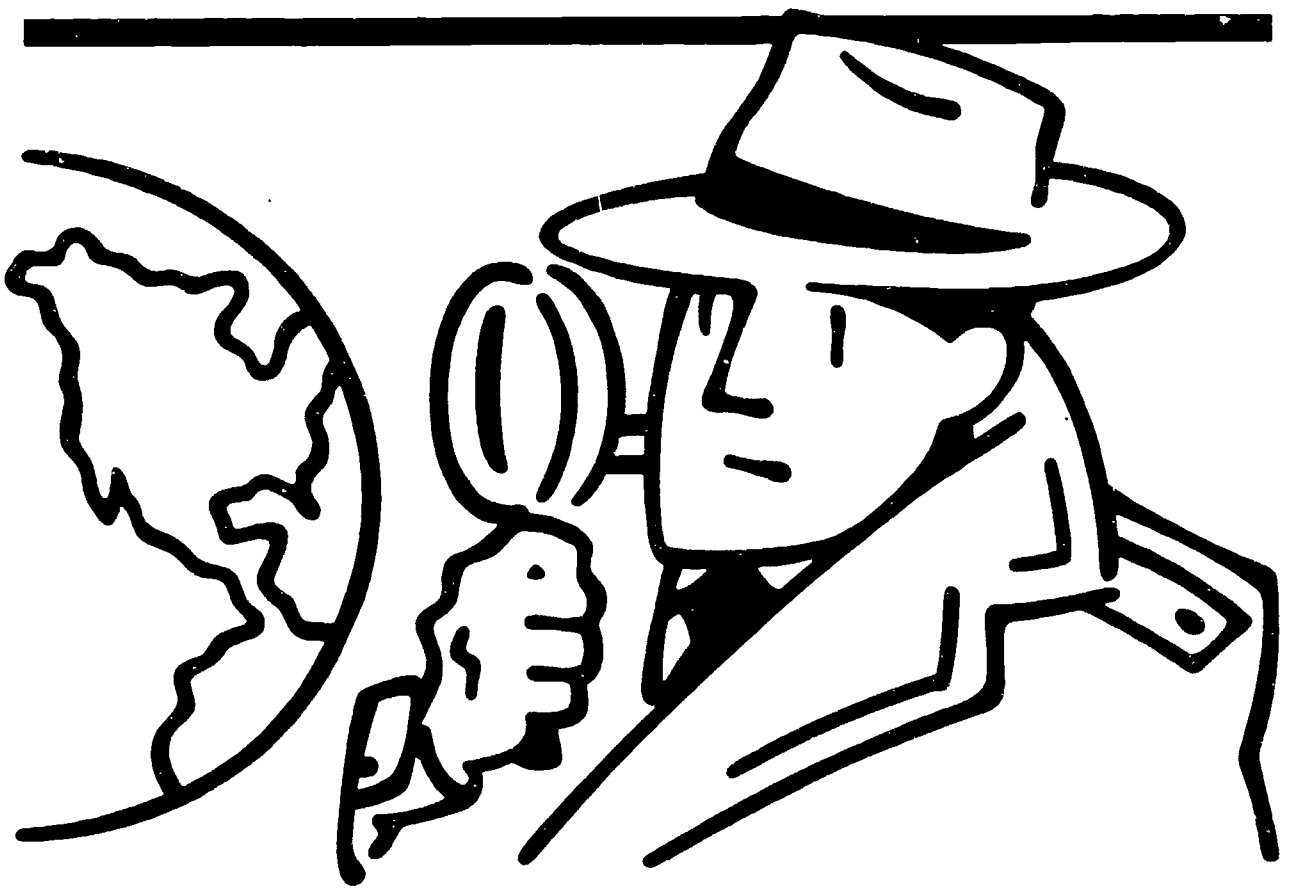
Step 5: Choose the Best Alternative

Based on our analysis, some form of tax, either on production or on actual waste, appears to be the best choice. However, as was mentioned above, because individuals weigh the criteria/goals differently, one cannot merely "add" +'s and −'s to arrive at a correct solution. For example, a strict environmentalist might choose to shut down the factory, even though this would be very detrimental for job security and freedom of action. For this person, the cleanliness of the lake is by far the most important criterion and outweighs all other consideration.

DECISION-MAKING GRID ANSWER KEY
The Case of the Polluted Lake

	CRITERIA				
ALTERNATIVES	Will clean lake	Fairness	Job security	Freedom of action	
Do nothing	− −	−	+ +	+ +	
Shut down factory	+ +	?	− −	− −	
Set waste limits	+	+	?	−	
Tax plastic products	+	+	−	+	
Tax amount of waste water	+	+	−	+	

SOLID WASTE SCHOOL CAFETERIA



Facts About Solid Waste

Did You Know That . . .

In the United States each year, we currently recycle 56 percent of our copper, 27 percent of our iron and steel, 50 percent of our aluminum, 20 percent of our paper, 50 percent of our lead, and 5 percent of our glass. These percentages are increasing.

Nearly $1 of every $10 spent for food and beverages pays for packaging. Packaging comprises 50 percent of the volume of household waste and 33 percent of all solid waste.

Buying products made from recycled materials helps create markets for these materials.

In landfills, paper and some "biodegradable" plastics take "forever" to decompose because sunlight and air are absent.

Americans use about 100 million steel cans every day. It takes approximately 13 steel beverage cans or 24 aluminum cans to equal one pound. Steel cans today contain 1/3 less metal than a steel can produced in 1975. Recycling aluminum cans is very cost effective because it takes less than 10 percent of the energy that is required to make the cans from raw materials.

Steel is America's most recycled material, largely because of the large amount of steel scrap derived from industry. It is probably the easiest material to separate from the waste stream since it is so magnetic. Steel degrades naturally into iron oxides if exposed to natural elements.

As a general rule, recycling program costs are greater than the revenues earned through recycling. However, the **net costs** of a recycling program are sometimes less than waste disposal costs, making recycling a cost effective option. In communities where recycling costs are very high, environmentally safe landfills may be the most cost effective option.

If recycled materials, such as glass, are not sorted correctly they can cause severe damage to furnaces and other equipment.

Next to paper and paperboard, yard wastes, such as grass clippings, leaves, and plant trimmings, occupy the most landfill space—15 percent to 20 percent. This is why many communities are initiating new programs to reduce or dispose of yard waste.

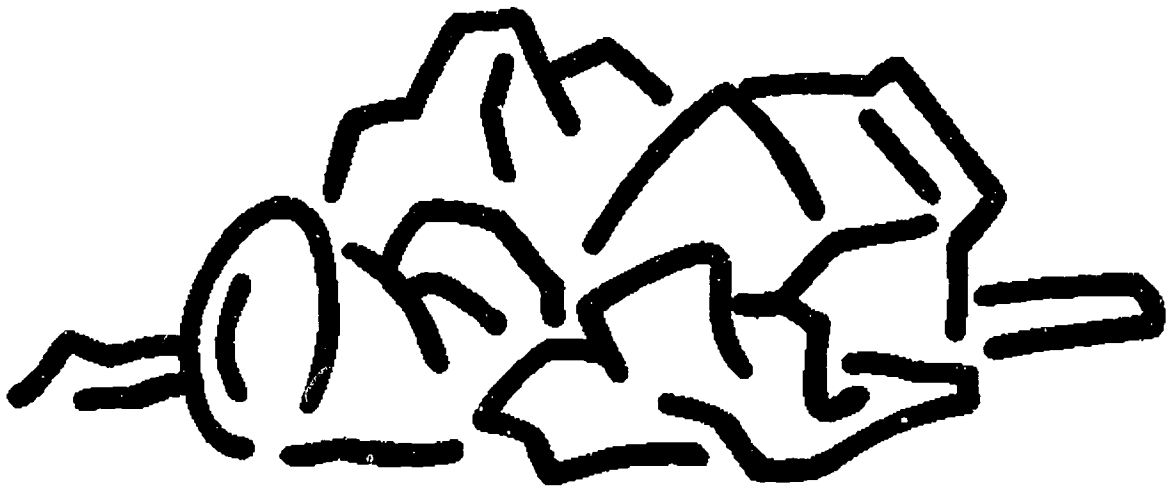
Recycling newspaper is a good way to keep large volumes of paper out of landfills; however, it is a mistake to think that doing so will save millions of irreplaceable forests. Trees grown for paper pulp are a renewable resource. They are planted, harvested, and planted again like other crops. Wood residue from lumber mills are also used to make paper.

According to recent estimates Indiana is recycling about 5 percent of its municipal (i.e., excluding industry) waste stream. The United States, as a whole, recycles 13 percent, up from 10 percent in 1986. There are currently over 50 recycling programs in communities throughout Indiana, with more programs starting every year.

Indiana burns 10–15 percent of its solid municipal wastes, primarily at two major sites: the waste-to-energy plant in Indianapolis and the incinerator in East Chicago. This percentage is comparable to percentages in other states. Nationally, the percentage is 14 percent, an increase of 3 percent since 1986. From the environmentalist's point of view, incineration programs should be integrated with recycling programs, so recyclable and hazardous materials are removed from the waste stream before they are burned.

According to a 1991 report by the National Solid Wastes Management Association, Indiana is one of 38 states that both imports and exports trash across state lines. Of the 15 million tons of solid waste (8 percent of the total volume) that moves across state lines each year, New Jersey and New York alone contribute 7.9 million tons. The report said that 76 percent of all "trash interactions" occur between neighboring states. There were no concrete numbers comparing Indiana's import-export balance of trash, although most experts believe that Indiana imports more than it exports.

(**Note**: Many of these facts were provided courtesy of the Indiana Institute On Recycling.)



Five Basic Methods of Dealing With Solid Waste

1. Source Reduction – reducing the quantity and toxicity of waste at its source

2. Reuse and Recycle – extending the life of a resource by using them again in production or consumption

3. Composting – decomposing organic matter to create humus

4. Landfilling – compacting waste and covering it with soil

5. Incineration (Combustion) – burning solid waste

Solid Waste Vocabulary

Biodegradable	capable of being broken down/decomposed into harmless and useful residues
Composting	decomposing organic wastes to create humus
Garbage	spoiled or waste food that is thrown away, generally defined to exclude dry material (trash), often used interchangeably with the word "trash"
Incineration	the process of burning wastes
Landfill	site of the controlled burial of solid waste
Negative Externalities	the harmful effects (i.e., spillover costs) of production that are imposed on innocent bystanders not directly involved in the buying and selling decisions that caused the pollution
Opportunity Cost	when making decisions, opportunity cost is the value of one's next best alternative; it is the value of what is given up when making a decision, every economic decision has an opportunity cost
Organic Wastes	wastes derived from plants and other living organisms, such as leaves, grass, and food, that can decompose
Recycling	separating, collecting, and processing used manufactured materials that otherwise would be disposed as waste
Scarcity	in economics, the condition that exists whenever wants are greater than the resources available to satisfy the wants, scarcity requires people to make choices
Solid Waste	all solid and semi-solid waste, including garbage, trash, yard, and industrial waste, and household discards such as appliances
Source Reduction	reducing the quantity and toxicity of waste at its source
Tipping Fees	the dumping fees for putting solid waste in a landfill
Toxic Waste	wastes that are particularly dangerous or poisonous
Trade-off	giving up some of one thing in order to get some of another
Trash	material considered worthless that is usually thrown away, generally defined as dry waste material (excluding wet waste garbage), often used interchangeably with the word "garbage"

CASE STUDY—UNIT 1

The Case of the School Cafeteria

Teaching Instructions

Overview:

In this case study, students analyze a problem concerning the large amount of trash generated by a school cafeteria. All students can easily identify with this problem, and probably will have some definite opinions about the solution. This problem is not at all hypothetical. Indiana school corporations currently are considering ways to reduce the large amounts of trash generated by their lunch programs.

Learning Objectives:

After completing the case study, students will:

1. Apply a five step decision model to solve a problem.
2. Identify the five basic methods of solid waste disposal: source reduction, reuse and recycle, composting, landfilling, and combustion.
3. Understand that policy decisions usually involve trade-offs.
4. Identify the opportunity costs of various choices.

Prerequisite Skills:

Students must know how to apply the five step decision-making model described in the Introduction. This involves making decisions based on personal and group goals and communicating ideas in a group setting.

Important Concepts to Emphasize:

All Production/Consumption Creates Some Kind of Waste. There is always some kind of waste whenever goods or services are produced and consumed. In the case study, even if all of the girls' recommendations were adopted, wastes still would be put into the environment. Instead of trash the cafeteria would have to get rid of dirty, soapy dishwater. If the water temperature is below a certain level, the cafeteria would have to use chemical drying agents that would enter the environment. Using dishwashers requires using energy, which has an impact on the environment.

Methods of Dealing with Solid Waste. Students should learn these five basic methods for dealing with solid waste.

a. Source Reduction—reducing the quantity and toxicity of waste at its source.

b. Reuse and Recycle—extending the life of resources by using them again in production or consumption.

c. Composting—decomposing organic matter to create humus.

d. Landfilling—compacting waste and covering it with soil.

e. Incineration (Combustion)—burning solid waste (Nonburnable waste is separated first).

Every Decision Has an Opportunity Cost. Because of scarcity, there is always a best alternative not chosen, and thus, there is always an opportunity cost. In the case study, if all the girls' recommendations are accepted, the opportunity cost will be the $1 (.20 x 5, worth of other things that each student cannot buy each week. Also, the opportunity cost would include the other things teachers and students could be doing during the extra 15 minutes that must be added to the school day. This is not to say that the girls' recommendation is flawed; rather, that there are opportunity costs that must be considered. Of course, there is an opportunity cost to **not** accepting the recommendation—the benefit gained from having less waste in the landfill.

All Policy Decisions Involve Trade-Offs. People usually are willing to give up part of one goal to obtain part of another. For example, one alternative solution to the case study, might be to accept part of the girls' recommendations. The parties could agree to use washable trays and silverware, while retaining paper napkins and milk cartons. There still would be more trash than the girls desired, but the price of lunch would not have to be increased drastically (the increase would depend on the specific calculations), nor would the school day have to be extended.

Recycling Is Not Costless. Recycling is a worthy goal; however, it is not a costless one. Those involved in recycling programs (collectors, processors, etc.) must be paid for their services. One of the main problems is that there are not enough processing facilities to handle large amounts of recyclable materials. Thus, there may be no market at all for some recycled materials, or the prices for materials may be too low to cover the costs of a recycling program. As a general rule, recycling program costs are greater than revenue. However, the **net costs** of a recycling program may be less than waste disposal costs, making recycling a cost effective option.

Teaching Suggestions:

1. Hand out the case study scenario. Divide your class into small groups, and let each determine a solution to the case study. Have groups report their solutions to the class.

2. To teach the five step, decision-making model, use the *Give and Take* videos *"You Chose: Scarcity and Personal Decision Making"* and *"We Choose: Scarcity and Social Decision Making."* An explanation how to use the five step

model to solve an environmental problem is described in the Introduction. (Videos available **free** from the Indiana Council for Economic Education—see resource section.)

3. If your students have not had much experience using the five step model, you may wish to suggest several of the criteria to begin the activity.

4. You can use other criteria than those listed in the sample Decision Grid. Three alternative solutions are listed in the Answer Grid; however, for this first lesson your class could consider just the two most basic alternatives—Accept Recommendations and Reject Recommendations.

Notice that we used the +/?/− marking scheme, using double + +'s and − −'s for emphasis. Do not be surprised if you or your students disagree on how we marked certain cells in the grid. Some disagreement is natural. The purpose is to clarify the analysis and to better understand the trade-offs among criteria/goals.

You may wish to have students write comments below the markings. We recommend this, because it forces students to express their logic verbally.

Notice that there is not a "correct" answer because conflicting personal values will cause students to weigh the criteria differently.

5. To extend this lesson, discuss the charts: What's in Our Garbage and Tipping Fees by Selected States. (The charts are listed in *"Decisions About Product Safety," A Teaching Unit for Economics Educators,* Proctor and Gamble Educational Services, 1990.)

DECISION-MAKING GRID ANSWER KEY
The Case of the School Cafeteria

	CRITERIA				
ALTERNATIVES	Helps Environment	Lunch Costs	Fairness	Extra school time required	
Accept girls' recommendations	+	− −	+	− −	
Accept some recommendations (wash trays & silver) (keep paper napkins and cartons)	?	?	+	+ +	
Reject girls' recommendations (Do nothing)	−	+	?	+ +	

WHAT'S IN OUR GARBAGE?

Amount (1988 data)	Millions Of Tons	%
Paper and paperboard	71.8	40.0
Glass	12.5	7.0
Metals	15.3	8.5
Plastics	14.4	8.0
Food wastes	13.2	7.4
Yard wastes	31.6	17.6
Other	20.6	11.5
Total	179.4	100.0

Source: Executive Summary, Characteristics of Municipal Solid Waste in the U.S., 1990 Update, June 1990, EPA Office of Solid Waste.

Tipping Fees By Selected States

	$/TON		$/TON
Alabama	$ 10.75	Minnesota	$ 40.06
Arkansas	6.75	Missouri	13.00
California	10.00	Nebraska	8.00
Colorado	10.50	Nevada	6.00
Connecticut	35.00	New Jersey	41.97
Delaware	24.82	New York	40.00
District of Columbia	14.00	North Dakota	9.00
Florida	27.40	Ohio	15.51
Georgia	13.50	Oklahoma	12.75
Hawaii	13.00	Pennsylvania	25.00
Illinois	14.70	Rhode Island	49.00
Indiana	15.15	South Carolina	4.75
Kansas	4.07	Tennessee	7.50
Louisiana	9.75	Texas	9.35
Maryland	40.00	Virginia	24.00
Massachusetts	65.00	Washington	42.00
Michigan	26.00	Wisconsin	14.25

Source: National Solid Wastes Management Association, 1988.

Key Questions to Ask Students

1. What is a landfill? What is solid waste? What is trash? (See vocabulary.)

2. Why is solid waste disposal a problem in the United States? (The **volume** of waste generated has increased greatly,and the **composition** of the waste is different from earlier days—less biodegradable and more toxic. Also, it is becoming more politically difficult to start new landfills.)

3. What are five ways to dispose of solid waste? (Source reduction, reuse and recycle, composting, landfilling, and incineration.)

4. What are some of the ways that the concept of **scarcity** is illustrated in this case study? (Scarcity of money, scarcity of environmentally safe landfill sites, and scarcity of time in school day.)

5. "Almost all production results in some type of waste." True or False. Discuss. (True. In our problem, washing dishes instead of using throwaway items still results in waste, albeit, a different kind!)

6. In the case study, what was the opportunity cost of accepting the girls' recommendation? (Giving up whatever the students would have bought each week with the extra $1 now spent on lunch and giving up 15 minutes of after school activities.)

7. What was the opportunity cost of **not** accepting the girls' recommendation? (Giving up the environmental benefits of having less trash in the landfill.)

8. Why wasn't recycling considered in the girls' recommendation? (There weren't any local processing facilities for the plastic trash, and there was no market for lightweight paper napkins and milk cartons.)

Other Teaching Materials:

The Rotten Truth—3-2-1 Contact, Produced by Children's Television Workshop, 1990. An excellent video that explains how garbage is disposed. It examines landfills, recycling, and incineration.

"Suds and Safety" and "Garbage Decision Making," These teaching activities, especially the latter, relate well with this teaching unit. They are found in *Decisions About Product Safety: A Teaching Unit for Economics Educators,* produced by Proctor and Gamble, 1990.

"Waste Disposal," *Elementary Economist,* Vol. 11, No 3, Spring 1990. This issue contains lessons for Grades K-7 on the economics of garbage.

The Case of the School Cafeteria

Student Directions:

Below is a situation about trash waste in a school cafeteria:

1. Analyze the situation and use the five step decision model to decide which recommendations should be followed.

2. You must complete the Decision Worksheet and the Decision Grid.

3. Be prepared to defend your final decision.

Scenario:

Christy and Maria were best of friends who always ate lunch together in their middle school cafeteria. One day, while they were waiting for the 12:40 bell to ring, Christy noticed the trash from lunch filled four large garbage cans. It really didn't surprise her, since the school lunch was served on plastic throw away trays and students used throw away plastic spoons and forks. Combine that with the empty milk cartons, the paper napkins, and the lunch bags brought from home and that created a lot of trash!

"What a waste!" exclaimed Christy. "Maria, why don't we use reusable trays and silverware in our cafeteria? It can't be that big of a deal to wash them. Just think about our local landfill getting filled up with solid waste. Our cafeteria is really contributing to the problem."

"Don't worry about it," answered Maria. "What can you do about it anyway?"

"Let's ask Mrs. Clifton if we can discuss it at the next student council meeting," responded Christy. "I bet she wouldn't mind."

"That's not a bad idea," said Maria. "She might be interested. It's worth a try."

As it turned out, Mrs. Clifton, the student council advisor, thought it was a very important topic to discuss. In fact, she asked the principal, Mr. Harris, and the cafeteria manager, Mrs. Downing, to attend the next student council meeting. On the day of the meeting Christy and Maria explained their concerns.

