DOCUMENT RESUME

ED 354 154 SE 053 122

TITLE	Decision: Earth.
INSTITUTION	Procter and Gamble Educational Services, Cincinnati, OH.
PUB DATE	Jun 92
NOTE	86p.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	*Class Activities; Conservation Education; *Consumer Economics; Consumer Protection; Definitions; Environmental Education; Grade 7; Grade 8; Grade 9; Junior High Schools; *Learning Activities; Lesson Plans; Manufacturing; *Marketing; Merchandise Information; *Natural Resources; Recycling; Solid Wastes; Teaching Methods
IDENTIFIERS	Composting; *Environmental Impact; *Packaging

ABSTRACT

This Proctor and Gamble produced and teacher developed environmental education unit is designed to teach seventh through ninth grade students about making informed consumer product choices. The unit focuses on the concept of consumer product life cycle analysis, an approach to assessing the environmental impacts of a product at each stage in its life from raw materials extraction through disposal. Using this approach, a product is evaluated in terms of energy consumed, atmospheric and waterborne emissions generated and solid waste created for disposal. Included is a mini-unit about municipal composting. The materials include overhead transparency masters, student worksheets, and a teacher's guide. A wall poster that comes with original copies has been reproduced here in segments. (Author/MCO)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED354154

DECISION:

EARTH

An Environmental Teaching Unit for Grades 7–9

Includes life cycle analysis and composting

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Tawnia B. True

BEST COPY AVAILABLE

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

- This document has been reproduced as received from the person or organization originating it
- Minor changes have been made to improve reproduction quality

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

SE 053 122

ERIC

DECISION:

EARTH

Dear Educator:

Procter & Gamble is pleased to bring you DECISION: EARTH, an environmental education unit designed to teach seventh through ninth grade students about making informed consumer product choices.

The unit focuses on the concept of consumer product life cycle analysis, an approach to assessing the environmental impacts of a product at each stage of its life from raw materials extraction through disposal. Using this approach, a product is evaluated in terms of energy consumed, atmospheric and waterborne emissions generated and solid waste created for disposal. This accounting of resources helps guide Procter & Gamble as we develop new brands or improve existing ones. In particular, it helps identify ways to improve the environmental impacts of our brands.

Life cycle analysis can help young consumers think about the impact of their purchase decisions beyond where they fit in the cycle. It also allows students to understand that they can play an important role in improving the environment.

Included with DECISION: EARTH is a mini-unit about municipal composting. This method of waste handling, already in operation in about 15 communities, can reduce the need for landfills by more than half.

Your classes may also enter the "Clean S.W.E.E.P." contest. S.W.E.E.P. stands for *schools with excellent environmental practices* and helps illustrate the importance of personal responsibility for the environment. To enter, classes conduct a waste audit and make recommendations to improve their school's environmental practices. They can win up to $500 to implement their ideas. Official rules and an entry form are enclosed. Remember, entries must be received by January 4, 1993.

We hope you find DECISION: EARTH a beneficial addition to your environmental education curriculum. We welcome your comments and encourage you to complete and return the enclosed postage-paid evaluation card.

Sincerely,

Carol Talbot

Carol G. Talbot, Associate Director
Educational Services

Bruce E. Jones

Bruce E. Jones, Associate Director
Professional & Regulatory Services

ERIC

DECISION: EARTH

Teacher's Guide

ERIC Full Text Provided by ERIC

Table of Contents

INTRODUCTION TO DECISION: EARTH

Environmental quality is a global issue affecting every citizen on earth. The countries of the world are becoming interdependent neighbors as our global economy and sophisticated communications technology bring us closer together. As neighbors, we affect one another economically, politically and environmentally for good or bad, through the decisions we make.

As one of the world's largest producers of consumer products, Procter & Gamble is committed to providing the world's consumers with products of superior quality and value. Concern about the potential environmental impact of our products and packaging is uppermost in the Company's commitment to environmental quality. We support the concept of "sustainable use of resources," which prescribes that as development proceeds, resources are available to meet the needs of the future. Through the wise use of resources and while best filling consumer needs, we are constantly evaluating our waste prevention and reduction efforts at the product design, manufacturing, consumer use and disposal levels. We believe it is possible for humankind to progress and still be responsible stewards of our natural resources.

Procter & Gamble believes that a shared commitment by government, industry and consumers to carry out this agenda will require informed understanding of the impact of consumer products on the environment, the wise use of resources, and the prevention and reduction of waste at all levels.

To this end, Procter & Gamble is pleased to send you *Decision: Earth*. This is an environmental curriculum supplement designed to raise student awareness of the complex consumer product choices they face and help them make informed choices based on a product's ability to meet their needs as consumers.

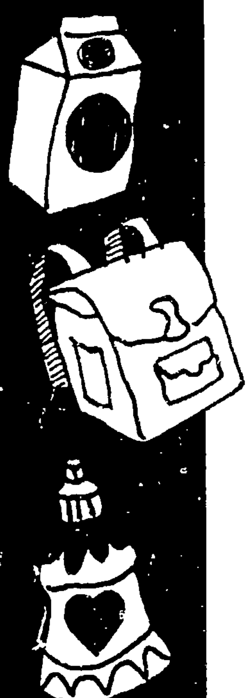
HOW WILL DECISION: EARTH HELP MY STUDENTS?

Educators agree environmental education provides ideal opportunities for interdisciplinary teaching and learning. This approach permits the classroom teacher great flexibility in presenting basic concepts by allowing the selection of lessons and activities that help meet the specific learning objectives and skill requirements within your curriculum area. *Decision: Earth*, a unit that traces the life cycle of consumer products, helps students learn about their role as an integral part of natural systems. As students come to understand the interrelationships, they will be able to determine the effects of society on natural systems.

The classroom activities developed for *Decision: Earth* present students with numerous hands-on learning opportunities, providing an experiential base which encourages critical thinking and responsible decision making. Group dynamics is central to the teaching and learning experiences offered in *Decision: Earth*. Students will be exposed to exercises demonstrating how the group decision making process can work to affect our environment in positive or negative ways.

Through *Decision: Earth*, Procter & Gamble hopes students will grow in awareness and understanding and in their concern and action for the state of our global environment.

WHAT THE DECISION: EARTH UNIT CONTAINS



Teacher's Guides

Decision: Earth — a comprehensive lesson guide with interdisciplinary classroom and extension activities to teach a unit on the life cycle analysis of consumer products. Vocabulary words highlighted in bold throughout the unit are defined in a separate reproducible Glossary for students.

Municipal Solid Waste Composting — a lesson guide featuring hands-on classroom activities to teach the benefits of municipal composting as a viable solid waste management option.

***Decision: Earth* Wall Poster** This colorful wall poster, featuring many of the daily activities your students engage in, is used interactively in the classroom with several activities and corresponding worksheets.

Municipal Solid Waste Composting Wall Poster This poster describes the municipal composting process.

Student Worksheets These reproducible masters may be duplicated in classroom quantities and are used to support the lessons in the Life Cycle Analysis and Municipal Solid Waste Composting Teacher's Guides.

Overhead Transparency Masters As with the student worksheets, these may be duplicated in classroom quantities for distribution to students or made into transparencies and used on an overhead projector.

Evaluation Survey Card It is critical that students understand the consequences and implications of their consumer product choices. We urge you to survey your students and indicate the consensus responses to these questions. This information helps us gauge the effectiveness of our consumer education efforts, and we thank you for your help.

ADVISORY PANEL

These classroom materials have been developed under the direction and review of classroom teachers like you as well as experts in the areas of life cycle analysis, the environment, and municipal solid waste composting. Procter & Gamble would especially like to acknowledge the contributions of:

Joan W. Hall, classroom teacher, Cincinnati, Ohio

Mark Koker, Curriculum Developer, Chemical Education for Public Understanding Program, University of California

Caroline Maslowski, classroom teacher, West Milton, Ohio

Anthea Maton, Curriculum and Assessment Consultant, Education Connections, Oklahoma City, OK, former National Coordinator, Project Scope, Sequence & Coordination

Robert E. Roth, Ph.D., Professor Assistant Director, School of Natural Resources, The Ohio State University, Columbus, Ohio

Thomas Shimalla, Environmental Curriculum Development, Pocono Environmental Education Center, Dingmans Ferry, Pennsylvania

Developed by Modern Talking Picture Service, Inc for the Procter & Gamble Co

ERIC Full Text Provided by ERIC

Analyzing the Life Cycle of a Consumer Product

How Do We Define "Consumer Product" In *Decision: Earth?*

Economists broadly define ***consumer goods*** as any tangible commodity produced, purchased and used directly to satisfy human needs or desires, and ***capital goods*** as those used to produce some other product or service. The differentiation depends more on how a product is used than on the product itself. For example, a washing machine is a consumer good when used by a family but is a capital good when used by a commercial laundry.

Whether we talk about consumer goods or capital goods, two broad categories of each may be distinguished as ***nondurable*** and ***durable***. Nondurable goods are those expected to last less than three years, while durable goods are expected to last longer than three years. Another distinction made by economists between these two categories is that nondurable goods are generally purchased when needed, so that the demand and consequent purchase rate for these goods generally parallels population growth. In contrast, the demand for durable goods tends to vary with the state of the economy, as the purchase of these items, such as large appliances or automobiles, can often be postponed.

How Do We Define Life Cycle Analysis In *Decision: Earth?*

The study of the relationships between living things is called ***ecology***. The word ecology comes from the Greek word meaning, "to study the home." The home includes the environment in which an organism lives, the interaction of organisms with each other, and the interaction of organisms with the non-living environment. In studying the environment, scientists have learned that whether conditions are artificially or naturally altered, the effects of such an event may have far-reaching consequences for all the organisms in that environment. This concept of interdependence is easily demonstrated through the examination of a food chain.

The life cycle analysis of a consumer product is extremely complex, involving study of all places that a product can and will impact the environment. Resources, waste emissions, energy usage and solid waste generated for products are evaluated through each of the five phases of the life cycle:

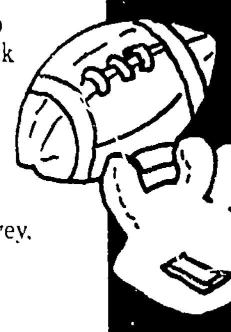
1) obtaining the raw materials;
2) processing or manufacturing;
3) distribution;
4) use and re-use; and
5) disposal.

During each of these phases, the amounts of atmospheric and waterborne wastes emitted, the amount of energy used, and the amount of solid waste generated are monitored. These factors are carefully studied by consumer goods manufacturers like Procter & Gamble to seek ways to minimize the environmental effects products have on the Earth.

The concept of an "industrial ecosystem" is now emerging among many industries. In an industrial ecosystem, just as in nature, the system is designed to maximize efficiency of materials and energy usage and to minimize waste. As an example, in an ideal system, the waste from one process — e.g., heat *loss* — can be captured to serve as a heat *source* for another process. This is not a new idea. It is a concept based on a scientific principal called the First Law of Thermodynamics which, in essence, says that matter and energy can neither be created nor destroyed, but only changed from one form to another. It follows from this that all the materials and resources that go into a process will come back to us in altered forms, ending up in the air, water, soil or as different products.

Begin this unit by introducing students to the concept of Life Cycle Analysis, using this section as background information and illustrating the concept with the Overhead Transparency Master, *Life Cycle Analysis of a Consumer Product.*

You may wish to pre-test student attitudes on Life Cycle Analysis issues by administering the survey, "Thinking It Through", included with the unit.



ERIC
BEST COPY AVAILABLE

Lesson One —

GOING TO THE SOURCE: AN INTRODUCTION TO NATURAL RESOURCES AND RAW MATERIALS

CONCEPT

All consumer products require a source of raw materials. These raw materials are harvested, mined, drilled or otherwise obtained. The sourcing of raw materials and the use of natural resources is the first step in the life cycle of a consumer product.

ACTIVITY 1

This Was Your Life

Objectives

1. To acknowledge as natural resources all the bounty of a nation, including its mineral, land and water resources, ecological communities, agricultural, climatic, technological, and human potential, as well as its natural beauty.

2. To identify natural resources as one of the factors of production of consumer products.

3. To identify the raw materials used to make several products.

Time Needed: 1 class period

Materials Needed:

An assortment of consumer products representing a range of raw materials and natural resources. Examples: wool sweater (sheep), bicycle inner tube (rubber), empty soda can (aluminum), old book or magazine (paper), audiocassette tape (plastic), perfume bottle (glass).

Introduction

This game introduces students to the concept that every consumer product begins with a raw material. It is designed to stimulate sequential, logical thinking among students as they trace a product backwards through its life cycle to identify the primary raw material or natural resource used to make it.

Procedure

1. Arrange students in a circle. Explain that the first go-round of the game, "This Was Your Life," is for practice. The object of the game is to share with the class something about the life cycle of an item in reverse sequence.

2. Hand a student the first item which you have brought to class. (Example: sweater) Speaking as the item, start the game at the point of throwaway or discard. The students' statements should proceed something like this: "I'm on my way to the thrift store." Pass to the next student, who continues, "I used to belong to______, but now I'm too small." "____ liked me so much, she wore me to school almost everyday." "I was bought at _______ Department Store." "I came to (your town) from a clothing factory in New York City." "The wool was imported from Australia." "The wool exporter bought me from the sheep rancher in the Outback."

3. Conclude each round with students identifying the primary raw material or natural resource for each of the items. What sorts of energy usage or waste may have occurred along the way?

4. If the students cannot identify the raw material used to make any item, have them research the answer for homework and bring in the answer the next day.