"We have learned that recycling the plastic items wouldn't work," explained Christy, "since there are no available processing facilities for these items, and there is no market for recycling the paper napkins and milk cartons. However, by following this plan, the school cafeteria can eliminate most of its trash."

1. *Use reusable hard plastic trays and metal silverware, instead of the disposable kinds. The reusable trays and silverware could be washed easily.*

2. *Use cloth napkins, which also could be washed and reused instead of paper napkins.*

3. *Use washable regular glasses instead of disposable milk cartons. Students would get milk from large dispensers like those found in some restaurants.*

Unfortunately, Mrs. Downing stated her concerns about the girls' plan. "It sounds good, but I'd have to pay a lot more in labor costs if we washed trays and silverware by hand, and that's expensive. Even if we bought dishwashers, there would be some additional labor costs. Anyway, dishwashers are expensive, and there are repair costs. And have you thought about the cost of additional water and the increased energy costs for heating the water? Also, don't forget that trays, glasses, silverware, and cloth napkins break, wear out, or can be stolen. They're expensive to replace. If we implement all of your recommendations, we'll have to increase the price of lunch from $1 to $1.20."

Mr. Harris also stated his concerns. "It would take more time to get students through the lunch line if students filled their own glasses of milk. Students already are pressed for time to finish their lunch. We'd probably have to add five more minutes to each of our three lunch periods. That would mean getting out of school fifteen minutes later each day. Are students willing to do this?"

"I can see your concerns," said Christy, "but someone has to make sacrifices. I still think our solution is best for the environment, and nothing is as important as saving the environment."

Decision Worksheet

Student Directions:

1. Complete this worksheet and the Decision-Making Grid to help you analyze the case study.

2. (Optional) Below the evaluation marks you place in each cell of the decision-making grid, make a brief comment explaining **why** you made a particular mark.

Step 1: Define the Problem

_____

_____

Step 2: List Alternative Solutions

_____

_____

_____

_____

Step 3: List Important Criteria

_____

_____

_____

_____

_____

Step 4: Evaluate Alternative Solutions

(Fill in the individual cells in the decision-making grid.)

Step 5: Choose the Best Alternative

(Which alternative do you think is the best solution?)

_____

DECISION-MAKING GRID

Name _____ **Class** _____

CRITERIA					
ALTERNATIVES					

CLASSROOM ACTIVITIES – Unit 1

Solid Waste

Classroom Activities:

The following classroom activities are recommended for this unit:

1. Investigating the School Cafeteria
2. Garbage Garden
3. Market Monitor/Is It Worth It?
4. Investigate Your Community
5. Debating the Issues
6. EEE Actions

State Proficiencies:

The activities in these EEE lessons are correlated with the *Indiana Curriculum Proficiency Guide* which emphasize the process of learning through direct experience.

Science

* Predicting skills
* Analyzing
* Experimenting
* Researching skills

Mathematics

* Calculating
* Computing
* Graphing
* Tabulating

Social Studies

* Tracing products
* Decision-making skills
* Comparing systems
* Planning strategies and skills

Language Arts

* Interviewing skills
* Debating skills
* Surveying
* Communicating skills

Investigating the School Cafeteria

Learning Objectives:

1. Design activities to reduce natural resource, energy, and food waste.

2. Compute the natural resource, energy, and economic savings.

Overview:

Middle schools in Indiana are major users of natural, energy, and economic resources. In middle school cafeterias across Indiana, students do not consume all the food they purchase, and very few schools recycle plastics, styrofoam, bottles, cans, and paper. As a result, tons of recyclable materials are sent directly from schools to local landfills. Many of these throw away materials are nonbiodegradable, which means they will never decompose. There must be better ways to reduce this solid waste.

Notes to the Teacher:

In many Indiana communities, schools are the largest employers of people and users of natural resources. Schools should be a community model for energy, environmental, and economic practices. Although there are several middle schools that are attempting to serve as models, very few have attained this status.

Direct students to investigate, research, manage, and propose solutions to reduce food, natural resources, energy, and economic waste. This method of teaching adds excitement and relevance to the curriculum. Students will be directly involved in activities to help improve environmental and economic conditions in their schools.

The activities in this EEE lesson involve students in direct experiences in the school and community. It is not the purpose of this program to turn middle schools into recycling centers. The purpose is to involve students in real-life problems and issues which affect them personally. It is a goal of this program to have schools serve as environmental, energy, and economic models for the community.

Begin this activity by surveying the attitudes of the school administration, school cafeteria staff, community, custodians, parents, and other teachers about the possibility of beginning a recycling program. Explain how this study of energy, economics, and the environment will support and strengthen science, health, mathematics, social studies, home economics, and language arts.

Student Activities:

1. Weigh the amount of food thrown away each day and graph this data on a weekly chart in metric and standard units.

2. Calculate the number of people in an underdeveloped country who could survive on food thrown away each day in the school cafeteria. Research the impact of a draught on food supplies and malnutrition in Africa.

3. Survey students to find out why they don't eat the food they purchase. Share these findings with the school cafeteria staff. Assist the school cafeteria in designing a menu which meets nutritional requirements and the needs of the student body.

4. After the menu has been changed, weigh the amount of food thrown away to determine how effective the change has been. Publicize the results in the school newspaper, classes, and community.

5. Count and weigh number of plates, spoons, and forks thrown away each day. Graph this data on a weekly chart. Trace school waste products taken to the nearby landfill. Interview the local landfill operator to find out about solid waste disposal in the community. Contact private and public trash haulers to determine the cost of disposing of waste.

6. Contact community health officials or environmental groups to locate recycling centers that will accept the school cafeteria's waste. Start a school recycling program for paper, cans, plastics, and styrofoam (when feasible).

7. When recycling cannot be used, conduct a study to determine the costs for:

   a. purchasing glass dishes and metal utensils
   b. purchasing automatic dishwashers
   c. employing cafeteria personnel to wash dishes

8. Compare the costs of purchasing throwaway paper and plastic materials to that of purchasing glass dishes and metal utensils which must be washed. Calculate these costs for one, two, and three years. Graph results and write a summary of your findings. Share the results with students and appropriate school staff.

9. Determine how much money is spent by the school for food, energy, plastics, and styrofoam plates each month and graph this data. Compute total costs per school year.

10. Calculate the savings resulting from a school recycling program for one month. Are these savings worth the additional costs? Share your calculations with students, administrators, and parents.

The Garbage Garden

Learning Objectives

After completing this activity, students will:

1. Identify different decomposition rates for different materials.

2. Predict which nonbiodegradable materials could be recycled.

Overview:

This activity helps students understand what happens to solid waste after it goes to the landfill. When a biodegradable material decomposes, it is broken down by small microorganisms and becomes part of the soil. However, many materials are not biodegradable, and decompose very slowly. Which materials **are** biodegradable? Find out by planting a "garbage garden."

Notes to the Teacher:

For sanitary reasons, be sure students use gloves when handling decomposed materials.

Student Activities:

1. Tell the class that they will plant a garbage garden to analyze how different materials decompose.

2. Students should collect items they think will decompose when planted and those that will not. Some suggestions might be part of a cardboard box, table scraps, paper, wood, orange peels, pieces of glass, plastic lid, rubber band, cloth, metal objects, etc. Have students predict the rate of decomposition for each planted item.

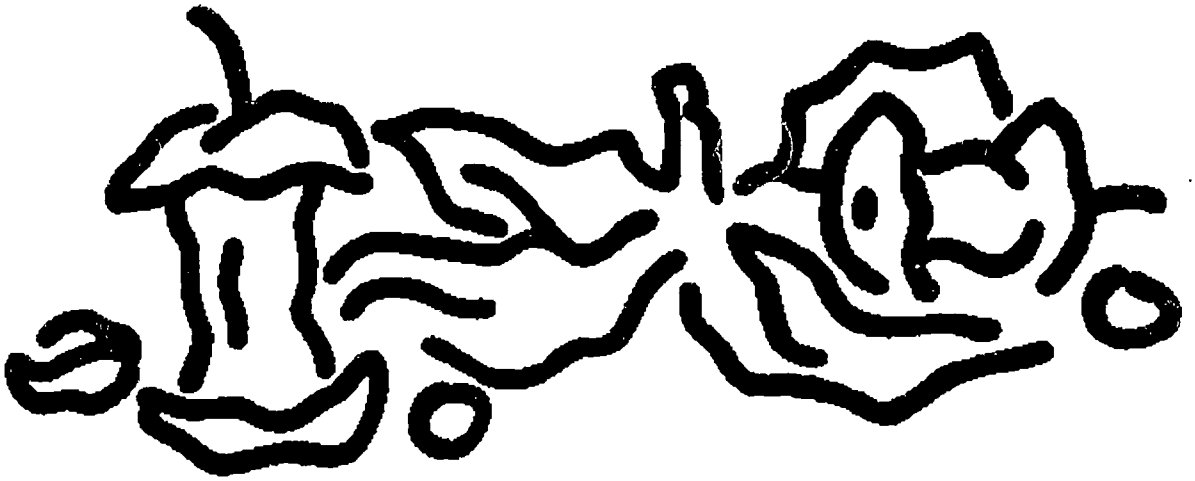
3. Plant the garden in a sunny location outside or in a container filled with soil. Label the items carefully. Water the garden. If you plant the items in a container, place it in a sunny location. After two weeks, dig out the items and record changes that have occurred. Which items have decomposed? Which have not? Why?

4. Make a chart classifying the buried items into the following categories: "Disappeared," "Deteriorated," "Intact." Discuss the results. How accurate were the students' predictions?

5. (Optional) Change some of the variables and determine if this affects decomposition rates. For example, vary the decomposition time, amount of sunlight, and amount of water. Graph the results, and write a report of the findings. (Hint: Change one variable at a time.)

6. Based on their findings, direct students to predict which kinds of "inert" materials could be recycled. Research which are recycled in their community. Discuss why some materials are recycled and some are not. (There are no established markets for some materials, and collection and sorting is often difficult or expensive.)

(**Note:** An original version of this activity appeared in the article "A Clean Environment, A Matter of Choice," by Robert W. Reinke and Diane W. Reinke, in *The Elementary Economist, Spring 1989.)*



Market Monitor and Is It Worth It?

Learning Objectives:

After completing the "Market Monitor" and "Is It Worth It" activities, students will learn that:

1. Markets exist for certain recyclable materials, and that these markets provide an incentive for individuals to recycle.

2. There are different market prices for various recyclable materials.

3. Prices for the same materials will vary depending on the location of the collecting site.

4. There is an opportunity cost to traveling a distance to get a better price for recyclable materials.

Overview:

Recycling only works if there are markets for the recycled materials. The *"Market Monitor,"* published monthly by the Indiana Institute on Recycling, gives current prices throughout the state for various materials. In these activities, the students answer questions based on the prices for the week of April 15, 1991. Contact the Institute to receive current price data. The address is: Room 921, School of Education, Indiana State University, Terre Haute, IN 47809.

Notes to the Teacher:

1. Point out that the markets are so weak for some materials that there is no price offered for them, but at least, they are "accepted." Emphasize that some materials have no market at all and are not accepted anywhere (milk cartons, paper napkins, etc.).

2. This activity is excellent for reinforcing math and geography skills. Let students create their own questions and exchange them with classmates.

3. The opportunity cost of one's time is crucial when considering whether it is worth collecting and selling recyclable materials. For example, it would not be efficient for a doctor to concentrate on recycling because this would keep the doctor from performing very valuable services. This issue affects whether it is cost effective to travel to other cities to sell materials. Even if a higher price covers travel costs, it may not be enough compensation for one's time.

Student Activities:

1. Students should complete the "Market Monitor" and "Is It Worth It?" worksheets. Let students use the data to create some additional questions to exchange with classmates.

Answers to Worksheet Questions:

Market Monitor

1. Old newspapers, old corrugated cardboard, used beverage cans.

2. UBC Alum - New Albany (possibly Fort Wayne or Bloomington)
   UBC Steel - Evansville, Indianapolis, New Albany, and Terre Haute
   OCC - New Albany
   ONP - Lake County
   Prices are different because supply and demand conditions are different at each site.

3. The price is the same—$5 per ton

4. $210, $187.50

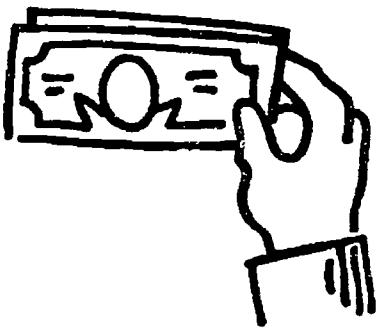
5. $25

6. Decrease

7. Increase

8. Increase

9. Decrease



Is It Worth It?

2. 1.75 inches = 58.3 miles
   2.00 inches = 66.7 miles
   4.00 inches = 133.3 miles
   2.75 inches = 91.6 miles

3. a. Columbus—$125, New Albany—$160, $35 more
   b. 58.3 miles x .25 = $14.58; Yes, not counting cost of one's time.

4. a. Indianapolis—$90, Lake County—$30, $60 more
   b. 133.3 miles x .25 = $33.33; Yes, not counting cost of one's time.

5. a. Logansport—$120, Indianapolis—$75, $45 more
   b. 66.7 miles x .25 = $16.68; Yes, not counting cost of one's time.
   c. No, $16.68 in travel costs + $35 opportunity cost = $51.68, which is greater than $45.

Market Monitor Worksheet

Directions:

Use the data from the Market Monitor table to answer the questions below.

MARKET MONITOR

Recent Prices Paid for Household Recyclables in Indiana

City	ONP	OCC	UBC Aluminum	UBC Steel	Glass	HDPE and PET
Bloomington	Accepting	Accepting	30¢ - 32¢ lb.	2¢ lb.	Accepting	Accepting
Columbus	Accepting	Not accepting	25¢ lb.	2¢ lb.	1/2¢ lb.	1¢ lb.
Evansville	25¢ per 100 lbs.	50¢ per 100 lbs.	26¢ lb.	3¢ lb.	1/2¢ - 1¢ lb.	1/2¢ lb.
Fort Wayne	Accepting	$5 ton - baled	28¢ - 38¢ lb.	1¢ - 3¢ lb.	1¢ - 1 1/2¢ lb.	2¢ - 3¢ lb.
Indianapolis	$5 ton	$22.50 ton	23¢ lb.	3¢ lb.	Accepting	Accepting
Lafayette	Not accepting	Not accepting	28¢ lb.	Not accepting	Not accepting	Not accepting
Lake County	$10 ton	Accepting	25¢	1¢ lb.	1¢ lb.	2¢ - 3¢ lb.
Logansport	$8 ton	Not accepting	25¢ - 27¢ lb.	1¢ lb.	1¢ lb.	1¢ lb.
Muncie	Accepting	Accepting	22¢ - 28¢ lb.	Accepting	Accepting	Accepting
New Albany	$5 ton	$26 ton	32¢ lb.	3¢ lb.	1¢ lb.	2¢ lb.
South Bend	Accepting	Accepting	25¢ lb.	Accepting	Accepting	Accepting
Terre Haute	Accepting	Accepting	30¢ lb.	3¢ lb.	1¢ lb.	Accepting

ONP, Old Newspapers, OCC, Old Corrugated Cardboard; UBC Used Beverage Cans; HDPE & PET, Plastic beverage containers. **"Accepting"** may mean buyer will accept material without payment. **Check your market. Market Monitor** reflects prices for the week of April 15, 1991. They should be used as general guidelines due to fluctuations in the market.

1. What do the abbreviations ONP, OCC, and UBC mean?

_____

_____

2. At what location(s) is the best market price for UBC Aluminum, for UBC Steel, for OCC, for ONP? Why are there differences in prices?

_____

_____

3. Is the market price for ONP higher at Evansville or New Albany?

4. At Lafayette, how much would someone receive for 750 pounds of UBC Aluminum? At South Bend?

5. How much more would you receive by selling 500 pounds of UBC alurninum at Terre Haute instead of Lake County?

6. If other things do not change, and the supply of ONP increases, would you expect the price of ONP to increase or decrease?

7. If other things do not change, and the demand of OCC increases, would you expect the price of OCC to increase or decrease?

8. If other things do not change, and the supply of glass decreases, would you expect the price of glass to increase or decrease?

9. If other things do not change, and the demand for UBC aluminum decreases, would you expect the price of UBC aluminum to increase or decrease?

Is It Worth It Worksheet?

1. On the map of Indiana neatly label the 12 cities found on the Market Monitor table. Under each city location write the local price of UBC steel, UBC aluminum, and ONP, using a different colored ink or pencil to represent each.

2. With a ruler, draw lines between the cities below. Using the scale, compute the distance between the cities. Put the distance on the map and in spaces below.

   New Albany – Columbus _____ miles

   Logansport – Indianapolis _____ miles

   Indianapolis – Lake County _____ miles

   New Albany – Evansville _____ miles

3. a. Suppose you collected and sold 500 pounds of UBC aluminum in Columbus. How much money would you receive?_____
   How much more would you receive if you sold 500 pounds in New Albany?

   b. Suppose it costs 25 cents a mile to transport the 500 pounds. Would you make the trip to New Albany to sell it? Show your computations._____

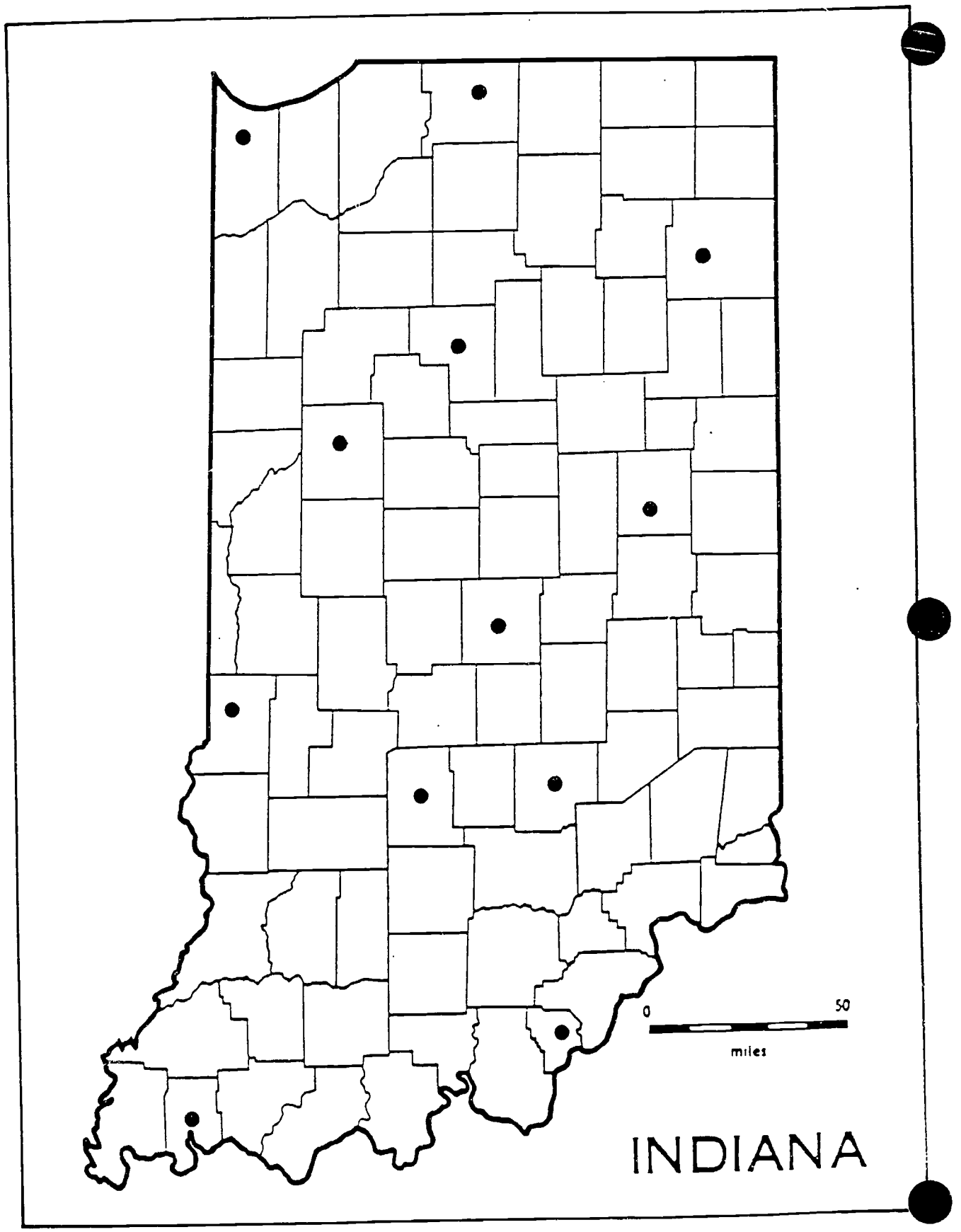
4. a. How much more would you receive if you sold 3000 pounds of UBC Steel in Indianapolis instead of Lake County? _____

   b. Would it be worth taking 3000 pounds from Lake County to Indianapolis if it costs 25 cents a mile? Show your computations. _____

5. a. How much more would you receive if you sold 15 tons ONP in Logansport instead of Indianapolis?_____

   b. Would it be worth taking the ONP from Logansport to Indianapolis if the cost was 25 cents a mile? Show your computations._____

   c. Suppose it takes a half day to make the trip, and that if you do, your opportunity cost is the chance to earn $35 mowing lawns. Would you still drive to Logansport? Show your computations._____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INDIANA

Investigating Your Own Community

1. Survey five families in the community by asking these questions. Summarize and share your findings.

   a. Are you presently recycling?
   b. What products are you recycling?
   c. Would you recycle if recycling drop-off areas were near? Why or why not?
   d. Whose responsibility is it to recycle?

2. Compile a list of recycling businesses in your community. Visit several of these recycling companies and interview the owners. Compose at least five questions to ask during the interview. Some suggestions are:

   a. What products do you recycle?
   b. What prices do you pay for glass, aluminum cans, paper, plastics, etc.? Does the market affect what you pay for recycled products?
   c. How many employees do you employ? What are their average hourly wages?
   d. Where do you send your recycled materials?
   e. How do you feel recycling will change in the next 30 years?

3. Investigate how leaves and yard waste are disposed of in your community. Is leaf burning allowed? If so, what are the rules regulating it? Is there a composting program? How much does it cost? Is compost available for citizens to use?

4. Is solid waste disposal in your community handled by public or private haulers or both? What are the garbage hauling rates? How have these rates changed over the last five years? Why?

5. Locate the landfills used by your community on a map. What are the tipping fees? What kinds of wastes are allowed or not allowed? What percent of waste comes from outside the community or state? When will the landfill have to close? Is the landfill environmentally safe?

6. Does your community have a recycling program? How does it work? Is there curbside pickup? What type of materials are collected? What is the overall cost of the program compared to the revenues?

7. Contact local private haulers of trash in your community. What are the different services provided? What are the rates? What are the wages and salaries of employees? Is the business growing? Is the business making a profit? Is the business headquarters in your community or somewhere else? In what way does this business benefit the community?

8. Visit a local hardware store. List the things you can buy without packaging. What things have packaging? What purpose does the packaging serve?

9. Visit a trash incinerator plant.

10. Investigate various career opportunities in recycling, environmental management, etc.

Debating the Issues

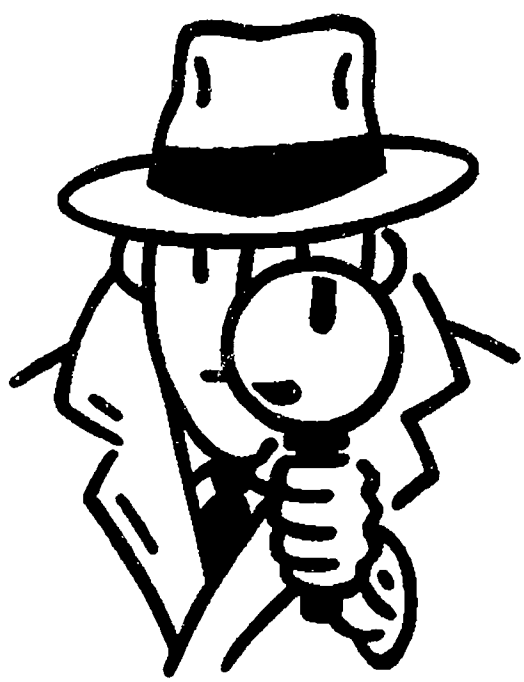
1. Recycling programs should be mandatory, and citizens who do not comply should be fined.

2. Communities should require individual citizens to separate recyclables at home in different containers, instead of having this done at centralized recycling facilities.

3. Communities should recycle even when it costs less to use an environmentally safe landfill.

4. Instead of a flat fee, communities should charge citizens for each bag of garbage picked up.

5. Debate the statement, "Money (costs) should be a major consideration when starting a recycling program."



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EEE Actions: You Can Make a Difference!

1. Make it a policy to take only food you will eat. Remember, many people in the world do not have enough to eat, and wasting food raises food prices for everyone.

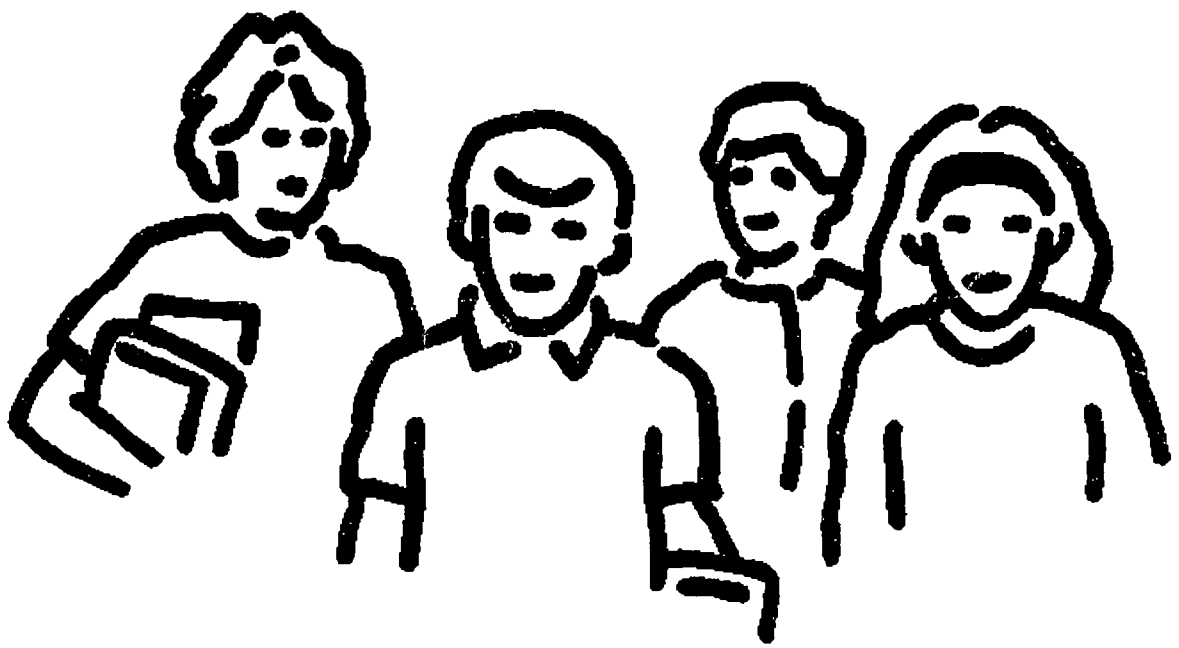
2. Buy products that are not over-packaged. Encourage your parents to buy fresh vegetables and fruits.

3. Write an article for the school newspaper which focuses on the food, energy, and natural resources wasted in the school cafeteria.

4. Diagram the construction of an environmentally safe landfill. Use reference sources to help you.

5. Compute how much paper trash is generated by your class/school/home during a specific time period. Design a plan for reducing this trash.

6. Design and build a compost pile. Use appropriate reference resources.



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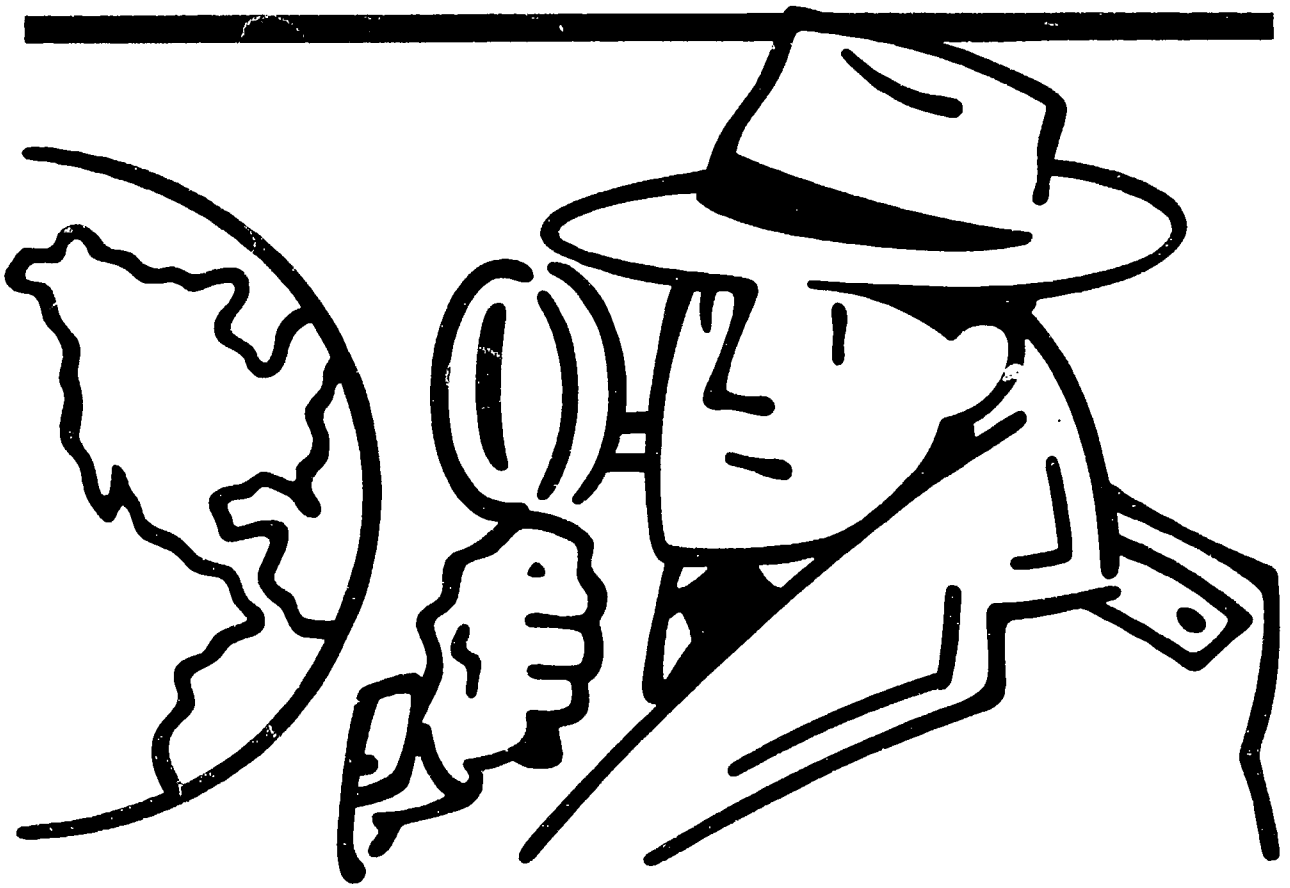
AIR POLLUTION BURNING LEAVES



Facts About Air Pollution

Did You Know That . . .

The term **ambient air** means the "air all around us."

The atmosphere is approximately 500 miles thick; however, 50 percent of the air is within 3 1/2 miles of the earth's surface and 95 percent of the air is within 12 miles.

There are two basic **forms of air pollution:**

1. Particles (dust, smoke, mists, etc.) and
2. Gases (carbon monoxide, sulfur dioxide, etc.)

Air pollutants are also produced by nature, e.g., pollens, spores, bacteria, soil dust, and volcano and forest fire emissions.

Air pollutants are classified as either primary or secondary pollutants. **Primary pollutants** are emitted directly from identifiable sources and are found in the same chemical form as when emitted. **Secondary pollutants** undergo chemical changes in the atmosphere resulting from the reactions among two or more pollutants.

The National Ambient Air Quality Standards (NAAQS) identify widespread and common pollutants shown to be harmful to human health and welfare. These **criteria pollutants** are: carbon monoxide, sulfur oxides, nitrogen dioxide, ozone, particulate matter, and lead. Hydrocarbons were taken off the list in 1983.

Most of the pollutants in the air originate from the **incomplete combustion** of fossil fuels used in transportation, heating, and industrial production. (If combustion was perfectly complete, the result would be carbon dioxide, water vapor, and ash.)

There are five primary **air pollution sources**. The approximate break down by source is:

1. Transportation (especially motor vehicles)	56%
2. Stationary Source Fuel Combustion (energy producing power plants)	22%
3. Industrial Processes	15%
4. Miscellaneous	5%
5. Solid Waste Disposal (usually incineration)	2%

The three basic ways to control air pollution are:

1. Prevent the formation of air pollutants.
2. Collect pollutants before they reach the atmosphere.
3. Dilute the concentrations of pollutants by better dispersion.

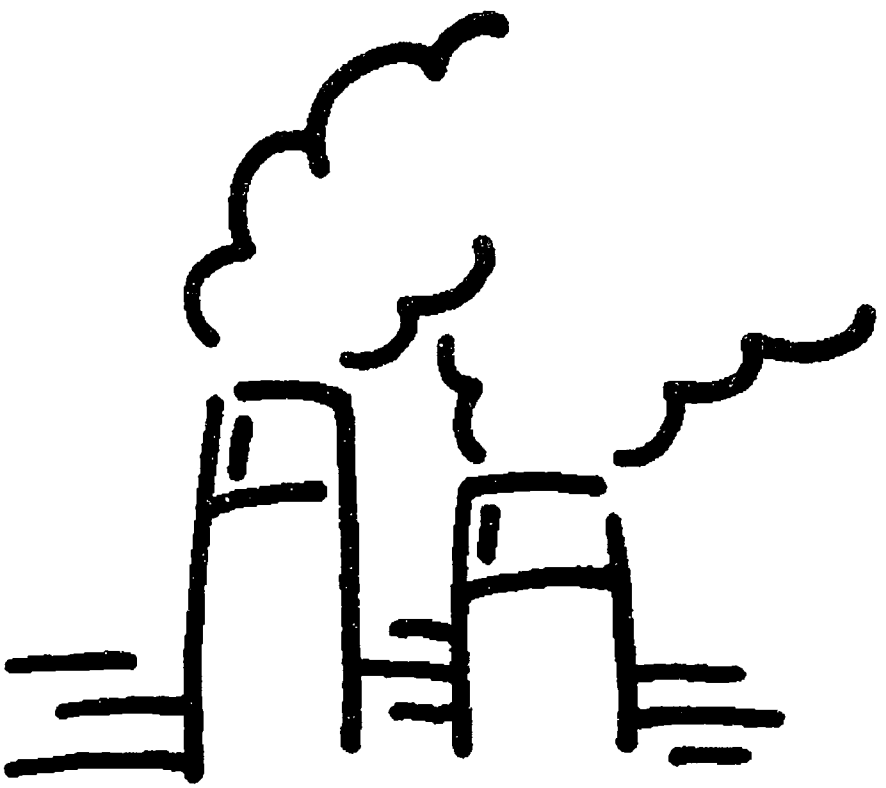
For air pollution control devices on an automobile to operate effectively, the carburetor must be adjusted properly, and the engine must be tuned.

The **catalytic converter** process on cars produced since 1983 eliminates 96 percent of harmful emissions (known as volatile organic compounds, or VOCs). Pre-1983 cars emit about 85 percent of the pollution, yet, only account for about 45 percent of the cars on the road!

The principal sulfur-containing pollutant gas is sulfur dioxide. Most sulfur dioxide (SO^2) pollution comes from the combustion of fossil fuels (especially, high sulfur coal) at power producing facilities, such as utilities.

Acid rain is precipitation that has a relatively high acidity level. Acid rain occurs when sulfur dioxide (and to a lesser extent nitrogen oxides) reacts with other substances in the atmosphere and is converted to acids. Rain falling through a clean atmosphere has a pH range of 5.6 to 7.0 pH units. While all rain is slightly acidic, acid rain is defined as having a pH lower than 5.6. Acid rain has adverse affects on bodies of water, decreases visibility, and corrodes buildings and monuments.

Ozone (O^3) is a gas that is a pollutant at ground level. It is formed when hydrocarbons combine with other pollutants, such as nitrogen oxides, in the presence of sunlight. Ozone is the primary component of smog. However, the ozone occurring naturally 6-30 miles in the stratosphere is "good" ozone and is our main shield against the sun's ultraviolet radiation.



Criteria Pollutants

National Ambient Air Quality Standards (NAAQS) identify widespread, common pollutants that have been shown to be harmful to human health and welfare. These pollutants are called criteria pollutants.

Pollutants	Symbol	Form	Type
Carbon Monoxide	CO	gaseous	primary
Sulfur Oxides	SOx	gaseous	primary
Nitrogen Dioxide	NO^2	gaseous	primary
Ozone	O^3	gaseous	primary and secondary
Particulate Matter	TSP	particulate	primary and secondary
Lead	Pb	particulate	primary
Hydrocarbons*	HC	particulate	primary

* This standard removed from list in 1983.

Air Pollution Vocabulary

Acid Rain	rain with a relatively high (less than 5.6 pH) acidity
Ambient Air	the air all around us
Catalytic Converter	device on motor vehicles that removes ozone-causing emissions
Criteria Pollutants	widespread and common pollutants identified as pollutants harmful to human health and welfare (carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, particulate matter, lead)
External Cost (Spillover Cost)	when the harmful effects (i.e., negative externalities) of pollution are imposed on individuals not directly involved in the buying and selling decisions that caused the pollution.
Incineration	burning waste materials
Marginal Cost of Pollution Control	the cost of eliminating an additional amount of pollution
Marginal Benefit of Pollution Control	the benefit of eliminating an additional amount of pollution
Ozone (O^3)	a ground level pollutant formed by the interaction of sunlight on nitrogen oxides and hydrocarbons, the primary ingredient of smog; also, a protective layer in the stratosphere 6-20 miles thick that helps block ultraviolet radiation from the sun
Particulate Matter	very small solid or liquid particles that are suspended in the air, such as dust, smoke, pollen, etc.
Primary Pollutant	a pollutant emitted directly from an identifiable source and found in the same chemical form as when emitted
Smog	a pollutant composed mainly of ozone that is formed when sunlight reacts with hydrocarbons and nitrogen oxides, pollutants emitted primarily by motor vehicles
Tipping Fees	the dumping fees for putting solid waste in a landfill
Trade-off	giving up some of one thing in order to get some of another

CASE STUDY

The Case of the Burning Leaves

Teaching Instructions

Overview:

In the case study, students analyze how a growing community deals with the air pollution caused by backyard leaf burning. Students will learn how the harmful effects (external costs) of this practice have led many communities to ban leaf burning. The alternatives usually are landfilling, mass incineration, or some form of composting. As your students will see, the solution is not always clear cut, and there is often disagreement. Your students will learn that environmental issues are often interrelated because many concepts about solid waste disposal from Unit 1 are encountered again.

Learning Objectives:

After completing the case study, students will:

1. Apply a five step, decision-making model to solve a problem affecting a community.
2. State why pollution from burning leaves results in external costs.
3. Identify the advantages and disadvantages of personal and city wide composting, landfilling, and incineration as solutions for leaf disposal.
4. Understand that policy decisions usually involve trade-offs.
5. Identify the opportunity costs of various leaf disposal options.

Prerequisite Skills:

Students must know how to apply the five step, decision-making model to solve a problem. This involves making decisions based on personal and group goals and communicating ideas in a group setting.

Important Concepts to Emphasize:

Pollution Control Efforts Involve Costs. Efforts to control pollution benefit the environment. However, these efforts are not costless, since they require the use of scarce productive resources. It takes resources to compost leaves, burn them in incinerators, or put them in landfills. To protect cities from smog, individuals must pay the cost of installing catalytic converters. As economists are fond of saying, "There is no such thing as a free lunch!" **Cost is a primary criterion to consider when making decisions about pollution control.**

Pollution and External Costs. The smoke from the burning leaves was an external cost (spillover cost) imposed on Mrs. Johnson. The external costs of air pollution arise because no one owns the air, and there is no cost for using it. Government often intervenes to correct this problem, usually, with regulation and/or taxation. The government tries to "internalize" these external costs, so the producers and consumers who benefit from using the air bear the cost.

Methods for Dealing With Solid Waste. Students should know the five basic methods for dealing with solid waste: source reduction, reuse and recycle, composting, landfilling, and incineration. With leaf disposal, the first two methods are impractical, so communities use the last three methods. Below are the advantages and disadvantages of these methods as they apply to leaf disposal.

Citywide Composting:

Advantages

a. Returns organic matter to the environment
b. Reduces amount of waste put in landfills

Disadvantages

a. Can be costly to implement and maintain
b. Compost must be redistributed back to citizens
c. Results in some air pollution from transporting

Personal Composting:

Advantages

a. Relatively inexpensive to implement
b. Most compost gets returned to environment
c. Results in no air pollution

Disadvantages

a. Regulating/insuring compliance can be costly or impractical
b. Can cause odors and animal problems

Landfills:

Advantages

a. Easy to implement
b. May be a relatively low cost solution
c. Organic wastes, such as leaves, are not harmful to landfills

Disadvantages

a. Increasingly costly as landfill rates increase
b. Doesn't return organic matter to home sources
c. Results in some pollution from transporting

Mass Incineration:

Advantages

a. Relatively low cost method for larger cities
b. Results in much less air pollution than individual leaf burning
c. Can burn all trash, not just leaves
d. Heat from combustion can be used as an energy source, reducing the use of coal, oil, etc.