Extension Activity

Consider setting up a *Decision: Earth* club and establishing a school thrift store stocked with reusable items in good repair that students can purchase for reasonable prices. The class may wish to conduct some market research among students to determine the school's interest level and potential participation in such an on-going fundraiser.

ACTIVITY 2

Resource or Re-source

Objectives

1. List the categories of natural resources.

2. Name examples of products made from each category of natural resources.

Time Needed: 2 class periods

Background

Defining Natural Resources

Natural resources, in the broadest sense, encompass the ecological vitality of plant and animal communities, agricultural, water, climatic, technological, human potential and natural beauty of a country. However, natural resources are more commonly thought of as the mineral resources and fossil fuels that the earth holds. Because the processes that formed deposits of natural resources around the globe occurred sporadically throughout geologic time, no one nation contains all of the important economic resources.

From the beginning of time, it seemed the Earth held an unlimited supply of natural resources. Since the Industrial Revolution in the eighteenth century, industrialized nations of the world have tapped this seemingly endless supply of resources. It is only recently that the conservation and environmental impacts of these actions are being recognized and addressed.

The world's diminishing supply of natural resources must now meet the needs of over 5.3

ERIC

billion people. Natural resources are generally divided into two classes, renewable and nonrenewable. Renewable resources are those which can be replaced by natural ecological cycles, natural chemical and physical processes (wind, sunlight) or through growth, reproduction and management. They include plants, trees and animals, fresh water supplies and other processes driven by the energy of the sun. But these resources can be considered renewable only so long as they are managed responsibly and their rate of replacement is greater than the rate of usage.

Nonrenewable resources include any resources that cannot be replaced or regenerated naturally within a reasonable period, such as minerals, fossil fuels, sand and rock. Experts agree that our nonrenewable resources need to be conserved. Most of the world's current energy demands are met by nonrenewable sources such as coal and oil. However, our future depends on the development of a safe, permanent energy system.

Renewable resources can be divided into two groups, exhaustible and inexhaustible. Processes driven by the energy of the sun are inexhaustible, but nevertheless must be managed responsibly. Biomass, the organic matter contained in plants, animals and microorganisms, for example, is ultimately produced by photosynthesis, making it an indirect form of solar energy. Forms of biomass already used by humans for the production of energy include wood, crops, domestic animals and harvesting wildlife, manure, urban waste, industrial wastes and municipal sewage. Some are burned directly, others are converted to methane or ethanol while still others are consumed by humans to provide the chemical energy required for survival. While any of these resources may become temporarily depleted through improper management, they can be restored because they are driven by the sun's energy. However, we must also consider the effects of any biomass diversion and the harvesting of agricultural crops and forests on the renewal process. Harvesting these renewable resources may alter the earth by eroding or depleting topsoil and stripping nutrients.

Water is a renewable resource that can be exhausted. The earth is sometimes referred to as the water planet, yet less than 3 percent of our water supply is fresh water that is usable for domestic, agricultural and industrial purposes. Concerns about water involve both quantity and quality. In theory, the earth's water supply should never run out, being constantly renewed through the water cycle of evaporation, transpiration, condensation and precipitation. However, in practice, water resources become depleted when used faster than the natural water cycle can replace it. In addition, available surface and groundwater supplies may be reduced due to pollution. A clean, fresh and readily available water supply is now one of our most precious resources.

Obtaining Natural Resources

Natural resources or raw materials must be mined or recovered by methods that are increasingly energy efficient and environmentally appropriate. Minerals are extracted by surface or subsurface mining while fluid resources are removed by drilling operations. Surface mining (strip mining, pits, quarries or dredging) is generally less expensive, permits more complete extraction, and poses fewer safety hazards. In the United States, land reclamation laws require that surface mining areas are restored when operations are completed. Any environmental danger from oil rigs, especially offshore operations, will usually come from blowouts (pipeline breaks) and oil spills.

Forests are one of our most valued renewable resources. American forests contain more wood than they did four decades ago. They rank first in productivity and vitality due to our temperate climate, favorable growing seasons, excellent soils, improved seedlings, and forest manage-

ERIC

ment expertise. Today, this valuable **renewable resource** is commercially harvested in one of several ways.

Clear cutting removes all trees within a stand of a few species to create new habitat for wildlife. Procter & Gamble uses this economically and environmentally sound method because it most closely mimics nature's own processes. Clear cutting removes large tracts of timber, just as a forest fire would, except in a more controlled manner. Clear cutting also opens the forest floor to sunshine, thus stimulating growth and providing food for animals.

Selective cutting is used on stands of unevenly aged trees and involves removing only mature trees. Shelter-wood cutting is an intermediate method between clear cutting and selective cutting that involves the removal of larger "overstory" trees to improve the growth of the remaining healthy trees. After saplings are established, mature trees are cut.

The raising and harvesting of agricultural crops requires strict attention to new techniques and reliance on soil enhancements and chemical additives. Integrated pest management relies on the best combination of natural and chemical pest controls to ensure disease- and pest-free crops with maximum yield per acre.

The harvesting of aquatic crops and certain aquatic species may help address the world food supply, however little is known of the effect this may have on aquatic ecosystems. For example many species, such as the sea otter, find shelter and feed in kelp beds. Algae, such as kelp, form the base of many aquatic food chains and are therefore necessary for survival of many organisms. Over-harvesting of kelp "forests" could lead to endangerment of many species further up the food chain.

Procedure

1. Introduce students to the concept of natural resources and how they are obtained as presented in the Background for this lesson.

2. On the board, build a list of resources by category, such as mineral, fuel energy, aquatic, forest and agricultural. Enlist student responses to identify several products from each category

Extension

1. Have students select a category of natural resources to research further, either individually or in groups. Pre-arrange with your school library media specialist to have on hand a selection of books on minerals, fuels, forestry, water and other resources.

2. Students or groups can develop a creative presentation. Some possibilities: A multimedia poster or sculpture using mineral resources such as clay, stone, rock; or a collage of forestry products such as a page from a book, newspaper, wooden airplane, cardboard box, wood. Let students be creative with their presentations.

3. Establish your grading criteria with students beforehand. For example, students must include information such as: Where is this material found? How is it acquired? How does this resource affect a country's or region's economy? What are the current reserves? How long are supplies expected to last? Is it used as a raw material or an energy source? What kinds of products is it used to make? Are alternative materials available?

ACTIVITY 3

**Fossil Fuels:
Natural Resources or National Resources?**

Objectives

1. Identify oil, coal and natural gas as the three primary energy resources.

2. Compare the uneven distribution of the world's energy resources.

3. Estimate, at current usage rates, how long the world's nonrenewable energy reserves are projected to last.

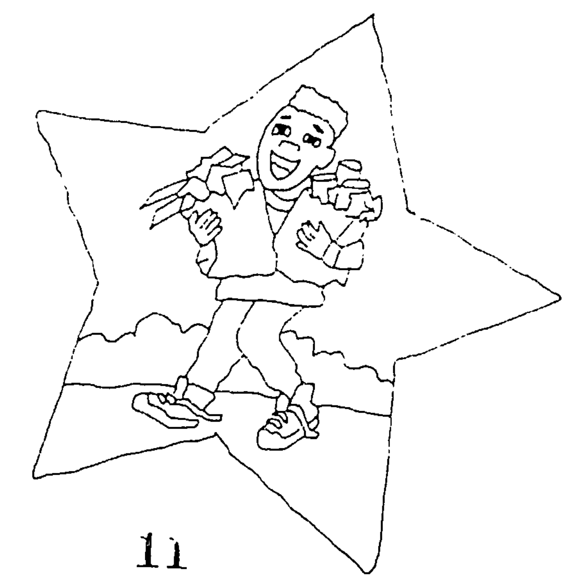
Time Needed: 1 class period

Materials Needed:

"Where Are They and How Long Will They Last?" Blackline Master Map and Student Worksheet

Background

By the 1970s, questions arose concerning environmental quality and available supplies of nonrenewable resources. To understand the availability of a resource, a distinction must be made between the terms ***reserves*** and ***resources***. Both terms refer to the amount of a resource. *Reserves* are deposits of energy fuels or minerals that are economically feasible to remove with current and foreseeable technology. *Resources*



refer to the total amount of an energy fuel or mineral known to exist. Resources can include a wide range of deposits, from those that are identified and quantified to those that are as yet undiscovered. This group includes even those deposits that are not economical to mine, such as thin strips of coal 2000 meters below the earth's surface.

Other nonrenewable resources include mineral ores from which iron, aluminum, copper, zinc, and other elements are extracted, as well as precious metals such as gold, silver and platinum. Improvements in mining and extraction technologies have increased our ability to recover mineral reserves. Between 1950 and 1974 the reserves of iron ore, bauxite, copper, lead and platinum have tripled as a result of these improved technologies. The demand for many important nonfuel minerals is expected to grow at a rate of 3 percent per year. Recycling and conservation measures may give the industrialized world time to develop new mining techniques and to find substitutes for these limited natural resources. As an example, the fiber optics industry has been able to replace the copper in telephone cables with quartz, which is extracted from sand.

Also included in the nonrenewable resources are the fossil fuels — oil, natural gas and coal. Oil is a black, viscous mixture of hydrocarbons that is refined and converted into products such as gasoline, diesel fuel, propane, asphalt and the chemicals needed to make plastics and synthetic fabrics. Natural gas is a mixture of low-molecular weight hydrocarbons, mainly methane, that is used as a clean-burning fuel. If estimates of world oil reserves prove reasonably accurate, current production volumes can be sustained until the year 2035, when shortages would force a production slowdown.[1] Natural gas reserves are expected to outlast those of oil because of lagging usage compared with oil.[2]

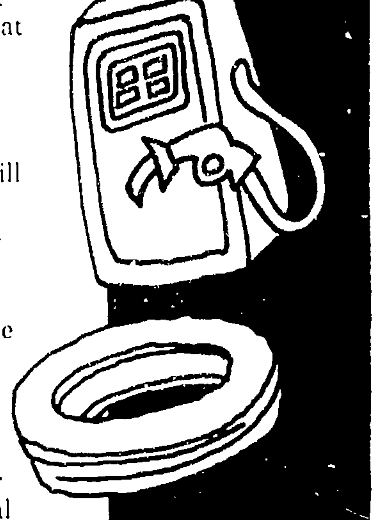
Coal is the most abundant fossil fuel, with projected reserves expected to last from several hundred to 3,500 years. Coal was widely used as a source of energy before oil and natural gas became readily available. The largest supplies of the world's coal reserves are bituminous, which is high in sulfur, and when burned, yields sulfur oxides, which have been linked to environmental issues such as acid rain. Legislation enacted in the 1970s, including the Resource Conservation and Recovery Act, requires the use of various filtration systems in coal-fired power plants to reduce the amount of particulates emitted into the atmosphere.

Introduction

What comprises the natural resources of a nation? For some, it is the people, for others it is the beauty, and for still others it may be the invisible resources lying just below the surface. To whom does a nation's resources belong — that country or the world?

Procedure

1. Copy and distribute the map and student worksheet, "Where Are They and How Long Will They Last?"
2. Have students name the three major nonrenewable sources of energy. (Coal, oil, natural gas)
3. Have students identify on the world map the regions of the world holding major deposits of these energy resources.
4. Using information from the chart on the worksheet, have students calculate and determine, at the current usage rates provided, how many years the reserves of oil, coal and natural gas are projected to last.
5. Ask students: What energy sources will be available to us when all the current energy reserves have been depleted? What products are dependent on the availability of these resources? Once these resources are gone, will we still be able to have these products? How would this be possible? Are there alternative materials these products could be made from? What might they be? If there are none, how should we deal with these limited resources? Should they be rationed? Should we invest in research to find alternative materials? Do we assess the need for the product? How would your lifestyle change if you had no fuel for your car? Heat or air conditioning for your house? Electricity? What processes or procedures can you think of that might be used to determine fair access to limited resources and in what quantities?



Lesson Two —

MANUFACTURING AND DISTRIBUTION: MAKE IT AND TAKE IT

CONCEPT

The manufacturing processes and distribution, phases two and three of a consumer product's life cycle assessment, account for a major portion of the energy consumption, solid waste and emissions impact of that product. If man-made systems were as perfect and efficient as nature's, an industrial "ecosystem" would be able to turn the waste products of one process into the raw materials for the next process. The following lesson

[1] Encyclopedia Britannica, 1989 Edition, Vol. 19, page 593.
[2] Encyclopedia Britannica, 1989 Edition, Vol. 19, page 598.

ERIC

focuses on the manufacturing and distribution phases of a product's life cycle to help students understand the complexity of the issues industry deals with to bring a product to the consumer.

ACTIVITY 1

Not all Soda Containers Are Created Equal

Objectives

1. To identify steps within the manufacturing process that can be bypassed when recycled materials are used instead of virgin resources.

2. To compare the air and waterborne emissions, energy usage and solid waste generated for three types of beverage systems (glass, plastic, aluminum).

3. To use research, role playing and interviewing skills to examine the manufacturing process of a specific product or industry.

Time Needed: 1 - 2 class periods

Materials Needed:

(4) Overhead transparency masters for aluminum, glass, plastic and paper manufacturing processes
Overhead projector
"Soda: How Do We Contain It?" data sheet

Background

Manufacturing

Manufacturing is a process which converts raw materials into consumer goods by mechanical or chemical means. Manufacturing began with the Industrial Revolution in the late 1700s as cottage industries and many hand-made goods were replaced by factories and their manufactured products. The Industrial Revolution brought about a dramatic change in the social, economic and environmental conditions. Mass production lowered costs and increased supplies to make goods more affordable to greater numbers of consumers and allowed the manufacturing of a wider range of products. In many instances, machine-made goods were more uniform and of higher quality than those produced by hand. With the increase in machine labor came an increase in energy demands for manufacturing and improved transportation to get these goods to markets. Along with the many positive outcomes of industrialization, such as improvements in sanitation, public health and agricultural advances, came unforeseen consequences.

Increased Demand for Resources and the Consequences

After World War II there was an increased demand for consumer goods not only in the United States but around the world. During the war many technologies and processes had been developed that could be adapted to peacetime applications as well. These were used to help meet consumer demand for new products.

The increased manufacturing and production required to meet consumer demand resulted in certain environmental consequences, including an increased need for raw materials and energy to manufacture the goods. Increased production led to increased production-related waste and sometimes to industrial pollution, as well as solid waste disposal problems.

Some of the technologies that were developed during this period resulted in the discovery or refinement of synthetic materials such as plastics, nylon, rayon and polyester, with applications ranging from medicine to fashion, which have improved the quality of life in many parts of the world.

Another example is chlorinated fluorocarbons (CFCs). CFCs have revolutionized the way we store food and make modern refrigeration and air conditioning possible. When the possible link between CFCs and the destruction of the ozone layer was recognized in the late 1970s, research began on substitutes. There is no doubt that the depletion of the ozone layer is an environmental issue of major importance. The fact remains that for now there are no practical substitutes for CFCs, and without refrigeration, life as we know it would be impossible.

These are complex issues and as we begin to examine them from multiple perspectives, it is difficult to see issues as simply black or white. What is important is that we properly manage the processes that affect our environment now that their positive and negative consequences are better understood. Through proper management, the benefits of living in a modern society and the enjoyment of a healthy environment are ensured.

Industry's Growing Environmental Awareness

Manufacturers shared the environmental concerns voiced by the public and the government and saw inherent benefits in improving plant operating efficiency. The Resource Recovery Act of 1970 and its subsequent amendments provide legislation dealing with the industrial generation, transport, treatment, storage and disposal of hazardous wastes. It also provides for EPA pre-market screening of new chemicals. The Public Utility Regulatory Policy Act of 1978 provides incentives to industries for energy conservation techniques such as cogeneration (two useful forms of energy produced from the same process). An example of this would be a gas turbine that supplies heat to a paper-drying machine while also driving an electric generator.

Increased Efficiencies in the Manufacturing Process

Because of this increased environmental awareness, industrial energy use in the United States in 1986 was 17 percent lower than in 1973, despite a 17 percent increase in overall production. The industries in which major energy improvements have been made are petroleum refining, chemical production, cement manufacturing, metal processing, paper production, glass manufacturing and clay processing.

Although energy conservation was the obvious focus during the "energy crisis" of the 1970s, manufacturers realized they needed to practice conservation in other areas as well. While some industries such as paper, glass and plastic manufacturing and steel processing have always practiced a certain amount of recycling, many other industries have started to focus on recycling as both a cost-effective and environmentally responsible move.

Another way to reduce environmental impact is through more efficient design of industrial processes. In an industrial "ecosystem," this is accomplished by designing a system in which all the wastes or by-products of one phase provide the raw materials for another. In addition, more efficient design also includes redesigning how a product is made or re-tooling equipment so that less raw material is required to make a product.

Like paper, glass and aluminum, plastics are used in the manufacture of packaging for many goods. These manufacturers generally recycle all of their manufacturing wastes as part of good business management practices. However, the Society of the Plastics Industry has developed a coding system enabling plastics recyclers to identify and sort post-consumer plastics easily by the type of resin used to produce them. Post-consumer recycled plastic is successfully sandwiched between layers of new material in most of Procter & Gamble's liquid laundry and cleaning product packages. Future plans call for the use of post-consumer recycled plastic to be used in virtually all plastic packaging. In 1991, the Food and Drug Administration approved the use of recycled PET plastic for use in making soda bottles, which will pave the way for using recycled plastic in other food packaging.

Introduction

One of the major factors in manufacturing is the cost of raw materials. This exercise helps students understand the economic and environmental benefits of using recycled versus virgin materials in the processing of three types of soda containers.

Procedure

1. Introduce students to the manufacturing processes for aluminum, glass, plastic and paper. Use the flow chart diagrams on the overhead transparency masters included in the unit. Keep the "recycling short cycle" portions of the diagrams covered up.

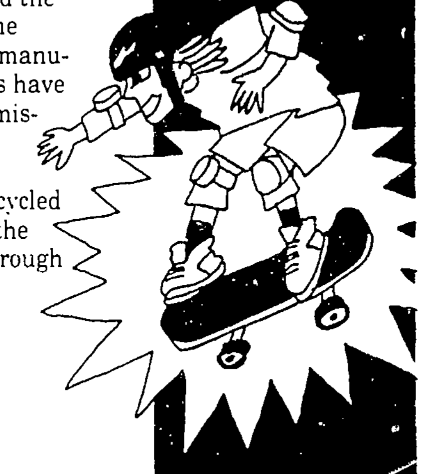
2. Ask students how and where they think the substitution of recycled materials for virgin materials might affect the manufacturing process. Have students indicate which steps of the manufacturing process might be eliminated or bypassed with recycled materials.

3. Uncover the recycling short cycle to reveal which steps each manufacturing process bypasses with the substitution of recycled materials.

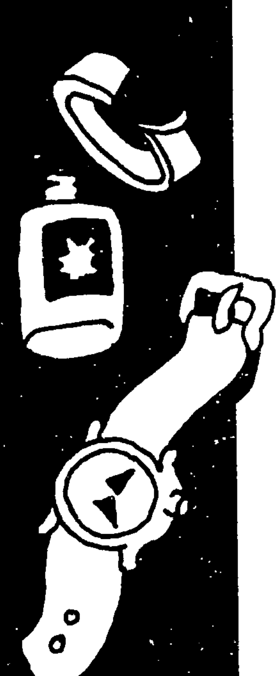
4. Discuss with students how and where in the diagrams the recycled materials save energy, lower emissions and reduce solid waste.

5. Copy and distribute the student datasheet, "Soda: How Do We Contain It?" This sheet provides a comparative analysis of the environmental impacts of three beverage packaging materials: plastic, glass and aluminum. Before examining the data sheets, use the Background information on The Role of Packaging provided on page 13 as a basis for guided class discussion. Understanding the purpose and functions of packaging will help provide the context for a broadened evaluation of packaging materials.

6. The data sheets compare the amounts of energy used, airborne and waterborne emissions generated, and solid waste produced from each of these systems using virgin versus recycled materials. Referring to the data sheet, ask students which virgin material requires the greatest amount of energy? Which requires the least? If these systems used 100 percent recycled materials, which would require the most and least amounts of energy? Calculate which container realizes the greatest energy reduction (in percent). Which containers manufactured from virgin materials have the highest and the lowest atmospheric emissions? Waterborne wastes? Solid wastes? Which containers manufactured from recycled or reused materials have the highest and the lowest atmospheric emissions? Waterborne wastes? Solid wastes? Calculate the percent reduction in these environmental factors realized by using recycled materials over virgin materials. What is the volume of waste diverted from landfills through the reduction of solid waste?



7. Based on class discussion and what students have learned in this unit so far, what decisions would they make when purchasing soda? Can decisions be based on environmental impact only? What other factors might need to be considered? Would you buy sodas in glass bottles if you had small children? Would single-serve soda cans be more convenient on a picnic than 2-liter soda bottles and cups? At home, is a 2-liter soda bottle for a small family a practical and cost-effective choice? Which can be recycled in your community?



EXTENSION ACTIVITY

Ricky Palace and 15 Minutes

Materials Needed:

Videotape equipment (optional)

Time Needed: 2-3 class periods

Introduction

In this role-playing activity, students will work in small groups to conduct a "60 Minutes"-type "investigation" of a business to learn its business philosophy, manufacturing approach, environmental position, research and development activities, and special problems relating to that industry.

Procedure

1. Note: For preparation, several weeks in advance have students write to various local or national companies requesting information about their products and manufacturing processes. Suggestion: Coordinate with members of the Language Arts or English faculty on this portion of the activity.

2. Each group should select a product or business that represents material diversity; OR, write out on slips of paper specific businesses or products representing material diversity, and have students pull their "investigative assignment" from a hat. For example, select a product from the plastics industry, the forest industry, textile industry, steel industry, etc.

3. Within each group, students will role-play: a company president or CEO, a public relations spokesperson, a research and development team representative, a manufacturing or production expert, an environmental spokesperson or consumer advocate, and the investigative reporter — Ricky Palace.

4. Have students first research the functions of each of these jobs by referring to sources such as the Encyclopedia of Careers and Vocational Guidance (William Hopke, Editor in Chief, J.G. Ferguson Publishing Co., 8th Ed., 1990, 4 vols.) in the school library.

5. Each person in the group will be required to "bone up" on his business and product for the interview, which will be conducted in front of the class as a skit. If your school has videotaping equipment, consider taping the "broadcast" to "air" again at a later date.

6. At the conclusion of the broadcast, as with "60 Minutes", have "viewers" write in about their reaction to the coverage of the stories. Place a "mailbox" in the classroom, and encourage students to write letters commenting on the various stories "aired" in class.

7. Share the letters with the class. Consider having students "rebroadcast" their stories about environmentally responsible, or irresponsible, businesses or products as part of your school's scheduled Earth Week or Recycling Month activities.

8. Consider inviting a representative of a local manufacturing plant to come to class to be interviewed and talk about the ways his or her company minimizes or manages emissions, increases energy efficiency and reduces solid waste in its manufacturing processes.

ACTIVITY 2

Calculating the Cost of Distribution

Objective

1. Students will use a map and shipping rates to calculate the costs to transport a product from its raw material source to its point of manufacture.

Time Needed: Begin in class and complete at home

Materials Needed:

"Following the Distribution Route for Coffee", Student Worksheet and Map

Background

Distribution

Transportation of raw materials to the factory and distribution of products to the consumer are economic, environmental and logistical issues for the manufacturing industry. In the past, factories and mills were located in areas having easy access to markets, labor supplies, fuel, available transportation, raw materials and energy sources. Depending on the industry, some of these factors were more important than others. For example, the paper industry placed mills in areas near logging operations, because the greater part of the transportation costs came from hauling wood.

Certainly every industry must consider transportation costs: transporting raw materials to the manufacturing plant and then transporting the finished product to the consumer. While a factor such as labor availability or energy cost may be critical to one industry, fuel costs may be a greater consideration to another. Oil refineries, for example, are often located near large seaports, to take advantage of lower-cost water transportation, while a labor-intensive industry may locate near large population centers.

After a product is made, manufacturers must get it to the consumer in the most cost-effective and efficient way possible. The type of transportation (such as truck, rail, ship, airplane), the cost of fuel, and the availability of each of these are important factors to be considered. Some industries have decentralized manufacturing plants in order to decrease shipping costs, while others have concentrated on reducing the weight and size of their products and packaging. For example, aluminum beverage cans and many pi...-tic bottles are thinner and lighter than they used to be. Even disposable diapers are thinner as a result of the addition of absorbent gels. Diapers are also packaged by a new method that squeezes out air, decreasing the size of the package and the amount of necessary packaging material.

Introduction

Part of the cost of a product is getting the raw material from its source to the place it is manufactured or processed and then to the market or store where it is sold. This exercise challenges students' map skills and math skills as they determine the cost to get coffee from Bogota in South America to the processing plant in New Orleans.

Procedure

1. Using the worksheet and map, "Following the Distribution Route for Coffee", students will work individually to determine the appropriate shipping rate and calculate the costs for shipping coffee to be processed.

Lesson Three —

CONSUMER PRODUCT USE

CONCEPT

Use is the fourth phase in the assessment of the life cycle of a consumer product. There are few activities in which we engage that do not involve the use of a consumer product. This lesson fixes the study of life cycle assessment for consumer products within a practical framework for students.

ACTIVITY 1

What Is a Consumer Product?

Objectives

1. List the seven functions of consumer products.
2. Compile a listing of consumer products and categorize them by their function.

Time Needed: 1 class period

Materials Needed:

Blackboard or flip chart and marker

Background

Products to Meet Our Wants and Needs

From the time your students were toddlers and watching cartoons on Saturday morning TV, they have seen advertising about the products they use like cereals, toys and games. As we grow older, our consumer product choices become even more wide-ranging and complex. In addition to considering a product's ability to meet our needs, its cost, convenience and overall quality, today's consumers also need to consider what the environmental impacts of their choices will be on their communities. A student may decide that the use of single serving canned sodas is better because with a small family, the 2-liter sizes go flat and result in wasted product. Because glass, aluminum and plastic soda containers are all recyclable, the single-serving soda is still an environmentally, as well as economically, sound purchasing decision. It is import~nt that consumers thoughtfully consider each purchasing decision.

The Overview of *Decision: Earth* (page 3) defined the term "consumer product." Consumer products can be grouped according to the consumer wants or needs they meet: food, shelter, clothing, transportation, health and grooming, information, and recreation and entertainment. Each of these seven groups can be characterized in one of three ways: necessary for survival; useful, but not essential; and luxury. While a student's ability to distinguish among the three may vary with the role of a particular product in his or her life, as well as the maturity level of the student, this concept will be brought into focus through the activities in this lesson. One of the key points to be made is that regardless of how a product is characterized — necessary, useful, or luxury — each of us has a personal obligation to the environment for the responsible disposal of that product's container or packaging.

Introduction

What do we mean by "consumer product"? Why do we have consumer products? What kinds of needs are they designed to meet? Can these needs be met by more than one kind of product? Students may be surprised at the range of options available to them.

Procedure

1. Introduce students to the functions of consumer products and the distinction between durable and nondurable goods as presented in the Overview section of this guide.