Disadvantages

a. Returns no organic matter to the environment
b. Results in some air pollution
c. The ash from trash incineration (not just leaves) is more concentrated and toxic than unburned trash. The ash must be put in a properly prepared landfill.

Trade-Offs. When policy decisions are made, there are usually trade-offs. For example, if Mrs. Johnson accepts Mr. Lucano's proposal to stop leaf burning and use the landfill, she gains cleaner air and better health, but gives up the benefits she perceives from having a compost program.

Opportunity Costs. Whenever decisions are made, there are always opportunity costs. For example, if the city chooses to continue leaf burning, the opportunity cost is poorer air quality and health problems for some citizens. If the city implements Mrs. Johnson's proposal, the opportunity cost would be all of the other things that would have been purchased from the $3 a month fee collected from each household.

Teaching Suggestions:

1. Hand out the case study scenario. Divide your class into small groups, and let each determine a solution to the case study. Have groups report their solutions to the class.

2. To teach the five step, decision-making model, use the *Give and Take* videos "You Choose: Scarcity and Personal Decision Making," and "We Choose: Scarcity and Social Decision Making" (available from the Indiana Council for Economic Education). An explanation of how to use the five step model to solve an environmental problem is given in the Introduction.

3. Students probably will list criteria other than those given in the suggested solution grid below.

4. While other leaf disposal options are discussed in the scenario (personal composting, incineration), in their decision, grid students should list only the three alternatives presented at the town meeting: Do Nothing, Citywide Compost Program, and Landfilling.

5. Students may disagree when completing the grid. The "$ Cost/Landfill" cell is especially interesting. There is a "?" in the cell; however, some students may put a "+" since the current landfill costs in Rosedale are low. Students could logically reason that only if landfill rates increase in the future would it be logical to shift to a compost program.

Key Questions to Ask Students:

1. What are the five basic methods of dealing with solid waste? (source reduction, reuse and recycle, composting, landfilling, incineration) Which are not practical for leaf disposal? (source reduction, reuse and recycle)

2. Which of the two basic **forms of air pollution** is the smoke from burning leaves? (Particles) Which of the **criteria pollutants** is smoke? (particulate matter)

DECISION-MAKING GRID ANSWER KEY
The Case of the Burning Leaves

	CRITERIA				
ALTERNATIVES	Safety	$ Cost	Helps environment	Fairness	
Do nothing (Allow burning)	–	+ +	–	?	
Citywide compost program	+	–	+	?	
Leaves in landfill proposal	+	?	–	?	

3. What are the advantages and disadvantages of landfilling, composting, and incineration when dealing with leaf disposal? (See advantages and disadvantages in Important Concepts to Emphasize section above.)

4. What are some examples of scarcity in the case study? (scarcity of landfill space, scarcity of clean air in the fall, scarcity of income)

5. Why is smoke from burning leaves an **external cost?** (Costs are imposed on others who do not benefit from the leaf burning.)

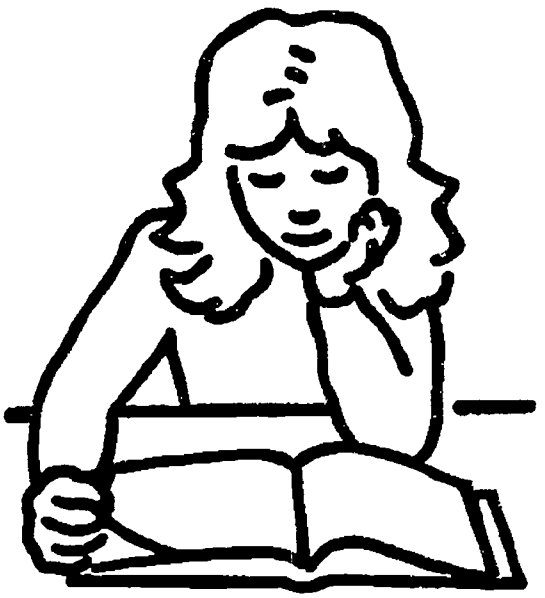
6. In the case study, what are the opportunity costs of banning leaf burning and implementing a citywide compost program? (the other things that would be purchased with the money used for the program) What are the opportunity costs of continuing to allow leaf burning? (increased health costs for some citizens, poorer overall air quality)

7. What is the trade-off for Mrs. Johnson if the city adopts a landfill program? (She gets relief from smoke, but gives up the benefits of a composting program.)

8. What limits officials from raising taxes to implement leaf disposal programs? (Citizens do not want a reduction in their income available for consumer purchases.)

Other Teaching Materials:

"Innocent Bystanders," from the *Trade-Offs* video series, designed for fifth and sixth grade students, covers the concept of externalities.



The Case of the Burning Leaves

Student Directions:

1. In the case study below, some citizens deal with a very real problem—how to dispose of leaves each fall. Different cities and towns have adopted different solutions to this problem.

2. Analyze the case study below and use the Decision Worksheet and the Decision Grid to help you determine a solution to the leaf disposal problem.

3. Be prepared to defend your final decision!

Scenario:

It had been a beautiful fall in the growing city of Rosedale. The trees were full of color, and Mrs. Carolyn Johnson should have been in the best of spirits. There was only one problem—her asthma was acting up again, as it always did when there was smoke in the air. As usual, the smoke from burning leaves was the problem. It seemed that all her neighbors had huge piles of leaves that they burned. This year, however, Mrs. Johnson decided to do something about it.

She called the Rosedale City Hall and asked to speak with the sanitation department supervisor, Mr. Ralph Simmons. He was sympathetic, but warned Mrs. Johnson that people in Rosedale might not like to have to pay for other ways to get rid of leaves. "That doesn't matter," said Mrs. Johnson. "Their leaf burning is causing me health problems. Why should an innocent bystander, like me, be forced to pay for their actions? I'm also afraid that sparks might cause a fire in the neighborhood, and the smoke makes it difficult for drivers to see children walking or playing near the streets."

That day Mrs. Johnson investigated other ways cities and towns handle leaf disposal. She discovered that leaves are sometimes put in landfills because the leaves decompose and are not dangerous like toxic wastes. Other cities have composting programs. Leaves are collected and placed in compost sites, where they take about two years to decompose. The compost is then offered to citizens to use on their gardens or lawns. In some places, citizens are encouraged to construct small compost piles on their own property for disposing of organic wastes. This avoids having to maintain a central compost site, but other problems occur. Incorrectly built compost piles can result in odors and can become infested with rats and mice. Finally, Mrs. Johnson learned that in larger cities, leaves and other trash are often gathered and burned in large incinerators.

At the next city council meeting, Mrs. Johnson proposed that leaf burning be banned in Rosedale, and that the city start a leaf compost program. Rosedale would purchase land for the site and maintain the compost site throughout the year. Citizens would pile leaves on the street for city pick up. To pay for the program, the city would add $3 a month to each person's sanitation bill. In her presentation, Mrs. Johnson stressed how air quality

would improve in Rosedale, resulting in less health problems. She was, therefore, rather surprised at the opposition to her proposal.

Sylvia Williams was adamantly opposed to Mrs. Johnson's proposal. She exclaimed, "Leaf burning only takes place for a month or so. True, it hurts air quality, but it really isn't that bad. In any case, I don't have any trees on my property, and I compost the few leaves that blow on my lawn. Why should I have to pay for those who burn lots of leaves? I propose that we leave things as they are now."

Sam Lucano, who had a yard full of trees and who didn't particularly like burning leaves each fall, was not totally opposed to Mrs. Johnson's proposal. However, he thought that instead of a composting program, the city should just put the leaves in the local landfill. "Right now, there is adequate space in our landfill, and it would be cheaper than starting a new composting program. I propose that we require citizens to put their leaves in biodegradable bags and put them out with the other garbage. Right now, that would only add about $1 a month to each sanitation bill. Bagging leaves would be safer than piling the leaves on the street. No matter how much you warn them, children still play in the leaf piles on the street."

Mrs. Johnson responded, "It's true that it would cost more now to start a composting program, but what about the future? As our landfill fills up, the tipping fees certainly will become more expensive. And doesn't it make sense to return compost back to our lawns and gardens where it can do some good, instead of putting it into a landfill?"

The City Council decided to review all the proposals before making a decision. The vote will take place next Monday night.

CLASSROOM ACTIVITIES - Unit 2
Air Pollution

Classroom Activities:

The following classroom activities are recommended for this unit.

1. Each Breath We Take
2. White Glove Test
3. Investigate Your Community
4. Debating the Issues
5. EEE Actions

State Proficiencies:

The activities in these EEE lessons are correlated with the *Indiana Curriculum Proficiency Guide* which emphasize the process of learning through direct experience.

Science

* Predicting skills
* Analyzing skills
* Experimenting
* Researching skills

Mathematics

* Calculating
* Computing
* Graphing
* Tabulating

Social Studies

* Tracing products
* Decision making
* Comparing systems
* Mapping skills

Language Arts

* Interviewing skills
* Debating skills
* Surveying
* Communicating skills

Each Breath We Take

Learning Objectives:

Students participating in this program will:

1. Gain the knowledge, experiences, and skills to enable them to take action to conserve and monitor air resources.

2. Value the importance of air resources to plants, wildlife, and people.

3. Support programs to ban smoking in public buildings and areas where it is a health hazard to others.

Overview:

This lesson focuses on air quality in the local environment. The lesson, also, suggests activities which encourage students to investigate how smoking effects human health and how people feel about smoking. Emphasize to your students that air quality effects everyone, not just adults.

Air is a vital natural resource. We can live much longer without water and food. Holding one's breath for 30 seconds will demonstrate the importance of air to the human body. Each person requires oxygen 24-30 times per minute. Wildlife, also, requires oxygen—rabbits, deer, birds, bugs, frogs, snakes, and eagles.

For years, our air resources have been abused and contaminated. Air has been contaminated with carbon dioxide, smoke, sulfur dioxide, and poisonous chemicals and gasses. Humans treated the air like it was a resource which had no value. It was free and appeared to be in unlimited supply. Air pollution became so bad in large cities throughout the world that children were not allowed to play outside. Air pollution, also, damaged buildings, agricultural crops, forests, plants, and wildlife.

In the 1970s, the situation became serious enough to motivate individuals, businesses, and governmental and environmental agencies to take action to improve air quality. A federal clean air act was passed and the Environmental Protection Agency (EPA) was assigned the responsibility of enforcing the new legislation. As a result of a national coordinated effort, the public was made more aware of the air pollution problems threatening the earth. In just a few years, air quality had improved greatly.

To maintain this environmental momentum, schools must teach students to make wise decisions about conserving air resources. This will help insure that future generations have the knowledge and skills to monitor and manage the earth's airsheds.

Notes to the Teacher:

The enrichment activities in this unit provide opportunities for you and your students to work closely with the community. Air pollution is an environmental topic that can be exciting and challenging to your students. Emphasize to them that although producing goods and services affects air quality, wise and careful use of air resources can insure a clean environment and a sound economy.

Student Activities:

1. Place a white sock over the cool tail pipe of the family car. Have a parent start the car, letting it run for one minute. Carefully remove and examine the sock. Write down observations. Predict what effects this pollution has on the environment.

2. Design a plan to help reduce the amount of air pollution in the environment. The plan could include not burning leaves, riding a bicycle as often as possible, keeping the family automobile(s) properly tuned and serviced, etc.

3. Investigate the impact coal has on air pollution and on the acidity of rain.

    a. Research what happens when high sulfur coal is used to make electricity. What effect does the burning of this coal have on air quality? What effect does the burning of this coal have on fresh water lakes in New York, Michigan, and Canada? What affects the acidity of rain? What are Indiana utilities doing to reduce air pollution?

    b. Interview a representative from a local utility to determine what is being done to improve the quality of air. Assist the students in composing good questions to ask during the interview. Have another team of students interview a scientist to gather important data and information about what is being done by the utilities to improve air quality. Compare and contrast the data and information collected to decide whether or not enough action is being taken to protect our air and water resources.

    c. Investigate the additional costs utilities must pay to improve air quality. Find out how these costs are passed on to the customers.

    d. Study the Clean Air Act of 1990. What will be the additional costs to the rate payers?

4. Research the impact that smoking tobacco has on the lungs, other people, plants, and the air quality within a building. Interview at least ten people to find out how they feel about smoking. Compose five questions to ask during the interviews. Have each student ask the same questions. Report this information to the class. Graph this data on a chart. Analyze this data and information. What does it tell us? Have students write a letter to a child in the year 2020 stating why individuals should or should not smoke. Design a nonsmoking pledge and try to recruit five people to sign it, including family members.

5. Predict the levels of air pollution in the year 2020 if Americans manage air resources more effectively. Interview environmental health specialists, energy experts, and high school science teachers to find out the major causes of air pollution. Take a walk around the community to look for good and bad examples of air quality.

The White Glove Test—How Clean Is Clean?

Learning Objectives:

After completing this activity, students will understand that:

1. It is costly to clean the environment.

2. Individuals usually clean the environment by doing the least costly activities first.

3. It is too expensive, in terms of opportunity cost, to have a 100 percent clean environment.

4. Individuals differ on their definition of a "clean" environment.

Overview:

This motivating group activity forces students to address the difficult question, "How clean is a clean environment?" Students learn a very important economic concept—that the opportunity cost of continuing to clean up the environment eventually becomes too great. That is, the marginal (extra) cost and effort required for additional environmental cleanup, at some point, is not worth the marginal (extra) benefit. When this situation is reached, scarce productive resources used for cleanup would best be used elsewhere.

Notes to the Teacher:

Important! Make sure you have enough "polluting materials," since some materials should be left after the first round. You'll be surprised how well 25 students can clean up a classroom in a minute!

Student Activities:

1. When your students are out of the classroom, litter the floor with a variety of different sized "polluting materials." Possible suggestions: books, balls of scrap paper, popcorn, pencil sharpener shavings, sawdust, small dots of paper from a paper punch.

2. When the students arrive inform them that a mysterious polluter has littered their classroom, and they have to clean it up. To make the cleanup more interesting tell the students you have decided to make a lesson out of this task.

3. Students must clean the room in three one-minute rounds. After each round, students must record on the board what they have picked up. By the end of the third round, the room should be rather clean.

4. After the third round ask, "Is our classroom environment clean now?" After the students agree that it is, use a white glove or handkerchief and find dusty areas of the room that obviously are **not** clean. Ask students why they said the room was clean when obviously it was not.

5. Discussion questions:

   a. Are all classrooms "polluted?" Are all environments? (Yes. All production and consumption results in some pollution.)

   b. Why did you say the classroom was clean when the "white glove" revealed it was not? (It was clean enough. There were dust and other tiny bits of pollution, but they were not very noticeable.)

   c. Why did you clean up the larger items of pollution first? (It was easiest and it resulted in a clean room very quickly. In other words, the cost was small and the benefit was great.)

   d. Why didn't you clean up **all** the pollution, including the dust, etc? (It would take too much time to clean room perfectly. The extra cleanliness was not worth the extra effort. Time would be better spent studying, etc.)

   e. What was the opportunity cost of continuing to clean the room? (The other valuable things that could be done with the time, such as studying.)

   f. After completing the first round, was the room clean enough for some people, but not for others? Is your room at home ever clean enough for you, but not for your parents? (Yes. One of the difficulties of solving environmental problems is that people have different tolerance levels for pollution.)

6. Relate this activity to cleaning the real environment. Students should understand that some pollution is inevitable and that it is too costly to make the environment 100 percent clean. After some point, it is better to use scarce productive resources for other valuable purposes instead of continuing to strive for a completely pollution free environment.

(An original version of this activity appeared in the article "A Clean Environment, A Matter of Choice," by Robert W. Reinke and Diane W. Reinke, in *The Elementary Economist,* Spring 1989.)

Investigating Your Own Community

1. Use these and other questions to survey at least ten people in the community. Find out what they do to help improve air quality. Report findings to the class.

   a. How often do they tune their automobile(s)?
   b. Do they burn leaves?
   c. Do they smoke?
   d. Do they feel smoking should be banned in public places?

2. Research the effects of air pollution on buildings, forests, and public recreational areas. Locate five examples of good air resource practices in the community.

3. Research what different cities in the United States and world did to improve air quality—Pittsburgh, London (England), Tokyo (Japan), etc.

4. Research the Environmental Protection Agencies pollution standards for air quality and compare these standards with your community. Contact the Indiana Department of Environmental Management for assistance with these standards. Find out how much air pollution can be tolerated before it becomes a health hazard.

5. The "What's In Our Garbage" table in Unit 1 shows that 17.9 percent of our garbage is yard waste. Investigate how your community disposes of leaves. How costly is it? Is burning leaves allowed? Invite a community official to class to discuss this issue.

6. List all the evidence of air pollutants around your school, home, and neighborhood (dust on cars, smokestack omissions, etc.).

7. Research what kinds of mass transit systems are available in your area. Are they sufficient to meet the needs? Are they underused? Why? What could be done to get more people to use mass transit systems?

8. Survey people in your neighborhood or community who have lived there for many years. Ask how the sources of pollution have changed over the years. Has the quality of the air become better or worse? Document the dates and results. Graph results on the board.

9. For one month, keep a diary of the air quality in your community. Note how changes in weather affect air quality.

10. Investigate how Indiana defines these three stages of air pollution: air pollution alerts, air pollution warnings, and air pollution emergencies. Find out what measures should be taken at each stage.

11. Examine natural air pollution in your community. Cover several microscope slides with petroleum jelly and suspend them with clothespins in areas where natural pollution readily occurs, such as on a fence post or clothesline. Also, suspend them in "protected" areas, such as a closet. Examine the slides under the microscope. Note the different types of pollution and the difference in pollution amounts because of slide location.

    (Hint: Keep slides clean until suspending them in polluted areas and cover slides when removing them.)

12. Interview a car dealer or mechanic in your community to find out what kinds of pollution control devices are on automobiles. How does this vary from car-to-car and from year-to-year?

13. Interview people in the community to find out how serious they feel the pollution is. Who do they think are the main polluters? Are pollution control regulations sufficient? Who is responsible for air pollution?

14. Find out from community officials what procedures new firms or industries must follow to be allowed to build a plant in your community. What pollution control regulations are required?

Debating the Issues

1. To improve air quality, large cities should ban automobiles and require citizens to use mass transit systems to and from work.
2. Smoking should be banned in all restaurants.
3. Pre-1983 cars on the road produce 83 percent of the auto emissions. These cars should be banned, requiring individuals to purchase newer models.
4. Since high-sulphur coal contributes greatly to air pollution, utility companies should be required to convert to natural gas, even if this means much higher electric bills.

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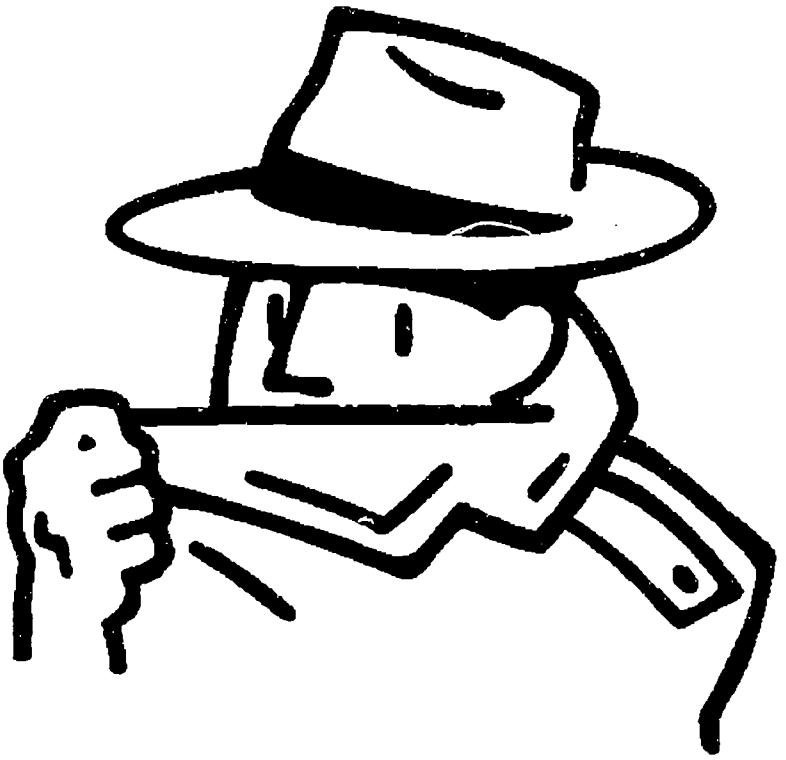
EEE Actions: You Can Make a Difference!