2. Enlist the class's help to name the seven functions of consumer products. (*Food, Clothing, Shelter, Transportation, Health and Grooming, Information, and Recreation and Entertainment*) Write them on the board or on a flip chart.

3. Divide students into seven groups and assign each group a category function for which they will develop a listing of products.

4. Review the listings the groups developed for each function. Some items may appear in more than one category. Good examples are television and personal computers, which can be used both to entertain and inform. Permit these duplications to remain on the lists. They will be useful for the extension activity.'

5. Have student groups tally the total number of items in their category. What is the ratio of durable to nondurable goods? Do certain categories have a greater number of nondurable items than others? Why? What are the *perceived* advantages of a durable item versus a nondurable one? The disadvantages? Can you say that durables are always better than nondurables? Why or why not? Take note of the class' responses to these questions.

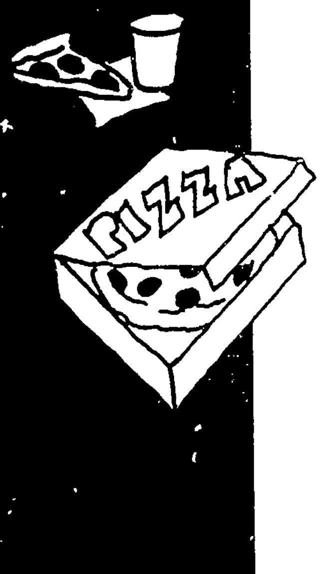
EXTENSION ACTIVITY
How Much of This Is Your Life?

Materials Needed:

"How Much of This Is Your Life?" Student Worksheet
Decision: Earth Wall Poster

Introduction

This extension activity is designed to help students understand that nearly all of our daily activities involve the use of a consumer product. It will encourage students to think about how behaviors or product choices — or perhaps *both* — can or should be modified to reflect environmental responsibility while also meeting consumer needs. The *Decision: Earth* poster features many activities that are part of the average young teen's daily routine. It provides the focal point for several activities in this lesson.



Procedure

1. Display the *Decision: Earth* poster in advance of this lesson and encourage students to view in small groups and comment on it. Observe student reactions to the poster. Ask students how many of them can relate to the activities they see featured in the poster. What other activities are part of their daily routine that are not depicted here?

2. Copy and distribute the student worksheet, "How Much of This Is Your Life?" Have students list the activities featured in the poster. Review and identify the activities.

3. Explain to students that virtually every daily activity in which we engage involves the use of a consumer product. Have students complete the worksheet in class by examining the poster again and listing at least two consumer products associated with each activity.

4. Then ask students whether they can spot any teens in the poster wasting resources or energy? Have students give the example and describe the wasteful behaviors they see. Direct discussion to the responsible use of consumer products and have students provide good and bad examples, again using poster to stimulate ideas. Examples from the poster include: Washing only dirty clothes; using the recommended amount of detergent for washing; recycling; using re-usable cloth shopping bags; hanging up clean clothes.

5. Instruct students to set their worksheets aside if you plan to use Activity 2 on page 13.

EXTENSION ACTIVITY
Values Assessment

Materials Needed:

Copy masters of student-compiled lists of consumer products developed in Activity 1. (Refer to Figure 1A below as a sample format.)

Introduction

If you asked students to name three things they couldn't live without, what are the chances they would fall into the food, clothing or shelter categories? Our ability to discern the difference between wants and needs often becomes blurred by our perception of the role a product plays in our lives. This extension activity will help students bring into focus the concepts of want and need and evaluate the criteria they use to make those determinations.

FIGURE 1A

FOOD	BASIC	USEFUL	LUXURY
Water	x		
Pizza	x		
Hamburgers		x	
Steak		x	
Potato Chips		x	
Candy Bar		x	
Caviar			x

Note: Collect the lists from the seven team leaders. This listing will form the basis for the extension activity, Values Assessment. If you plan to use this activity, save the listings and use them to prepare copy masters, following the sample format provided in Figure 1A on page 12.

Procedure

1. Discuss with students what criteria they use to determine whether something is a want or a need.

2. Copy and distribute the blackline masters you made from the lists of items the student groups developed earlier in Activity 1. (Refer to Figure 1A as an example of how to set up each chart.) For homework, have students indicate with an "X" in the appropriate column whether they consider the items: Basic; Useful; or, Luxury.

3. The next day, ask students to indicate by a show of hands how many of them have checked any of the items as "Basic" in the Transportation, Health and Grooming, Information or Entertainment and Recreation categories? How many "Useful"? How many "Luxury"?

4. Ask students to refer again to their lists and to circle five items from each list they feel are essential to have. After they have made those selections, tell them they must narrow down the selection to two items from each list. Then select only one item from each of the seven lists. From those seven final items, select only three items they could not do without. Ask the class to indicate by a show of hands whether their final three selections of items fall into the categories of Food, Shelter or Clothing? Do the items circled fall into the Basic, Useful or Luxury categories? Do any students think their final selections reflect a change in how they define a *want* and a *need?*

5. Follow up this exercise with a "What if ..." class discussion focussing on items that are essential for life versus those which increase the quality of life. Use soap as an example. While it is not essential for life, what if we didn't have any soap? (Sanitation problems would develop; germs would be more likely to spread; personal hygiene would suffer; social gatherings would be less pleasant!) Select other items from various categories outside the Food, Clothing or Shelter areas for further comparisons.

ACTIVITY 2

Why Does Packaging Get Such a Bad Wrap?

Objectives:

1. Identify the functions of packaging and evaluate the packaging of selected consumer products.

2. Gather and tabulate data on packaging materials and compare findings with national statistics.

3. Research the available forms of pizza products and evaluate how processing and packaging affect the product's price.

Time Needed: 1 class period

Materials Needed:

Overhead transparency master, "The Role of Packaging in Solid Waste"
Student worksheet, "How Much of This Is Your Life?"
Graph paper

Background

The Role of Packaging

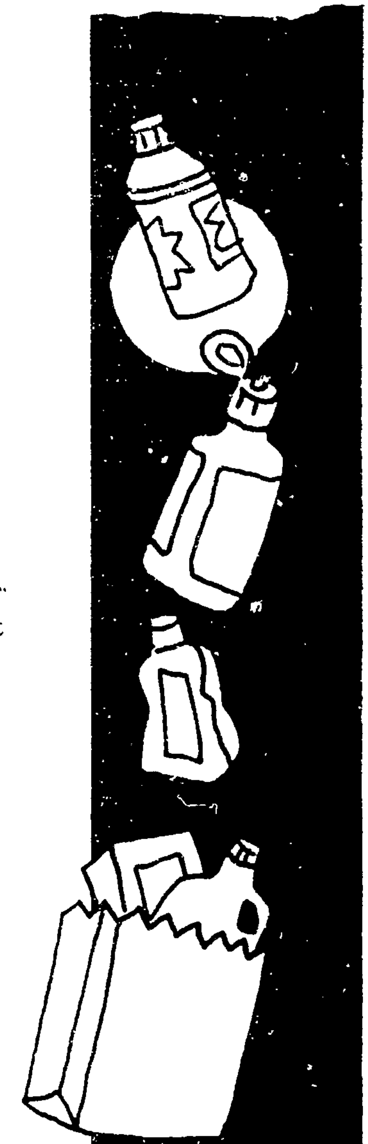
Many of the products we buy come to us in some form of packaging. While one-third of the solid waste in our landfills is packaging, that percentage is declining. (See the graph, "The Rise and Fall of Packaging in the Waste Stream" on the overhead transparency master.) The first recorded use of packaging was in 1551, when a German papermaker began placing his product in a wrapper with his marker's mark. Today, brand identification is a way to assure consumers of consistent product quality and safety. However, packaging also is designed to meet many other criteria, such as:

1. To protect during shipping.
2. To discourage theft, and to inhibit product tampering or access by children.
3. To keep the product sanitary.
4. To preserve product freshness and reduce spoilage.
5. To convey product warnings or cautions.
6. To provide instructions for proper usage of product.
7. To carry governmental required information.
8. To enhance product sales through eye-catching graphics and facilitate shelf display.
9. To help dispense the product.

In response to many of these needs, much of the more traditional waxed cardboard and glass containers and packaging has been replaced by lightweight plastic and aluminum which also has reduced breakage and saved energy in distribution.

Packaging and the Solid Waste Issue

As lifestyles have changed, the demand for convenience items and single-serve packaging has increased the amount of material used to wrap the same amount of product. For example, individual packages of small hardware items such as nails, washers, or tacks allow us the convenience of self-service. Many food items can be purchased in smaller size or single-serving containers which, although they require more packaging, are ideal for smaller households because food waste and spoilage are reduced.



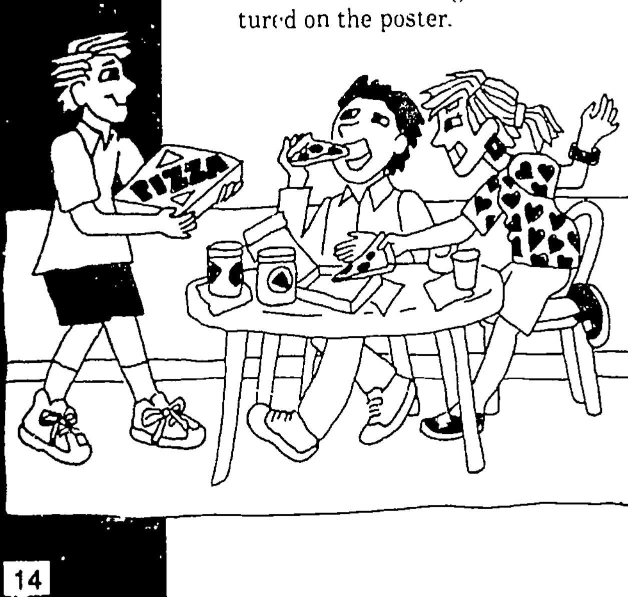
Many industries are addressing environmental concerns raised by packaging by providing alternatives and experimenting with new technologies. Individual consumers can vote for their preferences when making purchases. When available, select products packaged in recycled materials. Recycle all packages which your local recycling program selects. If it is not wasteful for your family or the product will not spoil, consider buying in larger sizes — one large package generally uses significantly less packaging material than two or three smaller packages. Buy products in concentrated forms or in refillable packaging, like Procter & Gamble's Downy fabric softener. Consider multifunction products, such as a shampoo plus conditioner, or laundry detergent and bleach in one. However, it is important that the products you choose meet your needs as a consumer without resulting in waste or inconvenience for you.

Introduction

While on the decline, packaging discards still represent nearly one-third of our waste stream. It is important for consumers to understand the functions of packaging as well as how we can reduce packaging and still meet health, safety and regulatory requirements.

Procedure

1. Use the background information on the functions of packaging and the overhead transparency master on the role of packaging in the solid waste stream to introduce students to the topic and to discuss the various materials used in packaging. The night before, have students survey their homes for packaging examples.
2. In class, refer students to products featured on the poster such as the CDs, the home video games, the earrings, the fabric softener, etc. Why is a product packaged in a particular way? Discuss how different packaging considerations are addressed, using several of the products pictured on the poster.



3. Have students complete their worksheets, "How Much of This Is Your Life?" by indicating the primary material (plastic, paper, metal, glass, other) used to package each item they have listed. Tally each material category. What type of packaging material is used most often?
4. Have students tabulate the percentages of the types of packaging materials used. What percentage of their packaging is paper? Glass? Plastic? Metal? How do their findings compare with the national packaging discards figures shown on the overhead?

EXTENSION ACTIVITY
A Pizza Is Still A Pizza...

Materials Needed:

"A Pizza Is Still A Pizza, But A Package Can Be Anything!" Student Worksheet

Time Needed: Variable, depending on implementation method. See Introduction below.

Introduction

This at-home assignment will help students understand how processing and packaging can affect product cost. This activity is best conducted over several days or up to a week. You may wish to have students work in teams and then pool the information as a class.

Procedure

1. Copy and distribute the worksheet, "A Pizza Is Still a Pizza, But a Package Can Be Anything." Students will go to the grocery store, consult newspaper ads or check their kitchens at home to collect the information needed to complete the pizza comparison worksheet.
2. Following instructions provided on the worksheet, students will list the various ways pizza can be purchased. When available, students should note the net weight of the product and the price. For pizzas requiring multiple purchases (e.g., jar sauce and dough separate), make sure all the costs are totalled. Note the recommended number of servings per container, and calculate the cost per ounce. Have students determine which pizza product costs the least per ounce. Students should be prepared to explain the type of packaging for each option as well. A strong visual impact would be to prepare a display of the actual packaging discards from three or four of the pizza options researched.
3. Evaluation: Are there any "hidden" costs to consider in deciding which pizza is the best value? Delivery costs for take-out? Time to prepare? Cost to cook? More clean-up? Which pizza tastes better? Are there left-overs that will be wasted? Can students find a correlation between the cost per serving or ounce and the extent to which the product has been processed? Packaged?

ERIC Full Text Provided by ERIC

ACTIVITY 3

Not Merely a Question of Convenience: Disposable Versus Cloth Diapers

Objectives:

1. Compare the environmental effects of cloth versus disposable diapers.

2. Discuss the health, safety, economic and lifestyle factors to consider in the selection of a diapering system.

Time Needed: 2 class periods

Materials Needed:

Comparison of Disposable Versus Cloth Diapers Student Worksheet

Background

One of the toughest decisions facing many consumers today focuses on disposable diapers. For parents to make an informed decision about which diaper is best for their baby, they need to know the full health, economic and environmental impacts of the diapering systems available to them.

In an effort to understand how disposable and cloth diapers compare, a leading firm specializing in municipal solid waste issues, Franklin Associates, recently completed a study comparing the two, in which they found that "All diapering options — cloth and disposable diapers — have some environmental and energy effects."

It is important to understand that every choice we make as consumers has an effect on our environment but it is equally important to consider the health and economic factors that reflect the product's ability to meet our needs as consumers. This is equally true of diapering systems.

Introduction

Many consumers concerned with environmental issues find it difficult to evaluate the differences between disposables and durables. *Decision: Earth* urges young consumers to look beyond the obvious advantages and disadvantages of disposable and durable products to examine the less obvious implications and considerations associated with the consumer product choices they make. This activity will have students examine diapering systems and consider the arguments surrounding the use of disposable diapers versus cloth diapers. This activity is designed to encourage students to think critically and to consider their needs as consumers along with other factors when they make consumer product choices.

Procedure

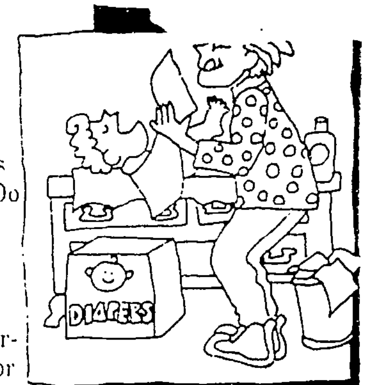
1. Before distributing data sheets, ask students if they have baby brothers or sisters at home. Do you know any families with babies? Do any of the students babysit? Have any of them ever changed a diaper? How many diapers a day do they think the average baby uses? Take an informal survey to determine whether the majority of their families or acquaintances use cloth or disposable diapers. Do any of them know what kind of diapers they wore as babies?

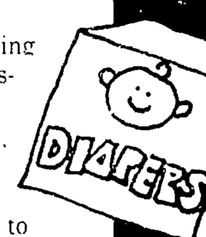
2. Copy and distribute the data sheet comparing the environmental effects of both cloth and disposable diaper systems.

3. Review and discuss the data with students. For homework, have students complete questions 1 and 2 at the bottom of the worksheet. Suggest that they survey families with babies to get opinions from parents on the diapering systems they use and why.

4. On the board, the next day select one of the life cycle assessment categories to plot and graph the data. Have students break up into small groups. Using the completed graph as a model, have each group plot and graph the data from one of the remaining categories on the worksheet.

5. After reviewing the quantitative data, ask students to evaluate qualitative considerations: how important are health issues such as diaper rash and reduced spread of infection in day care situations; what is the value of time to a working parent; what are some of the additional costs involved with the use of cloth diapers (pins, plastic pants, additional thicknesses needed as the child gets older, detergent, softeners, soaking liquids, diaper pails and disinfectants).





Lesson Four —

SOLID WASTE DISPOSAL: HOW TO CONTRIBUTE LESS THAN YOUR FAIR SHARE

CONCEPT

Waste disposal represents the final phase in a product's life cycle assessment — one that cannot be addressed independent of the earlier phases of the life cycle, i.e., materials sourcing, manufacturing and distribution, and use. However, it is an aspect of life cycle assessment that is receiving major attention because of the critical shortage of places to put waste as well as the controversy and public resistance to some of the waste disposal options we have.

Energy and Environmental Profile Analysis of Children's Disposable and Cloth Diapers, Final Report, Franklin Associates, Ltd., July 1990

ERIC

ACTIVITY 1
When Less Is More

Objectives:

1. Collect and tabulate data to determine the class's contribution to the waste stream and how it compares with national statistics.
2. Conduct research and make recommendation for a community's long-range solid waste disposal plan.

Time Needed: 3-4 class periods

Materials Needed:

"Throw-Away Journal" Student Worksheet
Overhead Transparency Masters, "What's In The Garbage?" and "Where Do We Put The Garbage?"
Large plastic garbage bags
Disposable plastic gloves or rubber gloves for each student
Tongs (one pair for every 2 students)
Plastic drop cloths or old plastic table cloths
Weight scale
Graph paper

Background

In assessing the life cycle of a consumer product, it is increasingly important to consider the amount of solid waste generated in each phase of its life cycle and how it is disposed of. The Environmental Protection Agency (EPA) supports a four-tiered integrated approach to managing the garbage America generates — 180 million tons in 1988 and growing every year. That approach, in priority order, involves:

Source Reduction, to decrease the total volume of waste;

Recycling and Composting, to reuse a major portion of the valuable resources in our waste and to further reduce the amount of waste going to landfills and incinerators;

Waste Combustion, to reduce the volume of municipal waste by up to 90 percent, with the added benefit of recovering energy; and

Sanitary Landfilling, for those materials that cannot be recycled, composted or safely incinerated, and for the material that is left over after garbage is incinerated.

SOURCE REDUCTION

In life cycle assessment, **source reduction** means minimizing the amount of waste generated *at each stage* of a product's life. This includes designing products and packaging requiring less raw material in the manufacturing process. For example, concentrated and multifunction products eliminate or reduce the need for separate purchases of several single-purpose products and larger sizes of products; and refillable packages help decrease the amount of packaging waste that is generated. Removal of heavy metal-based inks and dyes from packaging permits safe incineration in those communities with this waste-handling method.

RECYCLING AND COMPOSTING

Several years ago, the EPA established a national recycling goal of 25 percent by the year 1992. By 1996, that rate will increase to 40 percent. Currently, the national recycling rate for solid waste in the U.S. is just 13 percent. Therefore, to achieve these goals we must double our recycling efforts this year and nearly *quadruple* them by 1996! Certain materials, such as PET plastic soft drink containers and aluminum beverage containers, have dramatically exceeded these goals.

With extremely high value as scrap materials, PET plastic and aluminum are reprocessed to make more beverage containers and many other items, from insulation to carpeting, saving natural resources and significantly reducing the high energy demands to process products from "virgin" materials as we have already seen in Lesson 2. A study of beverage packaging systems has also shown that the use of recycled rather than virgin materials significantly lowered environmental stress.

While recycling is a way to recover valuable nonorganic material, *composting* is a natural form of recycling in which organic wastes are converted to a rich humus or mulch through a natural decaying process. It is estimated that as much as 60 percent of a community's solid waste such as food and yard clippings is organic and, therefore, compostable. Composting needs to be combined with materials separation and recovery processes to recover recyclables and to remove undesirable contaminants from ending up in the finished compost.

Since few new landfills are being sited and permitted and the capacity of our current landfills is rapidly diminishing, composting may be a natural alternative for handling large volumes of waste in many communities. Procter & Gamble was instrumental in establishing the Solid Waste Composting Council, a nonprofit organization formed to provide technical assistance and support to those communities interested in setting up a composting infrastructure.

Where would we put large-scale community composting facilities? Some suggest that locating them directly on top of existing or closed landfills might be appropriate. Ideally, composting facilities are designed to handle only organic

Option A only
Comparative Energy and Environmental Impacts for Soft Drink Delivery Systems. Final Report. Franklin Associates, Ltd. for the National Association of Plastic Container Recovery, March 1989. Tables ES-2 and ES-3

ERIC

waste, and therefore such facilities do not pose the same health or environmental concerns that landfills do.

To learn more about this increasingly important waste management method, refer to the Municipal Solid Waste Composting Teaching Supplement included in the *Decision: Earth* packet.

WASTE-TO-ENERGY

Waste-to-Energy (WTE) can be thought of as thermal recycling. The ideal WTE system couples combustion technology with recycling operations to recover all valuable scrap materials and to remove any environmentally hazardous materials prior to combustion. This step also raises the facility's operating efficiency by removing noncombustibles that may otherwise lower furnace temperatures.

When nonrecyclable waste is burned in a WTE facility, the garbage is converted to heat and captured as useful energy that can be used to provide electricity to operate the rest of the facility or used to power homes or businesses.

Many communities object to constructing combustion facilities in or near their area, citing concerns about air quality. However, advanced air emission technology is being applied in these WTE facilities, and studies have shown that in some communities, the air emissions from the WTE facilities are actually cleaner than the surrounding ambient air or emissions from the local coal-fired power plants.

LANDFILLS

Currently about 80 percent of our solid waste is landfilled. While technologies exist to ensure the environmentally safe site selection, design, operation and closure of landfills, only a small percentage of today's 6,000 operating municipal landfills meet these optimum criteria. By the mid-1990s, an estimated 50 percent of our landfills will be forced to close either because they have reached their volume capacity or because they fail to meet environmental standards.

This is likely to occur first in densely populated urban areas where large volumes of waste place heavy demand on existing landfills and other solid waste disposal systems. Combined with scarce land, public resistance to certain waste management systems, the NIMBY syndrome (Not In My Back Yard) and genuine environmental concerns, many communities have limited waste management options that they can consider.

In the meantime, as landfills reach capacity and as these communities work to put into place new, long-term alternative waste handling and disposal methods, they must rely on short-term disposal options that may include sending garbage to "host" states — those with available landfill space or those that have waste combustion facilities. For many communities, the fees collected for accepting garbage from other communities help to offset operating costs.

Even with source reduction, recycling, composting and incineration, the EPA acknowledges that landfills must remain an essential part of comprehensive solid waste management, particularly for nonrecyclables, for materials that cannot be incinerated and for the safe disposal of incineration ash.

Introduction

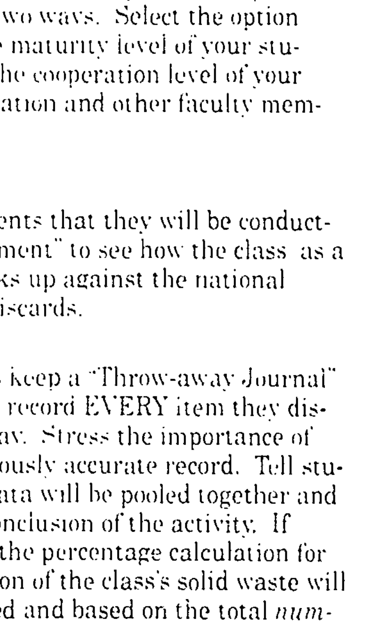
After completing the previous lessons, students should be very aware of the role of waste in each phase of life cycle analysis for consumer products. While students have little control over the waste generated at the raw materials sourcing and the manufacturing and distribution phases, they do have considerable control over how much waste they each generate through the product choices they make and how they use the product. NOTE: This activity can be implemented in one of two ways. Select the option that best suits the maturity level of your students and meets the cooperation level of your school's administration and other faculty members.

Procedure

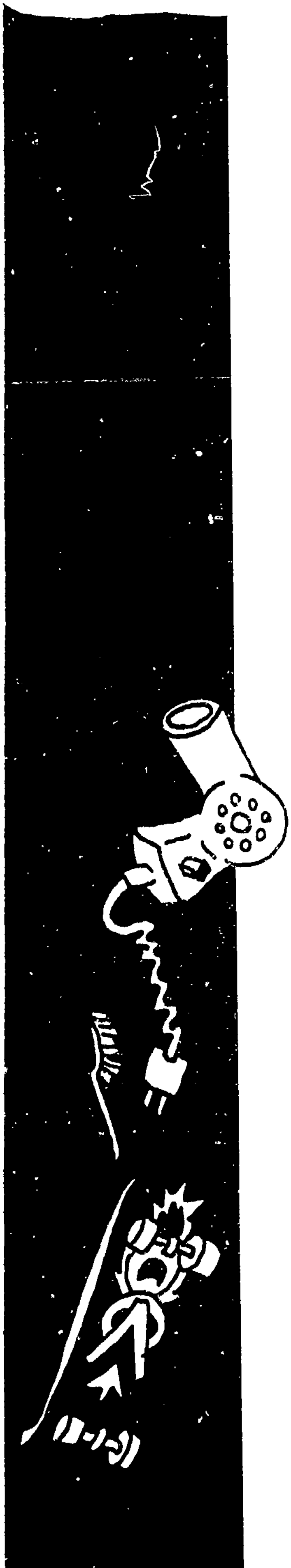
Explain to students that they will be conducting a "field experiment" to see how the class as a "community" stacks up against the national average in their discards.

(Option A)

1 Have students keep a "Throw-away Journal" in which they will record EVERY item they discard for one full day. Stress the importance of keeping a scrupulously accurate record. Tell students that their data will be pooled together and analyzed at the conclusion of the activity. If Option A is used, the percentage calculation for the characterization of the class's solid waste will have to be modified and based on the total *number* of items the class discards rather than on total *weight*, as in Option B.



Indianapolis Public Works Dept., press release, July 17, 1990.



(Option B)

1. Day 1: Students carry a large plastic garbage bag with them for one full day in which their discards (for sanitary reasons, food waste and personal hygiene products should be EXCLUDED) are deposited. However, as the activity progresses, it is important to talk about food waste. When one considers that it takes a total of 4,000 gallons of water to get one pound of hamburger from the animal to the table, throwing away half a burger can be a very wasteful behavior.

2. Day 2: Students weigh their bags of garbage and calculate a class garbage weight total. Then, in a place you have pre-arranged with the school administration and maintenance staff, spread out large plastic dropcloths (check with your maintenance staff on availability) on which students will sort their garbage by category (plastic, glass, metal, paper, textiles, misc.). Be sure to include a recycling pile for items that are intended for recycling.

3. Weigh the garbage for each category and determine that category's percent of the class's total waste stream as well as its recycling rate. How much garbage does each person in the class generate, on the average? (The national average is 4 pounds per day!)

4. Day 3: Chart the results of the data collected. An example is shown (Figure 1B). (Have students develop pie charts of their results for homework.) How do these results compare with the national statistics? Use the overhead transparency master, "What's In The Garbage?" to show students how the class stacks up against the national average.