1. If you smoke, stop smoking NOW!
2. Try to get your family to stop smoking.
3. Ride your bicycle or walk, whenever possible, to save energy and help improve air quality.
4. Refuse to burn leaves—start a compost pile.
5. Support community efforts to ban smoking in all public buildings.
6. Plan a bicycle outing for you and your family to a nearby park.
7. Find out if your family's car needs a tune-up. Help do it yourself!



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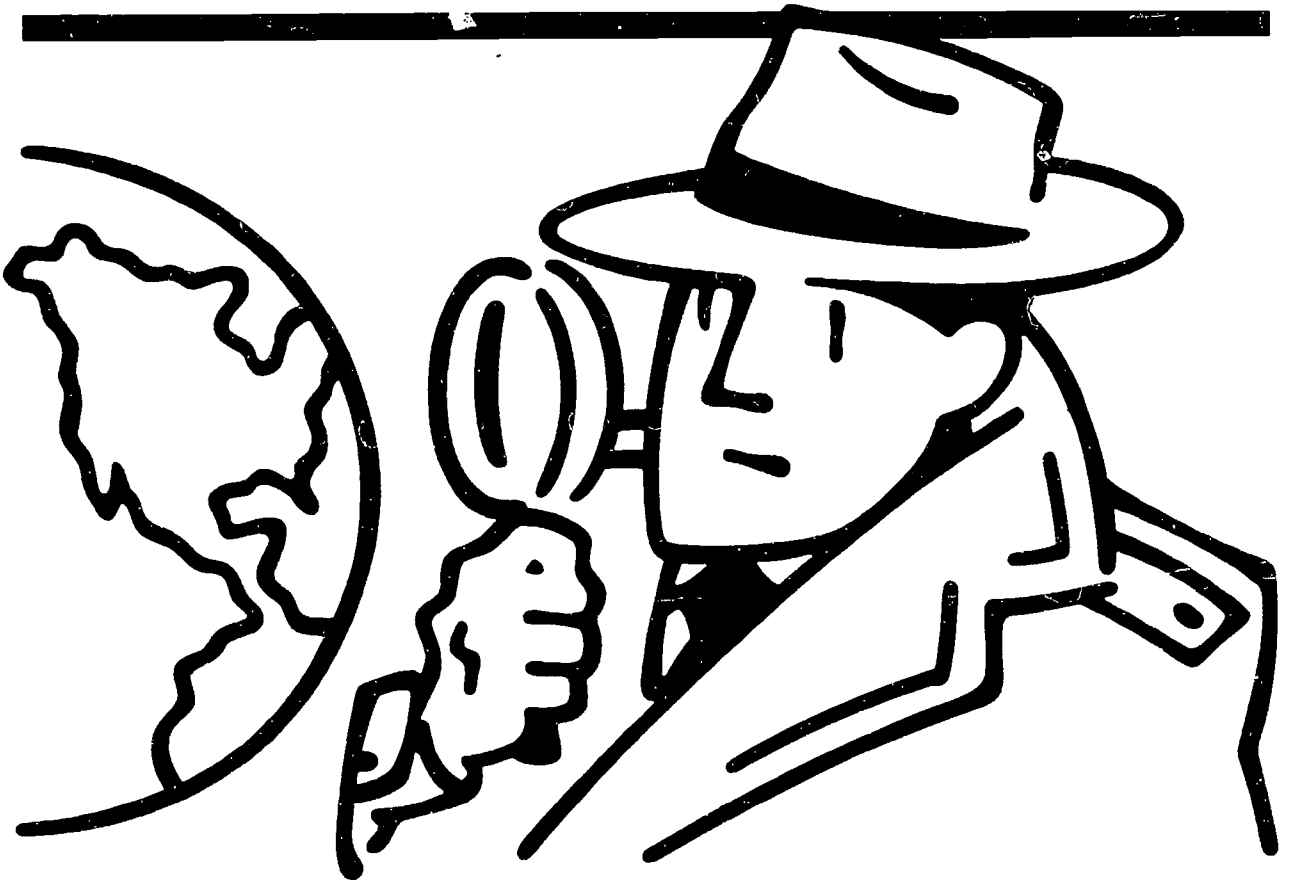
ENERGY POWER PLANTS



Facts About Energy Resources

Did You Know That . . .

Energy can be defined as the capacity to do work.

The unit of measurement used to measure the heat contained in energy resources is called a **British Thermal Unit** or **Btu**. One Btu is the heat energy needed to raise the temperature of one pound of water one degree Fahrenheit. A Btu is quite small. For example, if allowed to burn completely, a wooden kitchen match gives off one Btu of energy. A **quad** is used to measure large amounts of energy. A quad is equal to one quadrillion (1,000,000,000,000,000) Btu's. The United States uses one quad of energy every 4.5 days.

The daily per capita (per person) energy use in the United States is equal to the amount of energy stored in a little over 7 gallons of gasoline, 80 pounds of coal, or 107 pounds of seasoned hardwood.

There are many **primary sources** of energy in the United States, including petroleum, coal, natural gas, nuclear, hydropower, propane, geothermal, wind, solar, and biomass. Figure 1 shows the 1989 breakdown of consumption by energy source.

The United States has greatly increased its energy efficiency since 1973. In 1989, the United States used about 7 percent more energy than it did in 1973; however, there were over 20 million more homes, 50 million more vehicles, and the value of the nation's **gross national product** (the total value of all the goods and services produced in the economy in a year) was 46 percent higher.

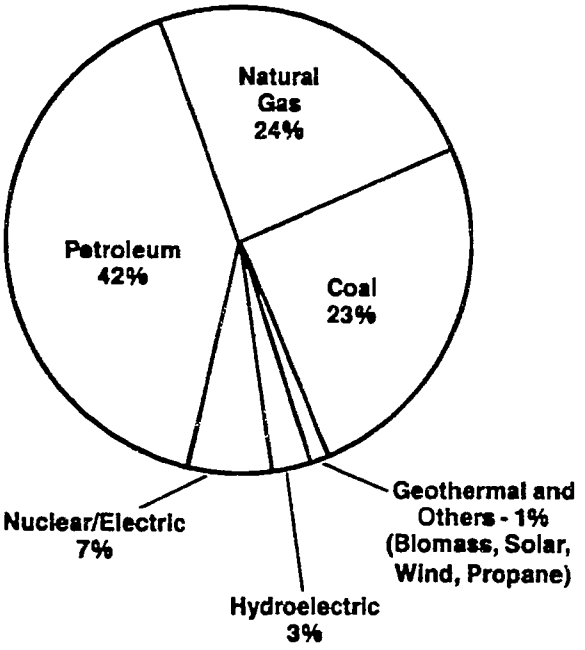
This increase in energy efficiency was largely due to the response to higher energy prices. In 1973, the Organization of Petroleum Exporting Countries (OPEC) cartel reduced oil supplies to the industrial nations. This action, and the reduction of oil supplies during the Iranian hostage crisis, caused the market price to increase dramatically. As a result, people and businesses used less energy and developed new energy efficient technologies. To a lesser extent, public concern about the environment was a factor.

Electricity:

Electricity is a **secondary energy source**. This means that we must use other **primary sources** to make electricity. About 28 percent of all primary energy consumed in the United States is used to generate electricity. Coal, nuclear, hydropower, natural gas, and petroleum were the top five primary sources for producing electricity. Unlike the primary sources, electricity is not classified as **renewable** or **nonrenewable.**

FIGURE 1

U.S. Primary Energy Consumption By Source 1989



There are basically three types of electrical power plants—fossil fuel, (coal, oil, natural gas) nuclear, and hydroelectric.

Electricity travels 186,000 miles per second. It is generated in large, central power plants, and is distributed through power lines to homes and businesses. A **watt** is a basic measure of electricity. A **kilowatt** is one thousand watts; a **megawatt** (MW) is one million watts; and a **gigawatt** is one billion watts.

Coal:

Coal is our most abundant fossil fuel. We have more coal reserves than any other nation, enough to last over 300 years at today's rate of use.

There are four major types of coal: lignite, sub-bituminous, bituminous, and anthracite. They are classified by hardness, lignite being the least hard, and anthracite the most hard. The harder the coal, the more efficient it is as a heat source.

Coal is used to make 57 percent of the electricity produced in the United States, more than any other source. Electric power plants use over 80 percent of all the coal used in the Untied States.

There are two basic ways to mine coal: **surface (strip) mining** and **underground mining.** Surface mining is used when coal is found close to the surface. It is used to mine over 50 percent of the coal in the United States. Underground mining is used to extract coal lying deep beneath the surface. It is potentially more dangerous than surface mining, so there are many regulations to ensure worker safety.

The two biggest environmental concerns with coal are the effects of **mining** and **air pollution.** Although coal mining does alter the landscape, federal law requires all mined land to be restored to a land use classification that is equal to or better than its original condition. A company must file an extensive reclamation plan before any mining can take place.

The biggest air pollution concern is with the two byproducts of coal combustion: sulfur dioxide gas and ash particles. When mixed with other chemicals, sulfur dioxide can be a health hazard. Also, sulfur dioxide combines with nitrogen compounds to form acid rain, which can damage lakes, forests, and streams. To reduce sulfur dioxide emissions, companies clean coal before it is burned, increase combustion efficiently, burn higher grade coal, and remove pollutants (often with **scrubbers**) after the coal is burned. Ash particles fly into the air when coal burns, so companies use special devices to trap the particles in the smoke stack.

Petroleum:

The United States consumes more petroleum (42 percent) than any other source of energy. About 6,000 products are made from petroleum. The four biggest users of petroleum in 1987 were transportation (63 percent), industry (25 percent), homes and businesses (8 percent), and electrical utility companies (4 percent).

To be made into gasoline, petroleum is **refined.** Refining removes unnecessary sulfur from oil, which increases gasoline efficiency and reduces pollution.

The largest oil producer in the world is the Soviet Union, followed by Saudi Arabia, the United States, Mexico, Venezuela, and China. However, because of recent political upheaval, oil production in the Soviet Union has fallen.

In 1989, the United States imported 42 percent of its oil, up from 30.5 percent in 1985. This increase was due to falling oil prices, which decreased domestic production and encouraged consumption. The OPEC nations are major suppliers, the leading nation being Saudi Arabia.

Oil is found using **seismic technology.** Special instruments, called **seismographs,** record reflected sound waves created by explosives. These waves give a rough picture of the geological formations and rock layers, providing clues about possible oil deposits. Exploring for oil is very risky, and 19 out of 20 wells come up dry. For this reason, low oil prices, while beneficial for consumers, greatly discourage exploration and production.

Oil shale is sedimentary rock containing an oil-like compound. The United States has substantial oil shale reserves; however, the price of oil would have to double to make shale oil recovery competitive with other sources of energy.

Nuclear Energy:

The basic substance used to produce nuclear energy is uranium; however, the uranium is not burned to produce energy. Instead, large amounts of energy are released when the uranium atoms are split. Atoms are very small. In size, an atom compares to an apple, as an apple compares to the earth.

Uranium is an abundant, nonrenewable resource. At current rates of consumption, uranium reserves are estimated to last over 500 years. A ton of uranium ore in the United States typically contains 3 to 4 pounds of uranium. Most domestic production occurs in Wyoming and New Mexico. In 1987, the United States imported 44 percent of its uranium.

About 7 percent of total United States primary energy consumption comes from nuclear energy, which is used almost entirely to produce electricity. Nuclear energy provides about 20 percent of the electricity in the United States. France, Belgium, and the Republic of Korea rely on nuclear energy for more than 50 percent of their electricity.

In the United States, all nuclear power plants must obtain a permit to begin construction and, later, must obtain a license to begin operations. The Nuclear Regulatory Commission is the agency responsible for licensing.

Obtaining a license is a lengthy process, and local hearings are held so that residents can testify and express their views. The average time needed to complete the construction of a nuclear plant and put it into operation in the United States is 14 years.

Nuclear energy has two major advantages:

1. It is a cost effective method of producing electricity, largely because fuel costs are low.
2. There are no air pollution problems, because the fuel is not burned.

There are also some disadvantages:

1. Disposing of dangerous radioactive wastes must be done in an environmentally safe manner, and choosing disposal sites is politically difficult.
2. Although the safety record for nuclear plants in the United States has been very good, the possibility of an accident is still a concern for many people.

Natural Gas:

Natural gas is a nonrenewable fossil fuel. It is a colorless, odorless gas composed mainly of methane, a natural compound formed when plant and animal matter decays. Natural gas is found trapped underground in porous rocks and is reached by drilling. Natural gas companies add an odorant to give natural gas its characteristic smell.

In the last 25 years, the use of natural gas in the United States has grown significantly, now accounting for 24 percent of our primary energy consumption. The United States produces over 90 percent of its natural gas, which is nearly 30 percent of the world's total

production. Experts estimate that, at current rates of consumption, the United States has at least a 50 year supply.

Industry is the biggest user of natural gas, which is used primarily to fuel boilers in manufacturing. The residential sector is the second largest user. Almost six out of ten homes in the United States are warmed with natural gas. Electric utility companies also use much natural gas. After coal and nuclear energy, natural gas is the third leading fuel for electricity production.

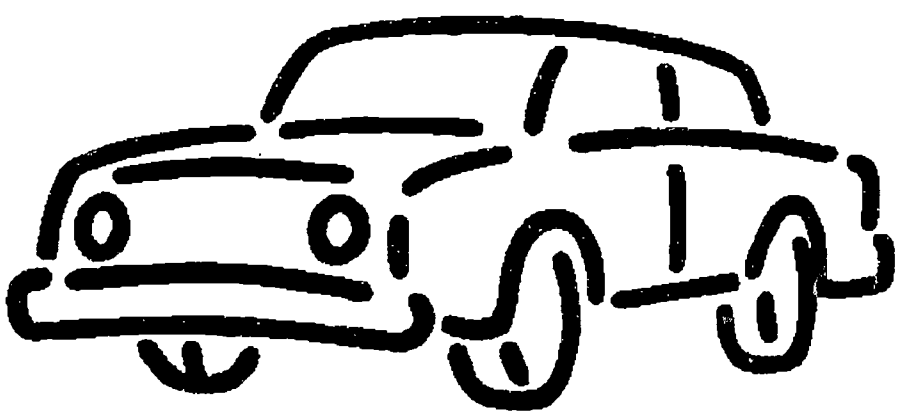
Natural gas can also be used for transportation. It burns cleaner than gasoline, costs less, and is safe to use. Over 30,000 cars, trucks, and buses now run on natural gas.

Natural gas is transported primarily by pipeline. It now can be converted into a liquid state and, thus, can be transported by ship throughout he world. The advantage of liquid natural gas is that it occupies far less space than the gas.

A major advantage of natural gas is that it is relatively safe for the environment; it is cleaner burning than coal and petroleum and emits no sulfur dioxide or ash particles.

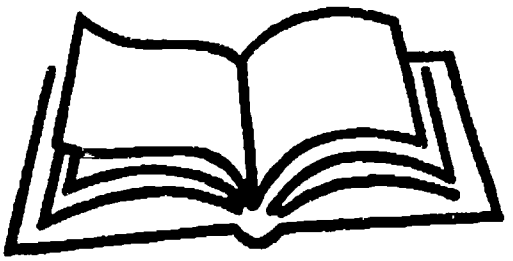
When consumers pay their gas bills, they are paying for exploration, drilling, leasing of land, operating costs, depreciation, return on investment, and taxes. In fact, taxes make up 30 percent of the retail gas price.

There are other renewable energy resources that are less well known, but that hold promise for the future. These include solar energy, wind, hydropower, biomass, fusion, and geothermal. Fact sheets about each of these renewable energy resources are available from the National Energy Education Development Project (NEED), P.O. Box 2518, Reston, VA 22090.



Energy Resources Vocabulary

Embargo	the restriction or prohibition of trade in a certain commodity
Energy	the capacity to do work
Fossil Fuels	fuels, such as coal, oil, and natural gas, which are formed by the compacting of decayed animal and plant materials
Gross National Product	the total market value of all the goods and services produced in the economy in a year
Market Price	the price of a resource as determined by its supply and demand in the marketplace
OPEC	stands for the Organization of Petroleum Exporting Countries, a cartel that controls a large part of the world's oil reserves
Primary Energy Source	direct energy resources, such as coal, oil, uranium, hydropower, and natural gas
Renewable Energy Resources	energy resources, such as the wind and sun, that are unlimited in supply
Nonrenewable Energy Resources	energy resources, such as fossil fuels, that are finite in supply
Scrubber	a device for removing sulfur dioxide from coal combustion gases
Secondary Energy Source	an energy source, such as electricity, that is produced using a primary energy source
Seismograph	a special instrument used in oil exploration to measure reflected sound waves
Sludge	the waste material remaining after using scrubbers to clean coal's combustion gases
Trade-off	giving up some of one thing in order to get some of another



CASE STUDY—Unit 3

The Case of the New Power Plant

Teaching Instructions

Overview:

In this case study, students analyze the trade-offs involved in developing new sources of electricity, discovering in the process that there are no easy answers. Every energy source involves both costs and benefits. Our choice of the "best" source for us depends upon the weights that we assign to various criteria or evaluation. Students will discover that there are opportunity costs involved in the production and consumption of energy, regardless of the source.

Learning Objectives:

After completing this case study, students will:

1. Explain that every choice involves an opportunity cost.
2. Identify the costs and benefits of the following three sources of electricity: coal, nuclear, and solar.
3. List the costs and benefits of energy conservation.
4. Use the five step decision-making process to weigh alternatives for eliminating a shortage of electricity.

Prerequisite Skills:

Students should know how to use the five step decision-making model to make personal or social decisions.

Important Concepts to Emphasize:

1. **No energy source is costless.** All energy sources involve some combination of environmental costs, health risks, loss of nonrenewable resources, space requirements, and/or high development costs. There is no unambiguous "right" energy source: each source involves compromise, and every society must weigh all of the short- and long-term costs and benefits in deciding upon the proper mix of energy sources.

2. **Conservation can be an effective way to stretch scarce energy resources, but even conservation involves costs.** For example, turning down our home thermostats can save a lot of energy, but it can, also, cause discomfort, or in the case of the aged or the sick, promote health risks. Conservation means using our scarce energy resources, so they provide the greatest benefit to society. It does not mean simply making them last as long as possible, which would require that we never use them.

3. **Energy efficiency is not the same thing as economic efficiency.** All of our resources are scarce, not just energy resources. Maximizing economic efficiency means getting the greatest benefit from **all** of our scarce resources; a goal of maximizing energy efficiency puts no value on other scarce resources. For example, we could make automobiles today that average more than 100 mpg, but society is not willing to pay the cost in terms of lack of power, crash protection, and payload. Similarly, solar cars are very energy efficient, but they are not yet economically efficient.

Teaching Suggestions:

Hand out the attached scenario and decision-making grid to your students. Ask students to evaluate each of the options, filling in the alternatives and criteria they think are important. You may wish to divide the class into special interests groups, each supporting a different alternative. If time permits, you may wish to have your students try "The Geologist's Dilemma," which is an excellent simulation of energy production from various sources, using black and blue beads and corn meal to represent coal, gas, and solar power.

Key Questions to Ask Students:

1. What are the advantages of each source of electrical power? What are the disadvantages?

   Coal: The main advantage is relative abundance, more than any other nation, with a supply for more than 300 years at today's rate of use. The primary disadvantages are the dangerous nature of coal mining and the environmental hazards from ash and sulfur dioxide emissions, which can cause acid rain.

   Nuclear: The advantages include the potential to produce energy with low fuel costs and no air pollution. The disadvantages result from the disposal problem with radioactive waste and the possibility, however slight, of a catastrophic accident.

   Solar: Advantages include low operational costs and no pollution. On the down side, solar power is land-intensive with high initial expense. Further, output depends on the weather, requiring sunny days.

2. What are the advantages and disadvantages of conservation as an alternative to building a new power plant? Some people argue that conservation is a "free" source of energy. Do you agree? Can you think of anything that is free?

   Conservation can stretch our energy resources, reducing or eliminating the need for additional generating capacity. However, even conservation is not "free." We use heating and cooling for comfort and health reasons. Giving that up, even in part, means making a sacrifice, especially, for the very old and the very young. Actually, nothing is truly free. Everything involves a cost. Students sometimes argue that friendship or love are free, but we must work to achieve and maintain them, so they are not really costless.

3. After filling in the decision grid, which solution in the case study do you think would be best for Ourtown? Explain your decision.

   Even after filling in the grid (see the following sample), there may not be a clear-cut answer. The "best" choice for Ourtown depends on the relative importance of the different criteria or goals.

Other Teaching Materials:

"The Geologist's Dilemma," from *Energy Tradeoffs in the Marketplace*. Washington State Council on Economic Education, and Superintendent of Public Instruction, State of Washington, 1980. (Check with you local Center for Economic Education regarding availability.)