Figure 1B

	TOTAL		RECYCLABLE	
Category	Pounds	Percent of Total	Pounds	Percent of Total
Plastic	18	24	3	4
Glass	15	20	10	13.3
Metal	6	8	6	8
Paper	20	26.7	17	22.7
Textiles	3	4	2	2.7
Other	13	17.3	5	6.7
	75	100.0	43	57.4

Total Weight of Class Garbage: 75 lbs.

Total Students: 25

Avg. Amt. of Garbage Per Student: 3 lbs.

EXTENSION ACTIVITY

My Pit or Yours?

Materials Needed:

Dilemma Cards, cut apart

Assorted magazine articles and free or low-cost brochures on solid waste management as listed in the Further Resources Section at the end of this lesson

Introduction

The garbage glut becomes a civics lesson in this library research and group dynamics exercise when students role-play members of a community garbage "task force." Each task force selects a dilemma card describing its community's solid waste crisis. The task force will evaluate the disposal options it has available or can consider for its solid waste management plan. These may include incineration, landfilling, exporting their garbage to another area, recycling/composting, or a combination of any of these methods. Task forces research each of these options and the conditions under which they are most appropriate and will present their recommendations at a "town meeting" for a vote.

Procedure

1. Introduce the EPA's 4-tiered approach to solid waste management as presented in the Background section of this lesson.

2. Many school and public libraries may not have a well-developed solid waste management section. Additional resource materials on this topic that are available free or at a very low cost are listed at the end of the lesson.

3. Stage a town meeting and allow "citizens" to pose questions to the task force members, during which the task force must explain and defend their recommendations.

4. Then, have the class "vote" on the solid waste plan the task force proposed for its community.

To conclude the *Decision: Earth* unit, photocopy and distribute the "Thinking It Through" confidential survey to students. If you also administered the survey prior to teaching the unit, ask students if their answers have changed.

FURTHER RESOURCES

Brown, Hamilton, et al., *Why Waste a Second Chance? A Small Town Guide to Recycling*, National Center for Small Communities, 1522 K St. NW, Suite 730, Washington, DC 20005, 1989.

Child, David, G.A. Pollette, H.W. Flosdorf, "Waste Stream Analysis." *Waste Age*, November 1986, pp. 183-192.

Decision-Makers Guide to Solid Waste Management. Environmental Protection Agency. EPA/530-SW-89-072. November 1989.

EPA. *Environmental Educational Materials for Teachers and Young People (K-12)*, Office of Solid Waste, Washington, DC, August 1988.

EPA. *Recycling Works! State and Local Solutions to Solid Waste Management Problems*, Office of Solid Waste, January 1989. Available through RCRA Hotline: 1-800-424-9346.

EPA. *The Solid Waste Dilemma: An Agenda for Action*, Final Report of the Municipal Solid Waste Task Force, Office of Solid Waste, February 1989. Available through RCRA Hotline: 1-800-424-9346.

Glebs, R.T., "Landfill Costs Continue to Rise." *Waste Age*, March 1988, p. 84.

Glenn, Jim and David Riggle, "Where Does the Waste Go?", *Biocycle*, April 1989, p. 38.

Keep America Beautiful, Inc. *Overview: Solid Waste Disposal Alternative*, KAB, Inc. Mill River Plaza, 9 West Broad St, Stamford, CT 06902, April 1989.

National League of Cities. *Municipal Incinerators: 50 Questions Every Local Government Should Ask*. Publications Dept., 1301 Pennsylvania Ave. NW, Washington, DC 20004, December 1988.

Peluso, Richard A. and Ernest H. Rockert III, "Waste Transfer: The Basics." *Waste Age*, December 1988, p. 88.

Robinson, William D., ed. *The Solid Waste Handbook: A Practical Guide*. John Wiley & Sons, NY 1986.

The BioCycle Guide to Composting Municipal Wastes, BioCycle, Box 351, Emmaus, PA 18041, January 1989.

Time Magazine. "The Urgent Need to Recycle," special advertising insert from the Council for Solid Waste Solutions, July 17, 1989.

BEST COPY AVAILABLE

ENVIRONMENTAL QUALITY IN PROCTER & GAMBLE'S CONSUMER PRODUCTS

Procter & Gamble is committed to providing products of superior quality and value that best fill the needs of the world's consumers. As part of this, Procter & Gamble continually strives to improve the environmental quality of its products, packaging and operations around the world.

To carry out this commitment, it is Procter & Gamble's policy to:

- **Ensure our products, packaging and operations are safe** for our employees, consumers and the environment.
- **Reduce or prevent the environmental impacts** of our products and packaging in their design, manufacture, distribution, use and disposal wherever possible. We take a leading role in developing innovative, practical solutions to environmental issues related to our products, packaging and processes. We support the sustainable use of resources and actively encourage reuse, recycling and composting. We share experiences and expertise and offer assistance to others who may contribute to progress in achieving environmental goals.
- **Meet or exceed the requirements of all environmental laws** and regulations. We use environmentally sound practices, even in the absence of government standards. We cooperate with governments in analyzing environmental issues and developing cost-effective, scientifically-based solutions and standards.
- **Continually assess our environmental technology** and programs to monitor progress toward environmental goals. We develop and use state-of-the-art science and product life cycle assessment, from raw materials through disposal, to assess environmental quality.
- **Provide our consumers, customers, employees, communities,** public interest groups and others with relevant and appropriate factual information about the environmental quality of P&G products, packaging and operations. We seek to establish and nurture open, honest and timely communications and strive to be responsive to concerns
- **Ensure every employee understands** and is responsible and accountable for incorporating environmental quality considerations in daily business activities. We encourage, recognize and reward individual and team leadership efforts to improve environmental quality. We also encourage employees to reflect their commitment to environmental quality outside of work.
- **Have operating policies, programs and resources in place** to implement our environmental quality policy.

Notes

Procter&Gamble

Printed on recycled paper.

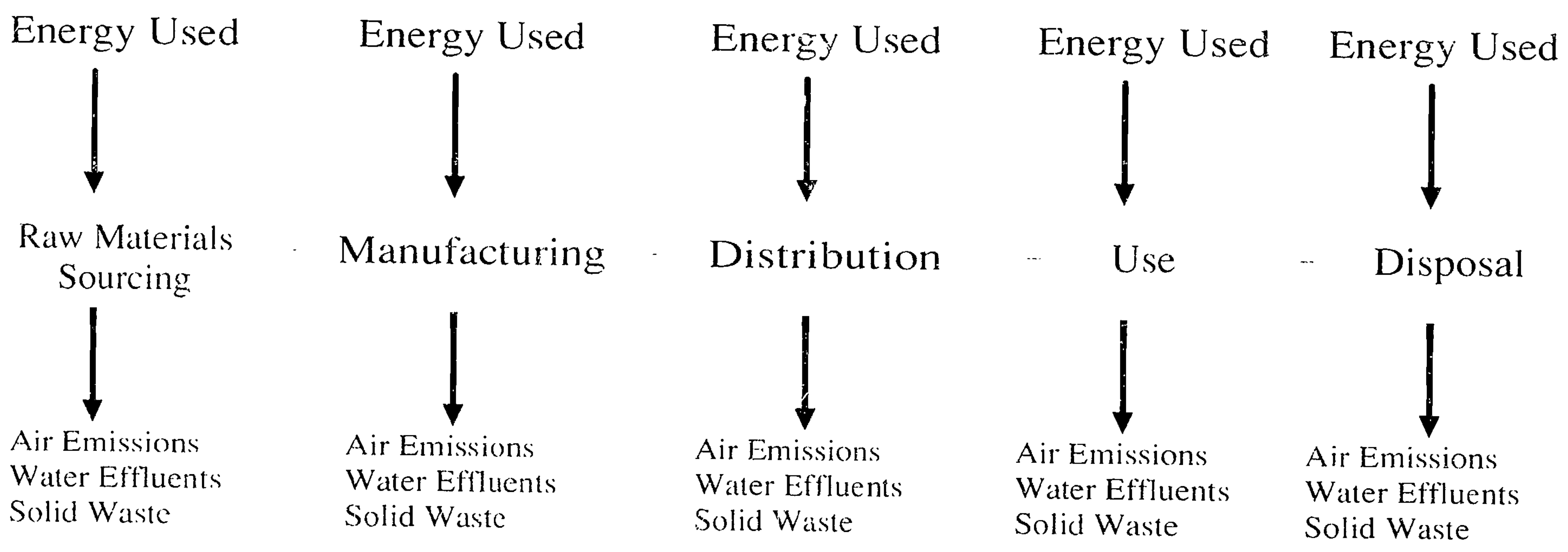
© 1992

Developed by Modern Talking Picture Service, Inc. for the Procter & Gamble Co.

ERIC Full Text Provided by ERIC

Overhead Transparency Master

Life Cycle Analysis of a Consumer Product



Life Cycle Analysis is a tool to measure the amount of energy used and waste produced (to air, water, soil) from the time raw materials are procured to the final disposal of the product.

May be reproduced.
Procter & Gamble Educational Services

THINKING IT THROUGH

What is most important to you in making a purchase? Cost? Quality? Environmental impact? Energy efficiency? How much garbage it produces? Whether it best meets your needs? This confidential survey will help you consider whether your consumer decisions are thoughtful choices based on life cycle analysis thinking. Circle the number that best describes your consumer purchases and total your score to see how you rate as a life cycle thinker.

DO YOU . . .		NEVER	SOMETIMES	OFTEN
1.	Think about what happens to a product or package when you are finished with it?	3	2	1
2.	Try to reuse things or repair them instead of disposing of them and buying something new?	3	2	1
3.	Consider what resources were used to make the product you are buying?	3	2	1
4.	Think about how much waste and pollution were created in the manufacturing of the things you buy?	3	2	1
5.	Participate in recycling opportunities in your area?	3	2	1
6.	Ever shop at second-hand stores or garage sales?	3	2	1
7.	Recycle soda containers?	3	2	1
8.	Ever buy products in refillable containers?	3	2	1
9.	Ever buy multi-function products, such as shampoo/conditioner?	3	2	1
10.	Ever find occasions when single serving containers are less wasteful than large serving containers?	3	2	1
11.	Ever say to a store clerk, "Thanks, but I don't need a bag" or you bring your own shopping bag?	3	2	1
12.	Express your concern about wasteful or harmful products to the manufacturer or government officials?	3	2	1
13.	Recognize the use of disposable products as better than durables in certain instances?	3	2	1
14.	Research consumer magazines to find out more about a product you plan to buy?	3	2	1
15.	Consider whether you really need a product before you buy it?	3	2	1
TOTALS:		________ +	________ +	________

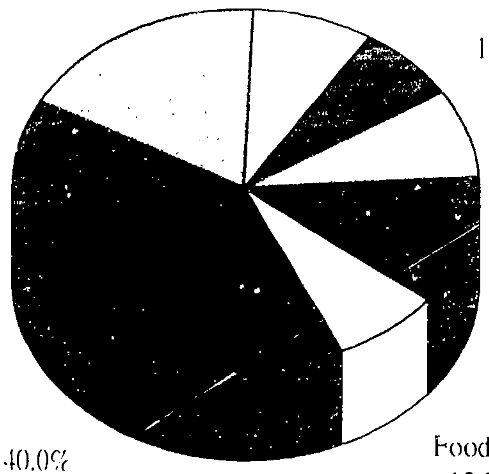
GRAND TOTAL:________________

If you scored ...

40 or more: The Earth says, "Think before you buy, and consider the whole picture."
21 - 39: The Earth says, "You're getting the message – resources don't last forever."
20 or less: The Earth says, "You're already a thoughtful consumer. Spread the word about life cycle thinking and encourage others to think about the whole picture, too!"

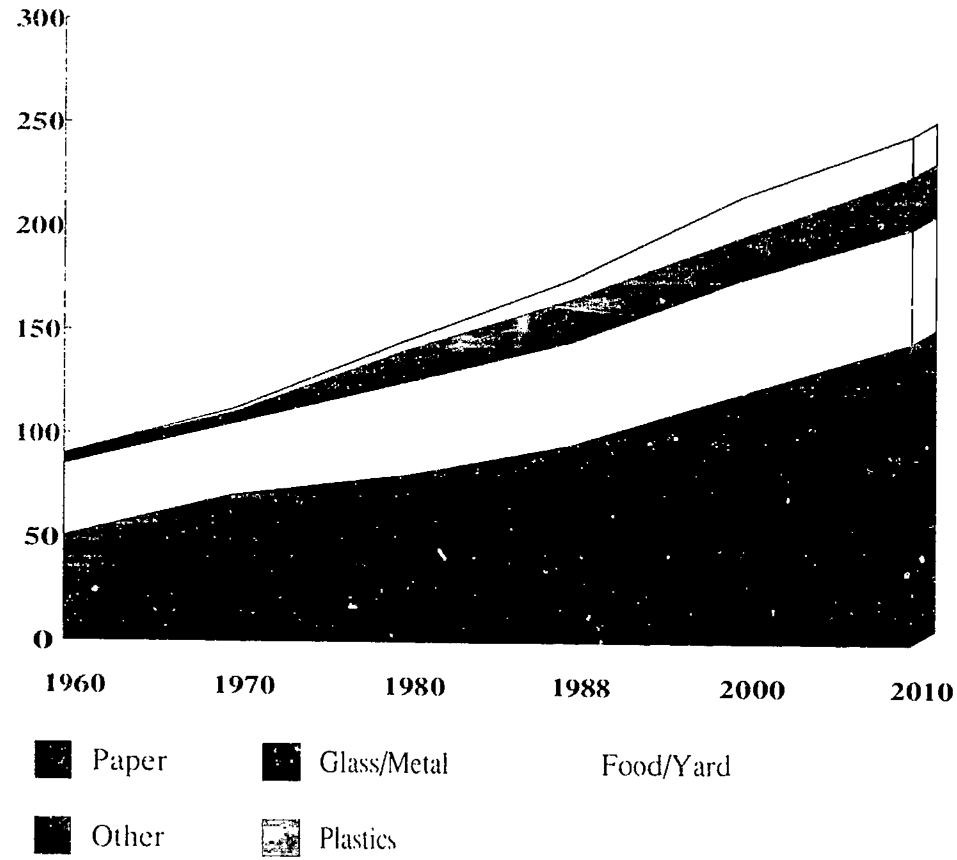
May be reproduced.
Procter & Gamble Educational Services

What's In The Garbage?[1]



TOTAL WEIGHT =
179.6 million tons

How Much Garbage Do We Make?[1] 1960 - 2010

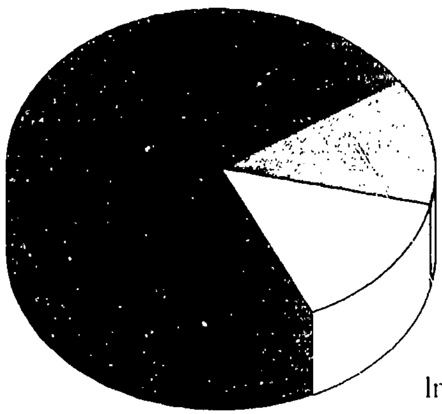


Source: Characterization of Municipal Solid Waste in the United States: 1990 Update, Executive Summary, June 13, 1990. USEPA, Office of Solid Waste.

May be reproduced.
Procter & Gamble Educational Services

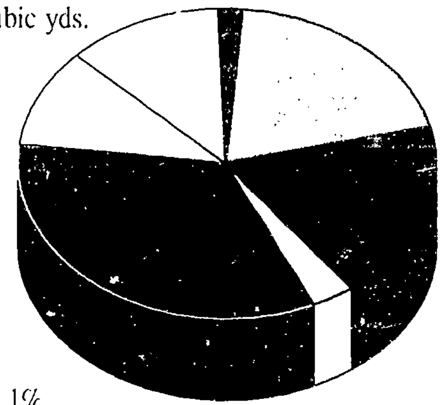
1. Percents are rounded to equal 100%

Where Do We Put The Garbage?[1]



TOTAL WEIGHT =
179.6 million tons

What's In The Landfill?[1]



TOTAL VOLUME =
400 million cubic yards

Source: Characterization of Municipal Solid Waste in the United States: 1990 Update, Executive Summary, June 13, 1990. USEPA, Office of Solid Waste.

May be reproduced.
Procter & Gamble Educational Services

1. Percents are rounded to equal 100%.

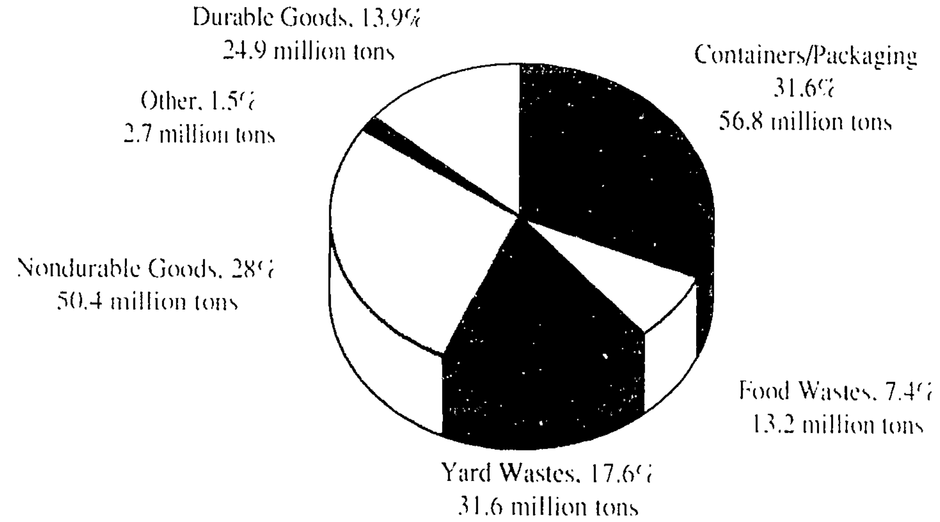
HOW MUCH OF THIS IS YOUR LIFE?

Directions: Use the chart below to list as many of the daily activities and corresponding consumer products as you can find on the poster. Use more than one sheet of paper if necessary. Later, as directed by your teacher, identify the primary materials that are used to package each of the products you listed by checking the appropriate column. An example is provided for the first activity.

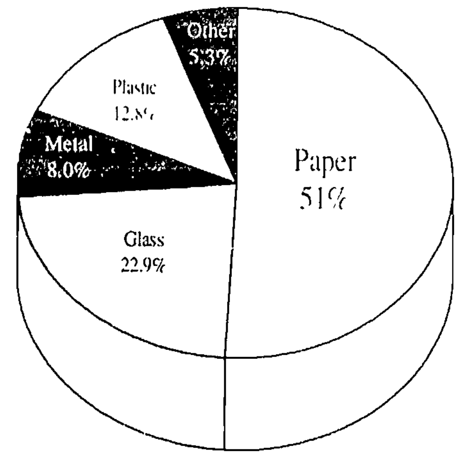
		PRIMARY PACKAGING MATERIAL USED					
ACTIVITY	CONSUMER PRODUCTS	PLASTIC	GLASS	METAL	PAPER	OTHER	NONE
Washing clothes	1 Detergent	X					
	2 Softener	X					
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						
	1						
	2						

May be reproduced.
Procter & Gamble Educational Services

The Role of Packaging In Solid Waste

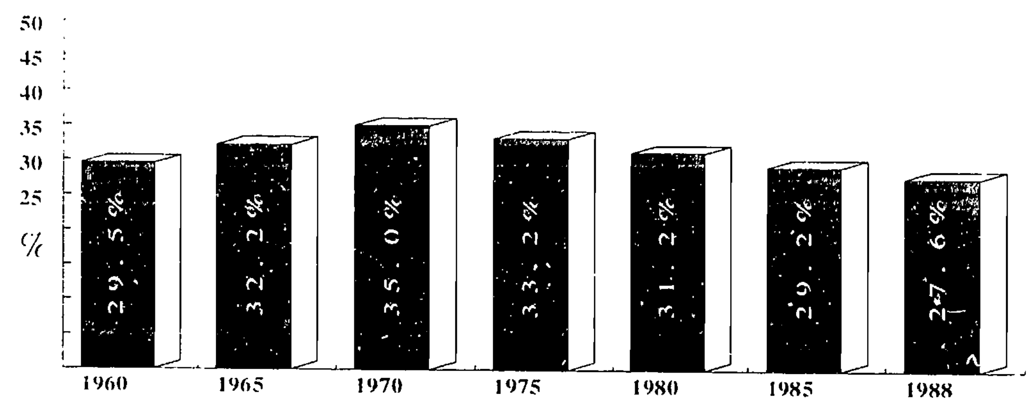


TOTAL WEIGHT = 179.6 million tons
Consumer Products Discarded[1]



Packaging Detail[1]

The Rise and Fall of Packaging in the Waste Stream

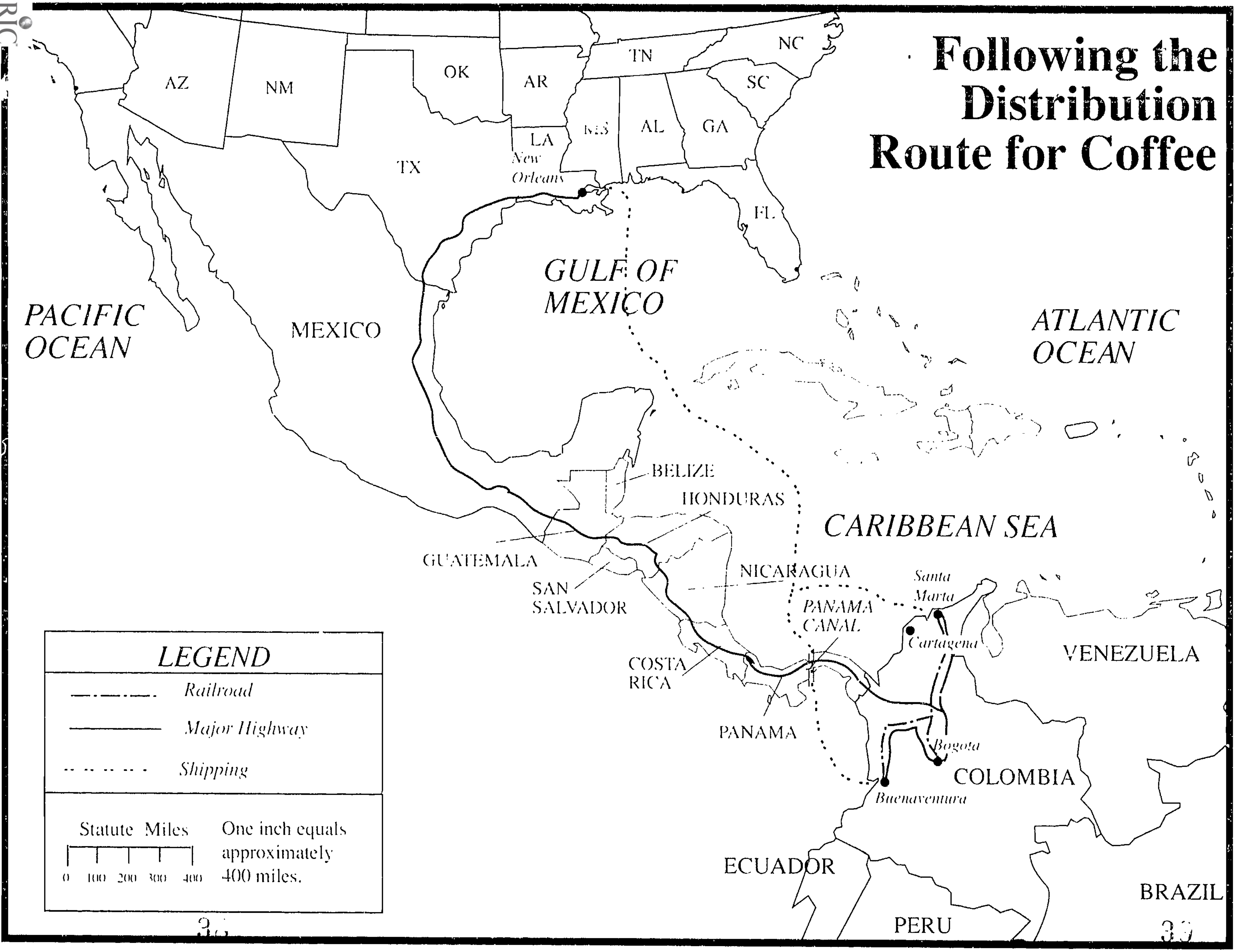


Source: Characterization of Municipal Solid Waste in the United States: 1990 Update. Executive Summary, June 13, 1990. USEPA. Office of Solid Waste.

May be reproduced.
Procter & Gamble Educational Services

1. Percents are rounded to equal 100%

Following the Distribution Route for Coffee



FOLLOWING THE DISTRIBUTION ROUTE FOR COFFEE

As a shipping agent for a major consumer products company, you are responsible for getting the raw coffee beans from the source to the factory for processing. Using the map of the southern United States, Central America and northern South America that is provided, determine the most cost-effective shipping method to get five tons of coffee from Bogota, Columbia to New Orleans, Louisiana. (Hint: shipping rates quoted are per ton/per hundred miles.) The first route has been calculated for you.