DECISION-MAKING GRID ANSWER KEY
The Case of the New Power Plant

	CRITERIA				
ALTERNATIVES	Solve shortage	Safety risk	Pollution	Convenience	Low Cost
Coal	+	?	−	+	+
Nuclear	+	−	+	+	+
Solar	?	+	+	−	−
Conservation	+	?	+	−	?
Do nothing	−	+	+	−	?

The Case of the New Power Plant

Student Directions:

You are members of the city council in the growing community of Ourtown. You must evaluate several proposals for dealing with a growing shortage of electricity. After evaluating the arguments by each group, fill in the decision worksheet and grid, using the five step, decision-making process to decide which recommendation to accept.

Scenario:

Ourtown is enjoying a period of economic growth that most cities can only dream about. It has grown from a sleepy little rural town to a city with plenty of jobs and a high standard of living. Luckily, it has avoided the big-city problems with crime and pollution that plague many other communities during their boom periods. It has become a place people want to live and a place where businesses want to locate. As a result, the population has doubled during the past 20 years, yet, electricity is produced in a power plant built in 1947 for a much smaller population. During a heat wave last summer, so many air conditioners were turned on that power outages occurred all over town. The situation is expected to get worse in the future.

While sitting in the local barber shop waiting for a hair cut, Mr. Alvarez, President of the Ourtown Chamber of Commerce, complains loudly to everyone within earshot that without a new power plant, the city can forget about economic growth or even having sufficient capacity to meet residents' current needs. He argues that the cheapest way to meet the community's energy demand is by building a new coal-fired power plant.

The barber, Sally Friedman, responds that nuclear power would be more economical, particularly, if we take into account the environmental costs of both producing and using fossil fuels. "The safety record of nuclear power is better than that of other energy sources," states Ms. Friedman. "We have built so many fail-safe mechanisms into our nuclear plants that the odds against a major accident are astronomical." Mr. Alvarez counters that coal is our most plentiful energy resource, and that modern power plants can burn coal economically and in an environmentally responsible manner. Mr. Alvarez adds, "Even though the odds are heavily stacked against a major incident at a nuclear power plant, if it does happen, it will be catastrophic. Are we prepared to take that risk?"

Fred Simpson, who manages the local Dairy Queen, reminds the group that his restaurant is solar powered. "Why can't we use some of that vacant land just west of town to build giant solar collectors to generate power to meet the city's growing energy demand?" asks Fred. "This would be essentially free electricity from the sun waiting for us to take it. And unlike the case with nuclear power, we wouldn't have any disposal problem with dangerous radioactive waste."

Ben Johnson, who is active in several environmental groups, argues that people simply need to cut back, that their energy consumption is wastefully high. He points out that just setting our thermostats a few degrees higher in the summer and lower in the winter would save enough energy to avoid a shortage without the environmental cost of building new facilities for generating electricity. "Further," Mr. Johnson adds, "we don't need those ridiculously long hours of operation at the mall. Why don't we just require stores to reduce their hours of operation? Surely 12 hours per day is enough." Mr. Johnson reminds the others that any energy source involves some costs. For example, solar collectors are expensive to build, take a lot of valuable space that could be used for other purposes and produces energy only on sunny days.

Ms. Friedman responds, "Ben, that sounds great, but what about people whose health prevents them from setting back their thermostats? And how about my daughter and her friends, who would rather give up food and shelter than cut back on trips to the mall? How do we decide for other people which of the "needs" are more important?"

The discussion dies down without the group reaching a consensus.

CLASSROOM ACTIVITIES – Energy Resources

Classroom Activities:

The following classroom activities are recommended for this unit:

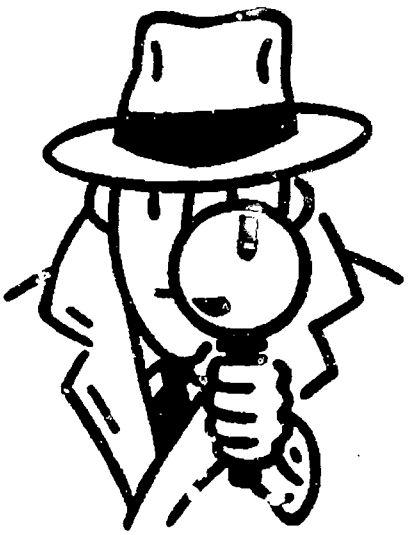
1. The Energy Time Capsule
2. Investigating Bikes and Alternate Sources of Transportation
3. Investigating Your Own Community
4. Debating the Issues
5. EEE Actions

State Proficiencies:

The activities in the EEE lessons are correlated with the *Indiana Curriculum Proficiency Guide* which emphasizes the process of learning through direct experiences.

Science

* Experimenting
* Selecting and using information
* Researching energy and transportation
* Predicting energy savings



Mathematics

* Charting and graphing data
* Estimating costs
* Measuring savings and energy
* Calculating costs and savings

Social Studies

* Comparing systems of transportation
* Examining interactions
* Drawing conclusions about economics and energy usage
* Making decisions about trade-offs, cost/benefit analysis

Language Arts

* Communicating information
* Interviewing adults and students
* Recording data and comments
* Creating surveys and questions for interviews

The Energy Time Capsule

Learning Objectives:

1. Prepare an energy time capsule for burial, showing the role of energy in today's world and its predicted role in the year 2000 and beyond.

2. Research major energy sources of the United States.

3. Research experts' predictions of America's future major energy sources.

4. Communicate current major energy sources to future earth inhabitants.

5. Explain the advantages and disadvantages of various energy sources.

Overview:

In this lesson, middle school students will explore energy use in the United States and the world. Students will interview parents and experts to determine the major energy sources to be used by their community in the year 2000 and beyond. Students will produce and collect energy related items for burial in a time capsule. These items will relate energy in today's world and in the future. A formal time capsule burial ceremony will conclude the lesson.

Notes to the Teacher:

Set a target date—perhaps National Energy Education Day—for the burial ceremony. Talk with the school principal early in the planning stages of the activity to get permission for the ceremony and to determine a burial location.

Obtain small, waterproof containers to use as time capsules. Ask local businesses, industrial classes, or a sheet metal firm to donate the capsules. Gather the necessary resources and have students begin their research. They can use materials from the National Energy Education Development (NEED) program, energy education materials in the school library, and materials from the U.S. Department of Energy. (Materials are listed in resource section.)

Students can also conduct interviews with local energy experts from business, government, utilities, or universities. Many utility and oil companies have speaker bureaus that will help arrange a speaker for students. (The NEED Resources guide provides helpful hints for contacting energy experts.)

Invite one or more speakers to address your students during their preparation period or invite several speakers from different fields to make a panel presentation to one class or the entire school. Get the experts opinions and predictions about energy usage in the year 2000 or the year students have chosen to unearth the capsules.

Student Activities:

1. Research the percentage of the nation's total energy consumption used to generate United States electricity today. Predict the percentage in the year 2020.

2. Predict the cost of a kilowatt hour of electricity in the year 2020. Compare these estimated costs to the actual costs we pay today for electricity. Research the quantity of kilowatt hours of electricity generated today and estimate how many will be generated in the year 2020. Have the students design graphs and charts to show kilowatt usage in each year, major energy users, and energy sources.

3. Predict the price of a barrel of oil and a gallon of gasoline in the year 2020. Have the students work in small groups and list at least ten products that will be affected by the price of oil. Create a skit which tells about time travel into the year 2020 to learn about energy sources being used for transportation, housing, and recreation. Compare these energy sources to the ones being used today.

4. Create a poster showing two barrels of oil. Under the first barrel write 1990 and under the second write 2020. Draw the barrels to scale. For example, if students predict the United States will be consuming 10 percent more oil in 2020 than today, draw the second barrel 10 percent larger. Create another poster showing products made from petroleum. Shade the barrels to show oil supplied by domestic production and by imports. In the import section of the barrels, write in the names and amount of oil supplied by the top five sources of foreign oil. In the domestic portion of the barrels, use two shades, one representing inland production, the other offshore. In addition to the sizes of the sections of the barrels, make sure to write the percentages for each fact.

5. Research the quantity and sources of oil imported by the United States. Research how much petroleum each state produces and predict what future production will be in the year 2020. Locate these nations and states on a national and world map or globe.

6. Investigate the amount and percentage of our nation's oil and gas coming from inland and offshore sites today. Estimate how many sites there will be in the year 2020. Locate on a map where these sites are located today. Research and locate where others may be in the year 2020.

7. List the cost of a thousand cubic feet of natural gas today and estimate what it will be in the year 2020. (See the NEED materials or interview local utility expert.) Have the students find out how many cubic feet of natural gas (if any) are used in their homes. Note the cost for this energy. Record this information on a chart and compare the differences in usage and costs.

8. Research the number of nuclear power plants operating today. Interview energy experts to determine approximately how many will be operational in the year 2020. Propose burial sites for nuclear wastes in the year 2020. Explain why you/your group chose these sites. Debate the pros and cons of nuclear energy. Interview at least five adults in the community about nuclear energy. Compose five questions for the interview.

9. Research the percentage of the nation's energy coming from each of the top ten sources. (Use the NEED Energy Fact Sheets located in the resource section.)

10. Research and record how much energy the United States uses today. Consult with energy experts to determine approximately how much will be used in the year 2020. Research which types of industry uses the most energy.

11. Using a poster board, make a pie or bar graph showing each major energy source and the amounts currently supplied to the United States. On the same poster, make a similar graph for the year 2020. The 2020 graph may differ in size depending on the amount of energy the United States is expected to be using at that time. The size of the sections on the graph may also differ as different energy sources may become larger or smaller suppliers of energy in the year 2020.

12. Tape interviews with experts, asking them about energy predictions for the year 2020. Research topics carefully and prepare questions for the experts. Mail letters introducing the school and including student questions. Explain how long the interview will last and that responses should be brief and to the point. If students plan to interview several energy experts, invite them all to come on the same day, so students can conduct a group discussion.

13. Predict the best, worst, and average miles per gallon ratings for new cars in the year 2020. Compare these ratings to the best, worst, and average miles per gallon ratings for cars purchased today.

14. Research gasoline usage in the United States today. Interview experts for predictions of how much gasoline will be used in the year 2020. Research the mark up on a gallon of gasoline. Determine how much of the price of gasoline is federal and state tax. How does this compare with gasoline taxes in other countries? How much profit does the gas station owner make on each gallon of gasoline?

15. Locate fuels used today for transportation and predict which fuels will be used in the year 2020. Collect information about solar powered cars, and share these findings with the class. Sketch a solar powered car. Research the future of transportation. Study what is being done in Japan and other nations to move people safely and fast. Predict mass transit systems in the year 2020.

16. Research energy efficient home appliances today and predict their efficiency in the year 2020.

17. Have the students list appliances which are the biggest users of energy. (Include energy usage charts from the utilities.) Teach the students to read meters and maintain records in their homes and school for a certain time period.

18. Obtain Energy Efficient Rating (EER) labels for several commonly purchased home appliances. Make two copies of the EER labels for each appliance, keeping one label intact. Cross out today's (or this year's) figures on the other and replace with predictions. Do the same with the MPG ratings found on the window stickers of new cars or from car advertisements in magazines.

19. List heating systems American homes have today and predict the types in the year 2020. Direct the students to design an energy efficient home for the future. Encourage cost effective and energy efficient designs.

20. List other items for the time capsule(s) that illustrate today's energy production and use. For example, if electricity now costs eight cents a kilowatt hour, put eight cents in an envelope. Have students project what a kilowatt hour of electricity will cost in the year 2020 and place this amount in another envelope. Consider including copies of electric bills, photographs of gasoline pumps, or signs showing the price of gasoline, sales brochures for appliances, etc. Display the items that will go in the time capsule on a bulletin board.

21. Brainstorm a list of 40 or more items to place in the capsule and discuss each of them. Make sure the list doesn't exclude any major energy areas. Reduce the list to 20 items and begin working on these.

22. Arrange an official burial ceremony for the time capsule. Prepare a ceremony agenda and send invitations to local officials, guest speakers, school officials, students, newspapers, and radio and television stations. Also, select one or more students to serve as hosts for the burial ceremony. Publicity for event needs to be planned—have students write articles for the school newspaper and a news release for the community newspaper.

    Display all the items that will be in the time capsule. Invite guests to arrive up to an hour before the burial ceremony to view the items that will be sealed in the capsule. Ask a guest speaker to address the audience at this time. Instruct students to place items into the capsule, with each giving a 10-15 second speech about his or her item.

23. Record the burial ceremony in the school records. Include a documentation file with photographs of the event, a list of the items enclosed in the capsule, the names of the student participants, a location map of the capsule, notes from the interviews and speeches, and any publicity clippings. Add a reminder for the unearthing ceremonies and assign specific class members to follow through on that aspect of the project (an excellent event for the 10-year reunion), or assign primary students to unearth the capsule when they are high school seniors.

Using Bicycles for Transportation

Learning Objectives:

1. Students will design a safe and acceptable Bicycle Transportation Plan for their school/community.

2. Students will work with decision makers in their communities to implement the pian.

Overview:

There are many benefits to using bicycles for transportation. Bicycles reduce the demands on fossil fuels, improve health, and are a source of recreation.

There are costs involved in using bicycles for transportation, especially, one's time. In the activities which follow, students will investigate the benefits and costs of using bicycles as a primary means of transportation. Students will investigate other forms of transportation to use to conserve energy. Students will, then, design a bicycle transportation plan for their school and community.

Notes to the Teacher:

Designing and implementing a bicycle transportation plan for a school and community can be a very exciting program for middle school students. If a decision is made by a school to implement a bicycle transportation plan, **safety** should be emphasized throughout the program. Helmets should be worn at all times when riding. Safe and secure bike paths and trails should be established in cooperation with the community. As the plan develops, involve students in all aspects of decision making. Students in this program could even design a bicycle with features to be used year-round. To be successful, it is essential that the community be involved in the program.

Student Activities:

1. Research fossil fuel sources to determine which ones we depend on for survival. Find out the proposed depletion rates for these fossil fuels and what we can do to extend the life of these resources. (Use project NEED materials.)

2. Calculate the impact automobiles have on fossil fuels and natural resources. Gather this data from the local library, automotive industry, and the NEED project. Estimate the amount of energy saved if every student walked, rode a bicycle, or car pooled to school for one day. Calculate the energy saved if everyone did this for one month and one year.

3. Although there are benefits to walking and biking, there are also costs, especially, in terms of time. Discuss and list these opportunity costs. Should everyone ride a bicycle to work? Could they?

4. Investigate the possibilities of implementing a safe bicycle transportation plan for the school and community. Survey the community to find out how people get to work. Also, find out how many own bicycles, how many would support the plan, how many would volunteer to help implement the plan, and how city officials would work with you to support such a plan.

5. Calculate the amount of energy, dollars, and natural resources saved as a result of ten bicycles replacing ten automobiles being driven to the school. Interview each car owner to find out how much it costs to drive to school. Ask each car owner what the opportunity costs are of bicycling to school. Ask the car owners to explain why they drive instead of using a bicycle. Record these responses. Have students graph and analyze this data. Prepare a report which shows how much energy was saved by bicycling. Project how much energy would be saved if 20 more staff at the school would agree to walk or ride a bike to school for one, two, or three months. If feasible, design a Bicycle Transportation Plan for the school and community. After analyzing the costs and benefits of the plan, present the plan to school administrators.

6. Students can help implement the plan by designing:

   a. Safe bicycle paths and trails.

   b. Promotional activities, such as posters, news releases, presentations to classes and community groups, and exhibits for the school and community.

   c. Records to show the impact of this program on conserving energy.

   d. Safety programs for the school and community.

   e. Orientation programs for parents.

   f. Student bicycle monitor program to encourage safety and participation in the program. Have students establish criteria for participating in the program. Each participant should register their bicycle with the local police department.

7. Have students research the role bicycles, railroads, rivers, canals, and automobiles played in early America transportation systems. Have them search for old songs and stories that tell about these early forms of transportation. Prepare reports on how countries, such as Japan, China, Germany, England, and France, use alternate forms of transportation to move people and products. Discuss why some of these countries place a high value on bicycles as a means of transportation. Create a play which tells about an American family trying very hard to use bicycles for transportation and recreation.

8. Research the number of days per year which can be used for riding bicycles in the local community. Prepare a bicycle weather calendar for the school and community. The calendar could be sold, and the proceeds could go into the local bike club.

9. Plan a bicycle trip for a weekend or week to a nearby state park or recreation area.

Investigating Your Own Community

1. Survey ten people in the community to find out:

   a. Do you car pool?
   b. Do you ride a bicycle to school or work?
   c. Do you use mass transit for personal transportation?
   d. Would you be willing to use one or more of these alternate forms of transportation? Why or why not?
   e. If the price of gasoline went to $5 a gallon, how would this affect your use of bicycles for transportation? What if the price of gas dropped to 50 cents a gallon?

2. Research how clean coal technology affects air quality and energy efficiency. (For information, check with your local electrical utility.)

3. Interview energy experts in the community to find out their predictions on how energy will be produced in the year 2020.

4. Trace electrical energy from the school to its generation point. How does it get to the community? Draw a chart to illustrate this. How is the price determined for this energy?

5. Investigate how much money is spent to heat and cool your school.

6. Have each student list five or more actions future inhabitants of this planet can take to conserve energy resources.

7. Have students research the kinds of careers that are available in the energy field.

8. Research the types of energy resources used to produce electricity for your community. What is the cost of these resources? What are environmental problems associated with the use of these resources?

9. Observe drivers in ten cars passing an intersection near your home or school to find out:

   a. How many people are riding in each car?
   b. Estimated miles per gallon (MPG) fuel efficiency?
   c. How many of the cars are foreign made?

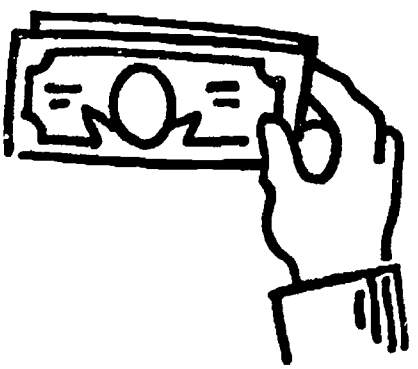
10. Share your findings with the class. Discuss what you learned from this activity.

Debating the Issues

1. The United States should encourage more use of nuclear energy.
2. To lessen our dependence on foreign oil, the United States should encourage more oil drilling in remote Alaskan wilderness areas.
3. To reduce our dependence on fossil fuels, the United States Department of Energy should require states to fund solar energy programs.
4. To lessen our dependence on foreign oil, the United States should put a $1 per gallon tax on gasoline.

EEE Actions—You Can Make a Difference!

1. Write on both sides of paper that you use. Calculate how much paper you will save in one week, month, and year. Use scrap paper for writing personal reminder lists, telephone messages, etc.
2. Estimate how much energy and money is saved if a family vacations at an Indiana state park, instead of Disney World in Florida.
3. Figure out at least one way to conserve energy in your home and do it!
4. If feasible, walk or ride a bicycle to work or to other activities.
5. During cold weather, try to lower your thermostat at home. At night, use an extra blanket on your bed. During the day, wear a sweater.



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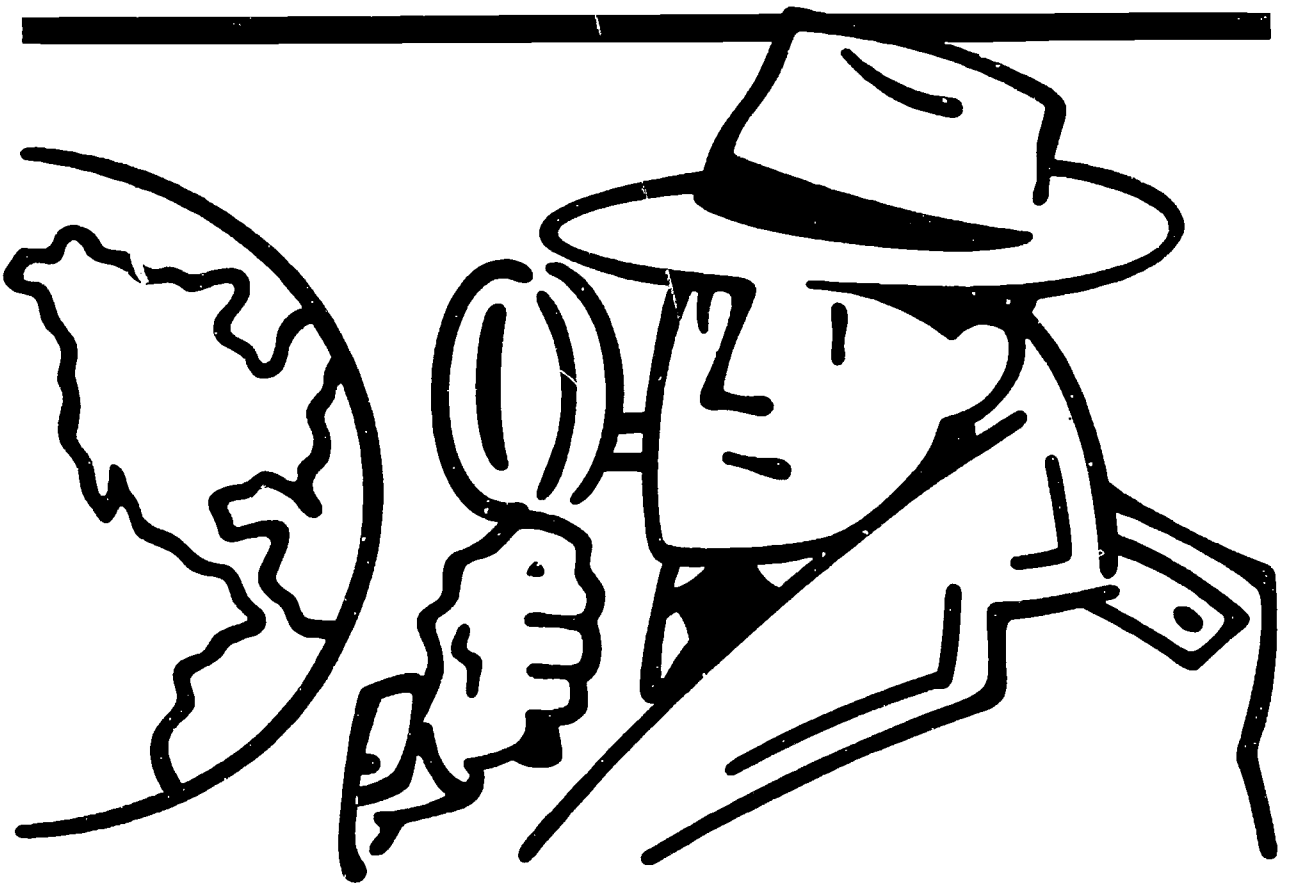
STEWARDSHIP NATURAL RESOURCES



Facts About Natural Resources

Did You Know That . . .

Natural resources provide the raw materials that are necessary in the production of goods and services.

Conservation can be defined as the wise and efficient use of our natural resources. Conservation can be viewed as a productive investment that reduces the demand for natural resources.

The **market price** of natural resources, such as oil, wood, and coal, is determined by the supply and demand for these resources. The market price of a resource is an indication of how **scarce** that resource is. Thus, a low market price indicates that a resource is relatively abundant; whereas, a high market price indicates that a resource is relatively less abundant.

The most powerful determinant in conserving a resource is a resource's market price. At higher prices, people will use (demand) less of a resource; at lower prices, they will use (demand) more.

Energy Conservation:

The United States significantly improved its **energy efficiency** during the 1970s and 1980s, primarily as a response to greatly increased oil prices. In 1989, the United States used only 7 percent more energy than in 1973, even though our **gross national product (GNP)** was 46 percent higher.

As oil prices increased, conservation efforts made great progress in the 1970s. Individuals and businesses made concerted efforts to conserve natural resources, especially, petroleum. For example, today's homes use 50 percent less energy than homes built in 1973. In the 1980s, however, conservation efforts waned because oil prices dropped dramatically. As a result, United States oil imports went from 28 percent in 1982 to about 50 percent in 1990.

The **Strategic Petroleum Reserve** was established to cushion the United States from cut offs in oil supplies from the politically unstable Middle East. In 1991, this reserve contained approximately 583 million barrels. The United States currently uses about 16 million barrels of oil a day.

About one third of the energy used in the United States goes to heat, cool, light, and power homes, offices, and other buildings. Experts believe that increased energy efficiency can reduce this energy use by 30-50 percent.

Water Conservation:

The United States uses about 400 billion gallons of water each day, the most important use being drinking water. More than one half of the population gets its drinking water from groundwater sources.

Because the amount of water that exists remains constant, a growing population and economy means more demands will be placed on our limited water supplies.

Every time water is used, its quality changes—it is polluted to some degree. To ensure adequate and clean water supplies, three things must occur:

1. **Water efficiency** must be improved,
2. **Pollution** must be controlled, and
3. **Effective water treatment** methods must be employed to allow water reuse.

Water efficiency measures how much water it takes to perform a specific task. There are many ways individuals can conserve water and improve water efficiency, such as fixing leaks, installing water saving devices, and economizing in general. New technologies are being developed to help industries increase water efficiency.

Communities vary in how much they charge for water. In some communities, residents pay no fee or a small flat fee regardless of how much water they use. In other communities, meters measure water usage and residents are charged by the gallon. Residents are more water efficient when they have to pay for exact usage.

In the western United States, farmers use 85 percent of the water.

The original **Clean Water Act** was passed in 1972 to protect our increasingly polluted water resources. Congress amended the act in 1977, 1982, and 1987, each time strengthening the goals and adding new requirements. Today the **Clean Water Act** addresses **point** and **nonpoint source pollution** in oceans, rivers, lakes, streams, wetlands, and estuaries. The act protects groundwater sources and has provisions for controlling toxic pollutants. Since the passage of the **Clean Water Act,** water quality in the United States has improved greatly, and continues to do so.

After water is used, it must be treated. Communities use primary, secondary, and advanced wastewater treatment to make water reusable again for the general public. Also, industries recover and reuse water in their manufacturing processes.

Conservation of Minerals and Forests:

Reusing and **recycling** certain materials, like glass, plastics, and paper, can help conserve natural resources. However, recycling itself requires the use of natural resources, and in certain localities can be very costly.

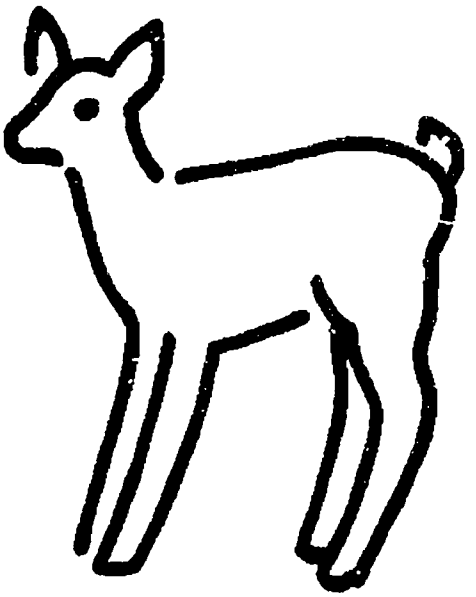
Recycling aluminum is especially cost effective, requiring less than 10 percent of the energy necessary to transform raw bauxite into aluminum.

The city of Seattle now charges a per can fee for garbage pick up. This has encouraged more than 70 percent of all residents to reuse and recycle, thus, conserving resources. Many local governments charge residents little or nothing for garbage pick up. This provides little incentive for residents to conserve in their waste production.

Improvements in technology can help preserve mineral resources. For example, in the 1960s, it took 164 pounds of aluminum to make 1,000 cans. Today, it takes only 35 pounds. In most cases, these technological improvements occur as businesses try to produce goods at the lowest possible cost.

A new generation of lightweight, durable engineered substances called **advanced materials** are being developed in the United States and in other industrial countries. These futuristic versions of metals, glass, plastics, and ceramics will replace more common materials. For example, the automobile industry in replacing metal parts with lightweight, but equally strong, advanced plastics. This reduces car weight and increases gas mileage. The plastics require 20 percent less energy to produce. Increased use of these advanced materials will lessen our dependence on many of the earth's natural resources.

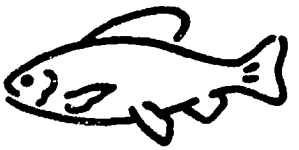
In the late 1700s, forests covered about 87 percent of Indiana. By the 1930s, much of these forests had disappeared, resulting in dwindling wildlife populations and eroding soil. Some of these damaged areas were acquired by the state Division of Forestry and are the basis of today's state forest system. These and other conservation efforts, since the 1930s, have resulted in much progress. Today, Indiana is 19 percent forested, equalling about 4.5 million acres, and is still known for its excellent hardwoods and forest products. Indiana's forest product industries generate over $2 billion in activity annually and employ over 50,000 people in the state. Indiana grown hardwoods are in demand worldwide.



Conservation Vocabulary

Advanced Materials	newly engineered versions of metals, glass, plastics, and ceramics, which are being substituted for more common materials
Clean Water Act	an act passed in 1972 to help protect and improve water resources
Conservation	the wise and efficient use of natural resources
Corporate Average Fuel Efficiency (CAFE) Standards	the average gasoline fuel efficiency for an automobile company's entire fleet of vehicles
Energy Efficiency	how much energy it takes to do a certain amount of work; increasing energy efficiency means using less energy to do the same amount of work
Gross National Product (GNP)	the market value of all the goods and services produced in the economy in a year
Market Price	the price of a resource as determined by its supply and demand in the market place
Natural Resources	raw materials, such as water, forests, and minerals, that come from nature
Nonpoint Source Pollution	pollution that does not enter surface water at any one point. Examples are rain runoff from factories, farms, and streets
Point Source Pollution	pollution that enters surface water from one particular source, such as wastewater from a pipe
Recycling	separating, collecting, and processing used manufactured materials that otherwise would be disposed of as waste
Scarcity	in economics, the condition that exists whenever wants are greater than the resources available to satisfy the wants. Scarcity requires people to make choices
Shortage	occurs when governments set a price for a good or service that is below a true market price; the simple solution to a shortage is to let prices seek their natural market level

CASE STUDY—Unit 4
The Case of the Waylaid Water



Teaching Instructions

Overview:

In this case study about drought conditions in a California community, students learn that water is a scarce resource responding to the laws of supply and demand. Specifically, if communities choose to hold down the price of water below market levels, we can expect shortages.

Learning Objectives:

After completing this case study, students will be able to:

1. Explain that every choice involves an opportunity cost.
2. Distinguish shortage from scarcity.
3. Show that a price of zero will cause a shortage of a scarce resource like water.
4. Demonstrate that there is an inverse relationship between the price charged for a good or service and the quantity that people will choose to buy.

Prerequisite Skills:

Students should know how to use the five step decision-making model to make personal or social decisions.

Important Concepts to Emphasize:

1. **Scarcity and shortage are not the same thing.** Water, like any other economic good, is scarce. This means simply that at a zero price, we cannot have all that we want. However, a shortage of water or any other good or service means that at the current price, people want to buy more than suppliers want to sell. In short, scarcity is a fact of life that is always with us; shortages, however, result from our efforts to hold prices below the level that will equate supply and demand.

2. **Rationing does not solve the problem of scarcity, or even eliminate shortages.** It simply provides an alternative to price increases as a way to restrict consumption in response to a shortage. In fact, price hikes are actually rationing, albeit, carried out by the market place rather than government. Whether through mandated rationing or price hikes, someone has to make the decision how to cut consumption (and by whom) when demand exceeds supply.

3. **The Law of Demand holds for water, just as it does for other goods and services.** This means only that people tend to buy more at a lower price and less at a higher price. Therefore, if price is allowed to rise during a drought, there need not be a water shortage—people have an incentive to conserve water when the price rises.

Teaching Suggestions:

Hand out the scenario and decision-making grid to your students, then ask them to evaluate each of the options, filling in the alternatives and criteria they think are important. You may wish to divide the class into special interest groups, each supporting a different alternative.

As a homework assignment, ask students to find out from their parents how much they pay for water and how much water their family uses in an average month. Point out that Indianapolis and many other cities are facing dramatic increases in water and sewage rates to pay for repairs to the deteriorating infrastructure. Ask them to find out what the family's response would be to a doubling of water rates.

If time permits, ask the students to complete the Graphing a Demand Curve survey form relating water consumption to price. You can combine responses for the entire class to get an overall demand schedule for water. To do so, simply add together all of the quantities students reportedly would consume at each price level on the survey form. The result should be an inverse relation between price and quantity used—as price rises, students' consumption of water should fall.

Show the movie or assign the book, *The Milagro Beanfield War* by John T. Nichols, (1987, Ballantine, $4.95 for paperback), and discuss the property rights of the developers versus those of the townspeople. Use the story to explain the costs and benefits of reallocation of resources, in this case, from bean production to recreational use of land.

Key Questions to Ask Students:

1. Scarcity means that we can't have everything we want. Is water scarce? If so, does this mean we will always have water shortages? In the case study, do you think Sacramento would have a water shortage if everyone had to pay $10/gallon for water?

   (Yes, water is scarce. If it were not scarce, there would be enough to satisfy everyone's desires at a zero price. Instead, we pay to purify water and deliver it to peoples' homes and businesses. Note that some people pay 50 cents or more per gallon for bottled water today. Of course, water shortages are not inevitable. No matter how scarce a good or service is, at a high price, demand will not exceed the limited supply. It is likely, for example, that at $10/gallon, people would stop washing cars, watering lawns, and even showering as often.)

2. Do the Graphing a Demand Curve survey results suggest that raising price can be an effective way to eliminate a shortage and conserve water? What else could eliminate a water shortage? What are the advantages of using the market approach, i.e., raising price to encourage conservation? What are the disadvantages?

   (Although the actual survey results will vary from class to class, the responses by any given class will support the Law of Demand. Students will wish to buy less water when the price rises. Alternatively, a community could decide to ration water usage through restrictions on certain uses, such as lawn watering. The market approach has the advantage of permitting residents maximum freedom to decide which way they will choose to conserve. The disadvantage is that some people with relatively low incomes may find it difficult to pay their water bills.)

Other Teaching Materials:

This case study was derived from "Water Rights in California: A Problem of Scarcity!", Module 2, Chapter 2, in *Economic Education Mandate: Handbook for Survival*, published by the California Council on Economic Education and the California Department of Education, 1991. The handbook is available on loan from the IUPUI Center for Economic Education in Indianapolis.

DECISION-MAKING GRID ANSWER KEY
The Case of the Waylaid Water

	CRITERIA				
ALTERNATIVES	Will limit consumption	Fairness	Freedom	Start-up costs	?
Ban watering	+	–	– –	+	
Limit usage to 100 gallons	+	–	–	+	
Water meters	+	?	+	–	
Do nothing	– –	–	+	+	

The Case of the Waylaid Water

Student Directions:

Bill, Anne, and Amy need your help. They cannot resolve the question of how to eliminate their city's water crisis. Read the scenario, then, decide what criteria, or goals, you should use to evaluate the alternatives. Complete the Decision Worksheet and the Decision Grid to help you decide which choice you feel would be best for Sacramento. Your teacher may wish for you to fill out a survey of the demand for water. If so, follow the directions on the survey form and fill in the amounts of water you would use at various prices. Draw your demand for water on the graph. Your teacher may combine your demand with that of other students to get a total demand for water by your class.

Scenario:

Anne and Bill live in Sacramento, California. Because of a drought that has continued for more than five years, their city is considering water rationing. Unless people cut back voluntarily, the city will be forced to take other measures. "Why don't we just ban lawn watering and car washing until the drought ends," suggests Bill. Anne, whose parents own a landscaping business, responds "That would put my family out of work, and besides, people don't like to see their grass turn brown. Why, in some towns, people are actually painting their dead grass green! Don't you think people have a right to water their lawns?" Bill, who usually gets stuck mowing the lawn, thinks that painted grass sounds like a great idea.

Anne's friend, Amy, asks why the city doesn't install water meters and charge people according to how much water they use, as is done in other parts of the country. "I don't think that would help," responds Anne. "People are already trying to cut back as much as they can."

Bill suggests limiting each household to 100 gallons of water per day until the drought ends. "But that's not fair," says Amy. "Large families and those with lots of grass to water would not have enough water, yet, some people wouldn't even need their share. And what about farmers who need to irrigate their crops?"

Bill, Anne, and Amy continue to argue without settling anything. "Look," says Anne, "each of us has a parent on the city council. Let's do a survey to find out if charging for water would make a difference. If so, I am willing to change my mind. And if we take the survey results to our parents, maybe it will help them decide." The others agreed to collect some information from others in the community and share the results with the city council.

Name: _____ Date: _____

Graphing a Demand Curve

1. **Graph the impact that an increase in the price of water has on the quantity demanded.**

   Record the following information for one week. Take a one gallon bucket and see how long it takes to fill it in your shower. Record the amount of time that you spend in the shower each week and calculate the amount of water used per week. Then complete the following questionnaire.

   Time spent each week in shower _____
   Amount of water used _____

If I were paying for my water and:

The price of water were:		**I would use:**
5¢	per gallon	_____ gallons per week
30¢	per gallon	_____ gallons per week
50¢	per gallon	_____ gallons per week
70¢	per gallon	_____ gallons per week
$1	per gallon	_____ gallons per week

Draw your demand for water on the graph below. Is an increase in the price of water an effective way to reduce the quantity of water demanded? _____

CLASSROOM ACTIVITIES - Unit 4

Conserving Natural Resources

Classroom Activities:

The following classroom activities are recommended for this unit:

1. Stewardship: Everyone's Responsibility
   a. Energy
   b. Forests
   c. Minerals
   d. Wildlife
2. Investigating Your Own Community
3. Debating the Issues
4. EEE Actions

State Proficiencies:

The activities in these EEE lessons are correlated with the *Indiana Curriculum Proficiency Guide* which emphasize the process of learning through direct experience.

Science

* Problem solving
* Researching energy and natural resource practices
* Observing energy and natural resource usage
* Tracing products

Mathematics

* Tabulating and graphing data collected
* Estimating costs
* Computing and calculating energy usage and costs
* Researching costs for harvesting hardwoods

Social Studies

* Mapping where natural resources are located
* Tracing where consumer products come from
* Designing plans for energy
* Decision making

Language Arts

* Communicating data and observations
* Interviewing
* Composing questions and reports
* Researching skills

Stewardship: Everyone's Responsibility

Learning Objectives:

1. Gain the knowledge and experiences to enable students to make wise and careful decisions about using the earth's natural resources.

2. Value water, energy, wildlife, soils, plants, forests, air, and other life support resources.

3. Accept responsibility for serving as stewards (managers) of earth's natural resources.

4. Analyze the costs and benefits involved in conserving wildlife, forests, minerals, and energy resources.

Overview:

Conservation is the wise and efficient use of the earth's resources—energy, water, soil, air, forests, wildlife, plants, and minerals.

Americans are practicing better conservation habits by recycling, driving more fuel efficient automobiles, managing wildlife habitats, reforesting land, protecting top soil, improving air quality, cleaning up water resources, and producing more energy efficient automobiles and appliances.

While we have made progress in the fight against the deterioration of earth's natural resources, there are still many environmental challenges facing our young people. Education will play an important role in helping prepare these future decision makers to be good stewards of the resources entrusted to them. Providing Indiana students with the necessary knowledge, skills, and values will make them better prepared to make wise and careful conservation decisions. Accomplishing this environmental education goal will require the involvement of classroom teachers throughout Indiana.

Notes to the Teacher:

Teach your students that the earth's natural resources provide each of us with:

- the water we drink
- the air we breathe
- the energy we need for driving, cooking, and heating our homes
- lumber for our homes
- minerals to make cars, toys, and radios
- plants for medicine and food
- soil for growing vegetables, fruit, and grains
- habitats (homes) for animals and people

Teach students that they are stewards of the earth's resources and, therefore, should accept responsibility for practicing good conservation habits. Encourage students to:

- recycle
- use water wisely
- protect air quality and their lungs by not smoking
- respect the natural landscape
- take care of their clothing, bikes, toys, books, and radios
- help their parents conserve energy, water, and other resources
- protect wild flowers, birds, and animals
- serve as environmental models for others
- use decision-making skills to help solve environmental problems
- use wise consumer skills when purchasing food and clothing
- provide homes (habitats), food, and water for wild animals

Teach students that depending on individual conservation efforts alone to resolve environmental/energy problems is not sufficient. Policymakers must also implement wise economic policies that provide incentives for people to be good stewards.

Student Activities:

Energy Resources

1. Divide students into small groups and have them compile a list describing at least ten ways people use energy each day. Place the list on a chart, and have students identify ways to conserve energy for each item. Write their ideas next to each item on the chart. Have students share their charts with the class.

2. Then, let student groups investigate how energy is used in the school. Conduct an energy audit. After the groups have completed their audits, report the findings. List all the efficient examples and wasteful examples of energy use on a chart or chalkboard.

3. Design an ENERGY ACTION PLAN for the school. Use the data collected from the energy audits to recommend better conservation practices. Ask a representative from your local utility to assist with the plan. Present the plan to the building principal and to the local school board. Assist the school in monitoring the plan and record both energy and money saved. Share the success of the energy savings program with other schools in the community.

4. Ask your students to conduct energy audits in their own homes and businesses in the community. Ask the local energy utility to help in preparing the audits. Learn how to read electric meters. Students could monitor their families usage for one week. Graph the usage and explain variations.

5. Students write a personal energy conservation plan. They list activities in their daily lives which use energy. Challenge them to think of ways to use energy more efficiently for each activity. Allow students to share their ideas with classmates.

Forest Resources

1. Have students compile a list of things they can do to help save the rainforests. Visit the school library to search for books, encyclopedias, articles, and other resources which provide information about the rainforests. Locate the rainforests on a world map. Compile a list of products which are made from plants, minerals, and trees from the rainforests.

2. Invite a forester or environmentalist to visit the class to present a program about tropical rainforests. Have the students compose questions for the speaker.

3. Take a field trip to local businesses to search for products which can be traced back to rainforests. Interview the business owners to determine the impact these products have on the local economy.

4. Work with the local soil and water conservation district (SWCD) and the local utility to plan a tree planting program for the school and community. Students should assist with the planning of the tree planting program. Assign them the following tasks:

   a. Determine the value of trees to the economy and the environment.
   b. Research what resources trees need to survive.
   c. Make a list of products in the school and home which are made from trees.
   d. Make a list of careers available in the forest products industry.
   e. Compose a letter to students in the year 2020 explaining the need for trees and forests on earth.

5. Research the kinds of trees which are best for lumber, shade, fruit, landscaping, etc.

6. Invite a timber resource specialist from the hardwood lumber industry to meet your students to discuss how their business depends on replenishing the forest to insure a future supply.

7. Research how the price of wood/lumber influences how we conserve paper and other wood products.

8. Identify interrelationships between occupations and natural resources. (Adapted from *Project Learning Tree,* "Economic Web of Life," see Resource Section.)

9. Describe ways in which consumer decisions have far-reaching economic, social, and environmental implications. (Adapted from *Project Learning Tree* and *A Side Order of Paper,* see the Resource Section.)

Mineral Resources

1. Students prepare a list of personal items they own and consume each day which are made from earth's minerals. Discuss some of the minerals which were used to produce these products. Trace two of the products back to their original mineral sources. List the minerals used to make the products. Share findings with classmates and prepare a display of products made from various minerals.

2. Locate on a national or world map where many of these minerals originated. Estimate the distance these minerals traveled to reach the factory or business where they were made into a finished product. Research the current price of these minerals and plot the price changes over time. Use inflation adjusted data to compare prices. Plot past prices to observe trends. Visit a factory in the local community to research what minerals are used in production. On a map, trace the origin of these minerals.

3. Design a mineral conservation plan with your students to help use minerals more efficiently. Implement a school action plan to recycle cans, glass bottles, paper, plastics, etc. Teach your students good consumer skills for selecting and purchasing food, toys, bicycles, automobiles, appliances, and other products.

4. Research new advanced materials (plastics, ceramics, etc.) that are replacing certain minerals. Research how prices provide clues about mineral scarcities.

Wildlife Resources

1. Research animals that are listed as endangered species. Check with the local library, Audubon chapters, National Wildlife Federation, and Indiana Department of Natural Resources (Project WILD). Encourage students to adopt one or more of these animals. Conduct an environmental education campaign within the school and community to help protect and prevent these animals from becoming extinct. Interview wildlife experts and environmentalists to find out why these animals are endangered.

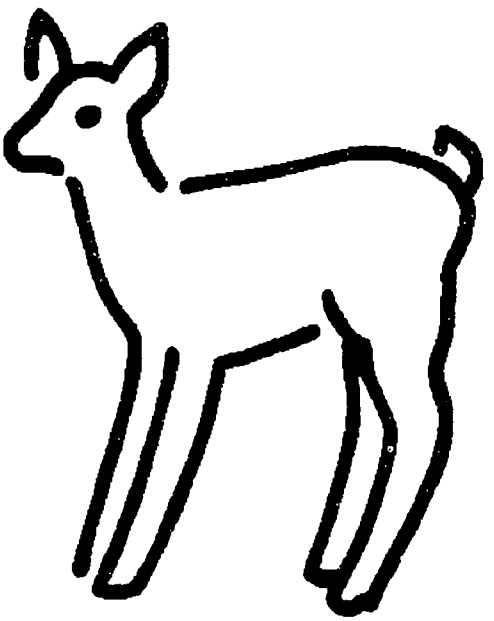
2. Develop wildlife habitats on the school site/outdoor classroom to attract acceptable species. Have students manage the wildlife habitats by conducting bird counts, building blue bird boxes on wooden fence posts, planting agriculture crops that attract birds and wild animals, planting flowers to attract butterflies and hummingbirds, and providing a source of water for birds and animals. Construct a small pond or place bird baths near windows where students can see birds bathing and drinking.

3. Assist the Division of Fish and Wildlife, Indiana Department of Natural Resources (IDNR), with the peregrine falcon, bald eagle, barn owl, wild turkey, and other wildlife improvement programs. Have students monitor wildlife movements and habitats in their community and wild areas. Report illegal hunting or destruction of wildlife habitats to IDNR conservation officers or local law officials. Analyze why bald eagles are endangered in Indiana, but domestic turkeys are not. (When property rights for resources, such as wild animals, are not clearly defined, the resources will be exploited. Turkey farmers have a vested interest in perpetuating the turkey species.)

4. Work with local energy utility staff to determine what effect electrical power plants have on fish and wildlife in water and natural areas surrounding the plant. Interview a local fisherman who fishes in the water near the power plant. What kinds of fish are caught? How do these fish compare to fish caught before the power plant was constructed?

5. Identify and describe some causes for extinction of animal species, define threatened, rare, and endangered, as applied to wildlife, and name threatened and endangered animals living in Indiana. (Adapted from *Project WILD* "Here Today Gone Tomorrow," see Resource Section.)

6. Identify a problem involving wildlife on their school grounds. Suggest and evaluate alternative means by which to solve the problem, or at least improve the situation. Undertake the project and analyze and describe the process by which they successfully solved the problem or improved the situation. (Adapted from *Project WILD*, "Can Do.")



Investigating Your Own Community

1. Have your students identify at least ten hardwood trees native to Indiana. Which of these trees is used to make furniture? Which of these trees is the most scarce? How does this affect the price of this wood? How does this affect the price of furniture made from this wood?

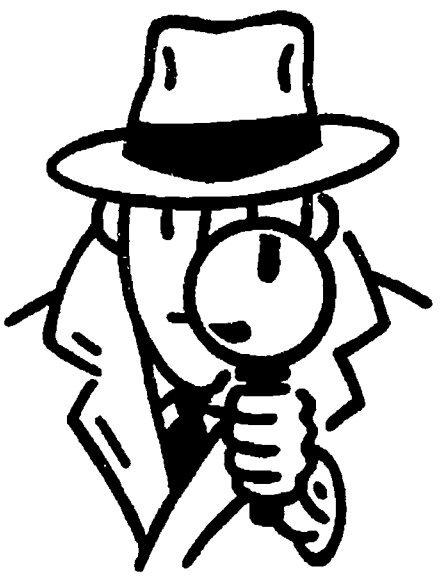
2. Research how wildlife in Indiana and other states helps the economy. What would happen to the economy if we polluted our lakes, rivers, and reservoirs so much that the fish were dangerous to eat? What would happen to Indiana's economy if we did not have deer, wild turkey, rabbits, squirrels, and pheasants?

3. Research how many state fish and wildlife areas exist in Indiana. Who manages them? Where are they located—locate them on an Indiana map. (Contact the Division of Fish and Wildlife, Indiana Department of Natural Resources—see Resource Section.)

4. Visit a state fish and wildlife area near your the school. Compose questions to ask the wildlife specialist during the field trip.

5. Inventory ten products in the classroom which are made from minerals, trees, petroleum, etc.

   a. List these products on the board.
   b. Trace where these products came from and identify natural resources used to produce these products.
   c. Discuss what will happen to these products after they have been used.



Debating the Issues

1. To save energy, government should require car makers to design automobiles that get 50 miles per gallon.

2. To save energy, citizens in cities should be required to:

   a. carpool.
   b. use public transportation.

3. To preserve wildlife, hunting should be banned.

4. To conserve water, the water rates should be doubled for all homeowners.

EEE Action – You Can Make a Difference!

1. Adopt a wild animal in the community to observe and monitor for a month—birds, squirrels, rabbits, ducks, geese, etc.

2. Assist local Audubon chapters with Christmas bird counts.

3. Provide water to wild birds during hot summer days. (If you start a watering program you need to continue it throughout the summer). Observe these wild birds using the fresh water for drinking and bathing. Photograph or sketch the wild birds.

4. Plant a tree each year for Earth Day and/or Arbor Day. Manage your tree throughout the year to make sure it receives enough nutrients and water.

5. Identify flowers and shrubs which attract butterflies and humming birds. Plant them in your back yard. (Ask your parents for permission and assistance.)

6. Think of at least five things you can do immediately to help conserve natural resources. Examples:

   a. Walk to the nearby store to purchase groceries you can carry.
   b. Check tire pressure on your bicycle and family car(s)—inflate when needed. This helps to conserve human and petroleum energy resources.

7. Purchase products which can be recycled and have been made from recycled materials.

BEST COPY AVAILABLE

Energy, Economics, and Environmental Education

Resources

Energy, Economics, and Environmental Education

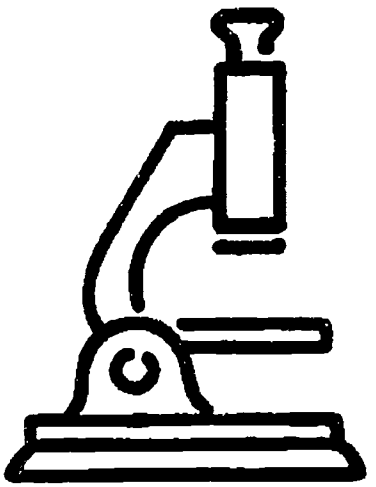
Resources

There are a number of energy, economics, and environmental education resources available in local communities, counties, the state, and nation. We believe the resources listed below are some of the best that are available to middle school educators. Many of these agencies have films, curriculum materials, resource materials, VCR tapes, speakers, facilities, and mini-grants (electric utilities), to support and assist local educators as they implement this module. We hope you will work with the local energy, soil and water, environmental, and economic resource agencies to involve them in your EEE program:

Indiana Michigan Power
One Summit Square
P.O. Box 60
Fort Wayne, IN 46801
(219) 425-2137
Contact: Mike Brian

Indianapolis Power and Light Company
P. O. Box 1595-B
Indianapolis, IN 46206
(317) 261-8708
Contact: Bob Golobish

Northern Indiana Public Service Company
5265 Hohman Avenue
Hammond, IN 46230
(219) 647-6215
Contact: Julie Burris



PSI Energy
1000 East Main Street
Plainfield, IN 46168
(317) 838-1443
Contact: Jeanna Keller

Indiana Department of Education
Office of School Assistance
Room 229, State House
Indianapolis, IN 46204-2798
(317) 232-9141
Contact: Harlan Day, Joe Wright, Marty Alenduff

Indiana Council for Economic Education
Krannert Center
Room 222
Purdue University
West Lafayette, IN 47906
Contact: Pete Harrington
(317) 494-8540

NEED (National Energy Education Development) Project
P.O. Box 2518
Reston, VA 22090

Indiana Petroleum Council
143 West Market Street
Indianapolis, IN 46204
(317) 639-2588
Contact: Gene Haflich

Indiana Department of Natural Resources
Division of Forestry
402 West Washington Street, Room 296
Indianapolis, IN 46204
(317) 232-4105
Contact: Sam Carman

Southern Indiana Gas and Electric Company
20 North West Fourth Street
Evansville, IN 47741
(812) 464-4526
Contact: Jane Fiessinger

Indiana Wildlife Federation
301 East Carmel Drive
Suite G 200
Carmel, IN 46032
Contact: Harry Nikides

Indiana Department of Commerce
Office of Energy Policy
1 North Capitol, Suite 700
Indianapolis, IN 46206-6015
(317) 232-8948
Contact: Bob Berlin

Indiana Gas Company
P.O. Box 5389
Lafayette, IN 47903
(800) 666-3090

Citizens Gas and Coke Utility
2020 North Meridian Street
Indianapolis, IN 46202
(317) 924-4438

Edison Electrical Institute
1111 19th Street, Northwest
Washington, DC 20036
(202) 778-6400

Indiana Department of Environmental Management
Chesapeake Building
105 South Meridian Street
Indianapolis, IN 46206-6015
Contact: JoAnne Joyce

Other Organizations Offering Lesson Plans, Activities, and Resources:

AMERICA'S CLEAN WATER FOUNDATION
Sponsors activities to enhance youth education in environmental sciences.
444 North Capitol Street, Northwest
Suite 330
Washington, DC 20001
(202) 624-7833

ANDREWS AND MCMEEL
50 Simple Things Kids Can Do To Save The Earth - Price: $6.95.
4900 Main Street
Kansas City, MO 64112

BIOLOGICAL SCIENCE CURRICULUM STUDY (BSCS)
Provides a variety of materials for teachers and students including textbooks, modules, manuals, and films.
BSCS
The Colorado College
Colorado Springs, CO 80903
(303) 473-2233

BLUE PLANET
A collection of information, activities, and resources about environmental and earth science topics for Grades 3-12.
Office of Education
National Air and Space Museum
Washington, DC 20560

EARTH DAY 1990
Offers lesson plans and activities for Grades K-12.
P.O. Box AA
Stanford University, VA 94309

EARTHKEEPERS
An educational program for helping young people live in harmony with the earth.
Institute for Earth Education
P. O. Box 288
Warrenville, IL 60555

ENERGY EDUCATION RESOURCES
This booklet, which is updated yearly, lists many energy education resources that are available to educators, K-12. An excellent source of information.
Energy Information Administration
National Energy Information Center
United States Department of Energy
Washington, DC 20585
(202) 586-8800

EXXON ENERGY CUBE
Richard G. O'Sarrell
Exxon Corporation
225 E. John Carpenter Freeway
Irving, TX 75062
(214) 444-1170

GEOLOGY: THE ACTIVE EARTH
Curriculum guide for Grades K-7.
National Wildlife Federation
1400 16th Street Northwest
Washington, DC 20036-2266
1(800) 432-6564

GEOLOGIC PUBLICATIONS OF INDIANA
Lists map resources and other information about natural resources in Indiana. Some county specific information is available.
Publications Section
Geological Survey
611 North Walnut Grove
Bloomington, IN 47405
(812) 855-7636

1 : C

GLOBAL TOMORROW COALITION
Carries environmental education curricula on tropical forests, marine and coastal pollution, and global issues.
1325 G-Street, N. W.
Washington, DC 20005
(202) 628-4016

GLOBAL WARMING AND THE GREENHOUSE EFFECT
LHS GEMS
Lawrence Hall of Science
University of California
Berkeley, CA 94720
(415) 642-7771

HANDS - ON NATURE and WASTE AWAY
Information and activities for exploring the environment with children.
Vermont Institute of Natural Science
Woodstock, VT 05091

INDIANA INSTITUTE ON RECYCLING
Publishes *The Indiana Recycler*, a monthly newsletter that describes recycling efforts in Indiana.
Room 921, School of Education
Indiana State University
Terre Haute, IN 47809

INDIANAPOLIS RESOURCE RECOVERY FACILITY
Ogden Martin Systems, Inc.
Operates waste to energy plant in Indianapolis. Tours and information available.
2320 South Harding Street
Indianapolis, IN 46221
(317) 634-7367

NATIONAL AUDUBON SOCIETY
Publishes newsletters, newspapers, posters, and *Audubon Adventures,* an environmental education program for students.
Education Division
950 Third Street
New York, NY 10022
(212) 832-3200

NATIONAL ENERGY INFORMATION CENTER
Annual Outlook with Projections to 2000 —Free.
E1-20 Energy Information
Administration Forestry Building
Room 1F-048
Washington, DC 20585
(202) 252-8800

NATIONAL GEOGRAPHIC SOCIETY
Offers a wide variety of educational materials for students.
Educational Services
Department 5413
Washington, DC 20036
(800) 368-2728

NATIONAL WILDLIFE FEDERATION
Provides environmental science activities, kits, books, videos, and magazines.
School Programs
8925 Leesburg Pike
Vienna, VA 22184-0001

COMPLETING THE CYCLE - IT'S UP TO ME
OUTDOOR CLASSROOM
NATIVE AMERICAN
SAVE OUR STREAMS
TAKE PRIDE IN AMERICA
EARTH MONTH EVERY MONTH
Information about these programs is available from the
Indiana Department of Education
Office of School Assistance
Room 229, State House
Indianapolis, IN 46204-2798
(317) 232-9141

PROJECT WILD and PROJECT LEARNING TREE
Division of Forestry
Indiana Department of Natural Resources
6013 Lakeside Boulevard
Indianapolis, IN 46278
(317) 290-3223

PROTECTING THE OZONE LAYER: WHAT YOU CAN DO
Environmental Defense Fund
527 Park Avenue South
New York, NY 10010
(212) 505-2100

PURDUE UNIVERSITY COOPERATIVE EXTENSION SERVICE
Can provide information on recycling and solid waste management. This information is also available from local county extension offices.
301 South 2nd Street
Lafayette, IN 47905
(317) 494-6794

SCIENCE FOR CHILDREN: RESOURCES FOR CHILDREN
This resource guide identifies many science and environmental education curricular materials and programs. It lists only those which have been evaluated by the National Science Resources Center in Washington, DC
National Academy Press
2101 Constitution Avenue
Washington, DC 20077-5576
Price: $7.95

SCIENCE AND ENVIRONMENTAL EDUCATION RESOURCE GUIDE
Directory of national science and environmental education resources.
California State Department of Education
821 Capital Mall
Sacramento, CA 95814

SIERRA CLUB
Provides free teachers' newsletters, list of environmental education materials, filmstrips, slides and videos, and a literature list for children.
703 Polk Street
San Francisco, CA 94109
(415) 776-2211

THE WASTE CASE
An activity-based teaching guide on trash and the environment.
Buhl Science Center
Allegheny Square
Pittsburgh, PA 15212-5363
(412) 237-3363

THIS WORLD OF ENERGY
A filmstrip about energy resources.
National Geographic Society
Educational Services
Department 90
Washington, DC 20036

U. S. ENVIRONMENTAL PROTECTION AGENCY
Provides a directory of environmental education materials for Grades K-12.
Office of Community and Intergovernmental Relations
Mail Code A-108 EA
U. S. Environmental Protection Agency
401 M Street, South West
Washington, DC 20460
(202) 382-4454

WATER POLLUTION CONTROL FEDERATION
Offers curriculum materials on water resources.
Public Education Department
601 Wythe Street
Alexandria, VA 22314
(703) 684-2400

DIRECTORY OF GREAT LAKES EDUCATION MATERIALS
Beverly Croft
International Joint Commission
100 Guellette Avenue, 8th Floor
Windsor, Ontario Canada N9A 6T3
(519) 256-7821

ALWAYS A RIVER
Thelma B. Johnson
United States Environmental Protection Agency
Public Affairs Office
26 West Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7212

KIDS FOR CONSERVATION
Contact: Phil Wilson
Illinois Department of Conservation
Lincoln Tower Plaza
524 South Second Street
Springfield, IL 62701-1787

LIST OF ENDANGERED SPECIES
Director, Office of Endangered Species
United States Fish and Wildlife Service
United States Department of the Interior
Washington, DC 20204

HEAR THE CRY

Let historians record that people heard the cry of the Earth, and came to heal her. We hear the Earth cry as her rainforests are shredded at the rate of 2 acres per second—We hear the Earth cry as her species are lost, permanently, at the rate of one per hour—We hear the Earth cry when our chemicals rip a gaping hole in the delicate ozone layer that protects us and all other life from deadly radiation.

Is there a more fundamental right than the right to breathe free? Breathing isn't a matter of choice. Breathing is a right. When a 20-year-old smoker in Los Angeles has the lungs of a 40-year-old smoker, her fundamental rights are being violated.

We hear the cry of the Earth. But to heal her, we must also heal ourselves. There are no boundaries between ourselves and the environment. We eat our environment. We drink it. We breathe it. The Earth flows through us, as well as around us. To treat ourselves with respect, we must treat the Earth with respect.

I've been asked thousands of times, "What should people do?" The answer is to look inside yourself for your own moral compass, and follow it. Don't let others define what you are. Don't let advertisers mold you; don't let zealots ensnare you; don't let the conventional wisdom trap you.

Look deep inside and ask yourself what's right. Whether you are buying a car or casting a ballot, choosing a job or planning a family, weigh carefully the consequences of your choice.

Remember, you are part of something far larger. Go out tonight and look at the stars. Put life in perspective by remembering the 3,000 year old bristlecone pines, the silent, cathedral-like mood of the redwood canopy, the elegiac verse of the humpback whales. Weigh your choices mindful of the poor in the ghettos, and the destitute of the world. . .

Let historians record that we heard the cry of the Earth, and we demanded that she be healed.

Dennis Hayes
International Chair, Earth Day
Chairman, Green Seal

Developed by:

Office of School Assistance
Indiana Department of Education
Room 229, State House
Indianapolis, IN 46204-2798
(317) 232-9141

Policy Notification Statement

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Inquiries regarding compliance with Title IX may be directed to the Human Resources Director, Indiana Department of Education, Room 229, State House, Indianapolis, IN 46204-2798, or to the Director of the Office of Civil Rights, Department of Health and Human Services, Washington, DC; **H. Dean Evans, State Superintendent of Public Instruction.**

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