Shipping Rates per 100 miles	
Boat	$10/ton
Railroad	$15/ton
Truck	$20/ton

Do your figuring here

Route A	Method	Distance (mi.)	Rate
Bogota - Santa Marta	Railroad	500	$375.00
Santa Marta - New Orleans	Boat	1,900	$950.00
TOTAL		2,400	$1,325.00
Cost per pound			13.2¢

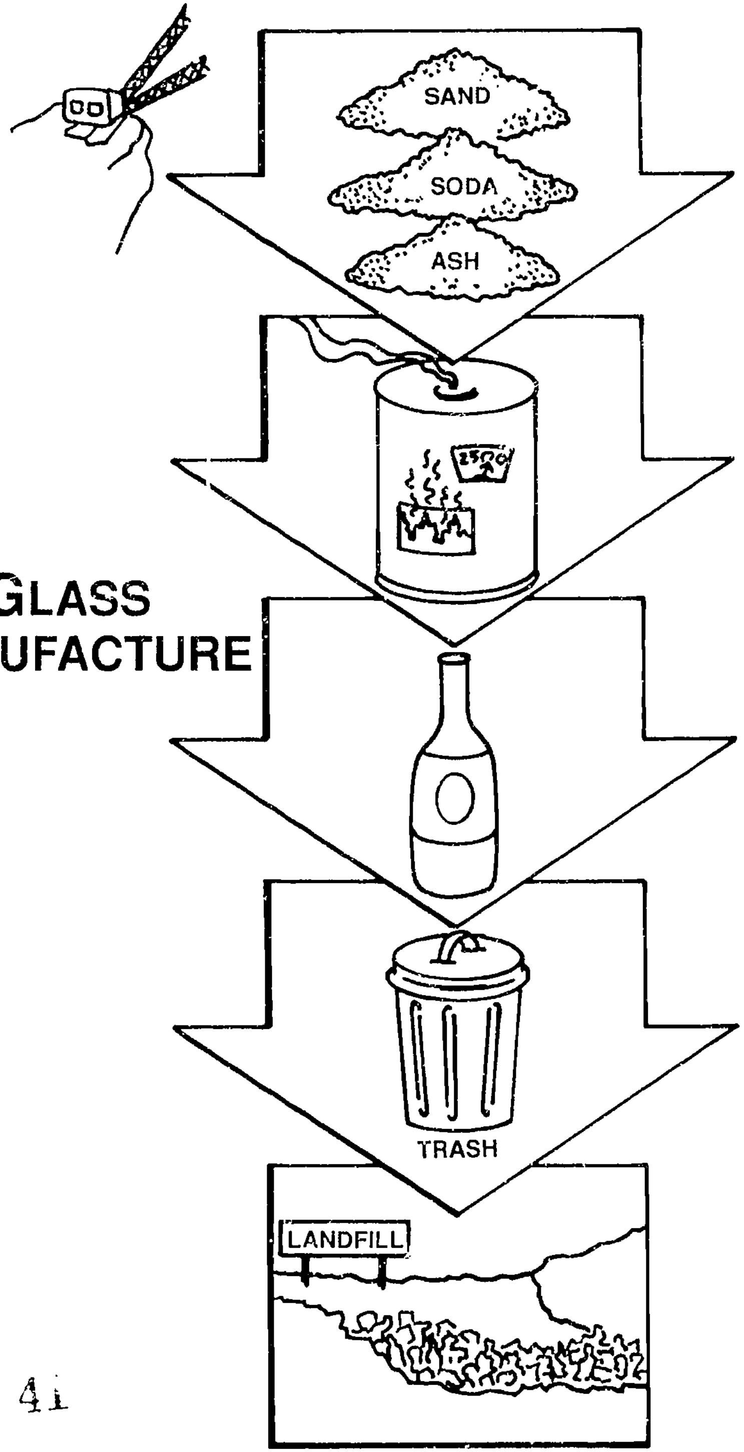
Route B			
Bogota - Bonaventura	Railroad	500	______
Bonaventura- New Orleans	Boat	2,400	______
TOTAL			______
Cost per pound			______

Route C			
Bogota - New Orleans	Truck	3,300	______
TOTAL			______
Cost per pound			______

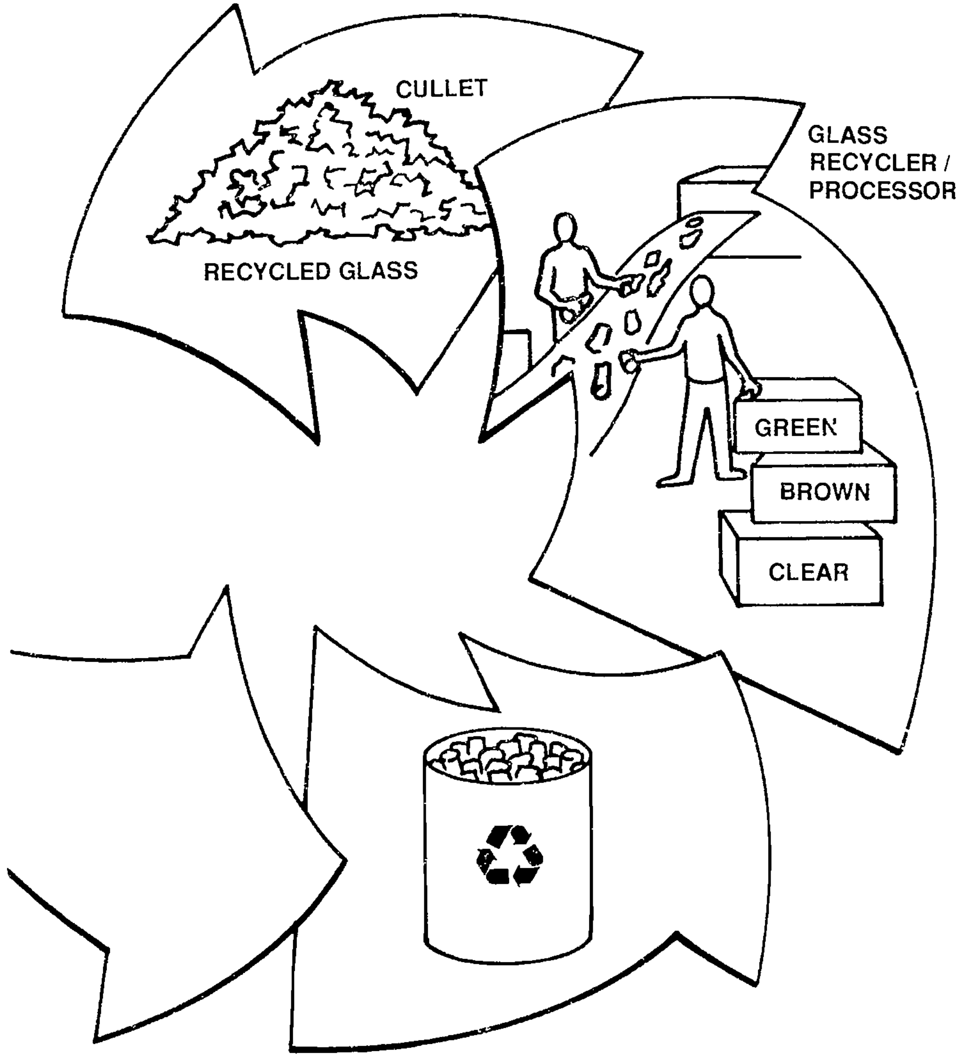
Route D			
Bogota - Panama Canal	Road	500	______
Panama Canal - New Orleans	Boat	2,050	______
TOTAL			______
Cost per pound			______

Answers. Route B - $1575.00, 15.8¢ per lb Route C - $3,300.00, 33¢ per lb
Route D - $1525.00; 15.3¢ per lb

May be reproduced.
Procter & Gamble Educational Services

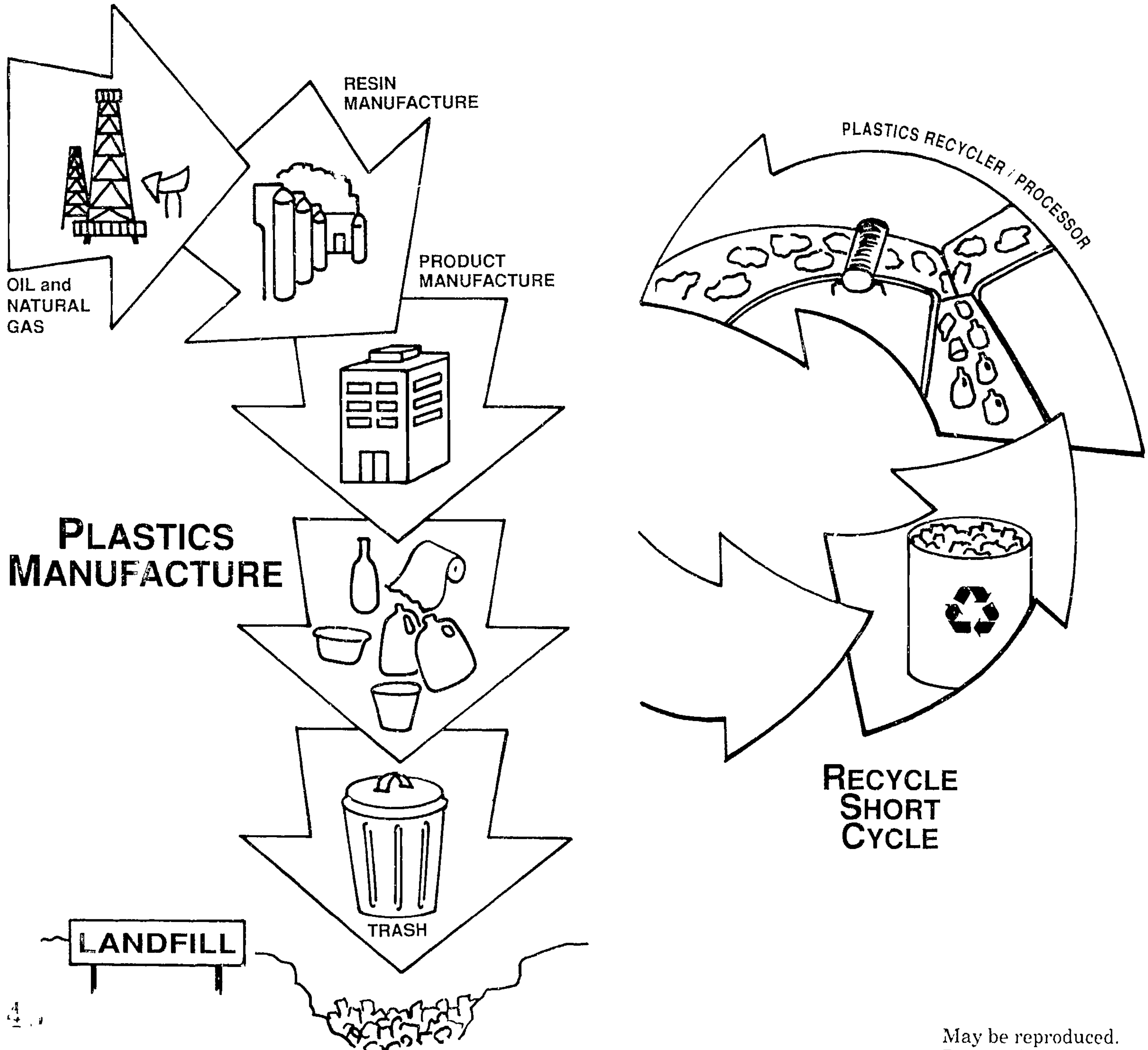


GLASS MANUFACTURE

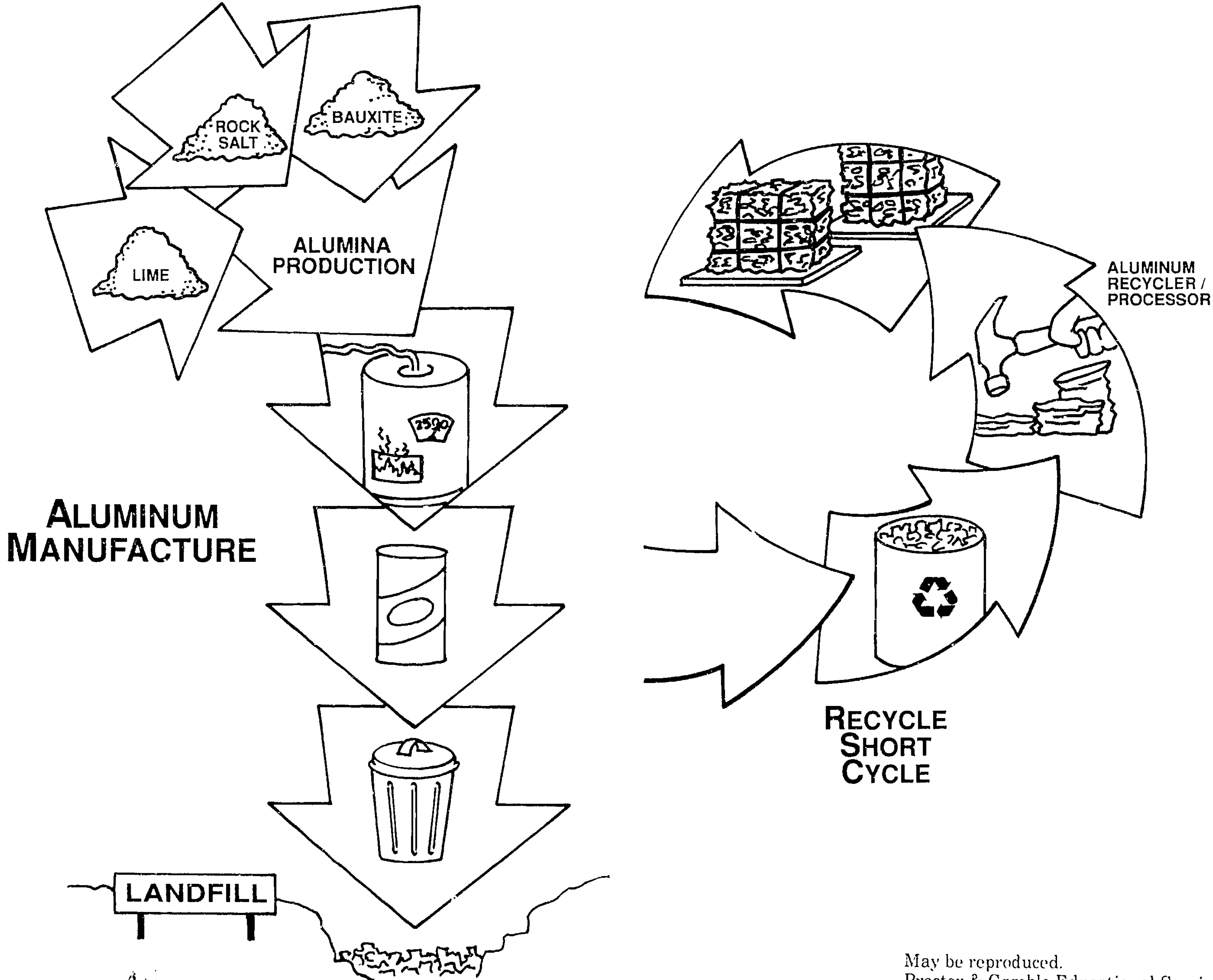


RECYCLE SHORT CYCLE

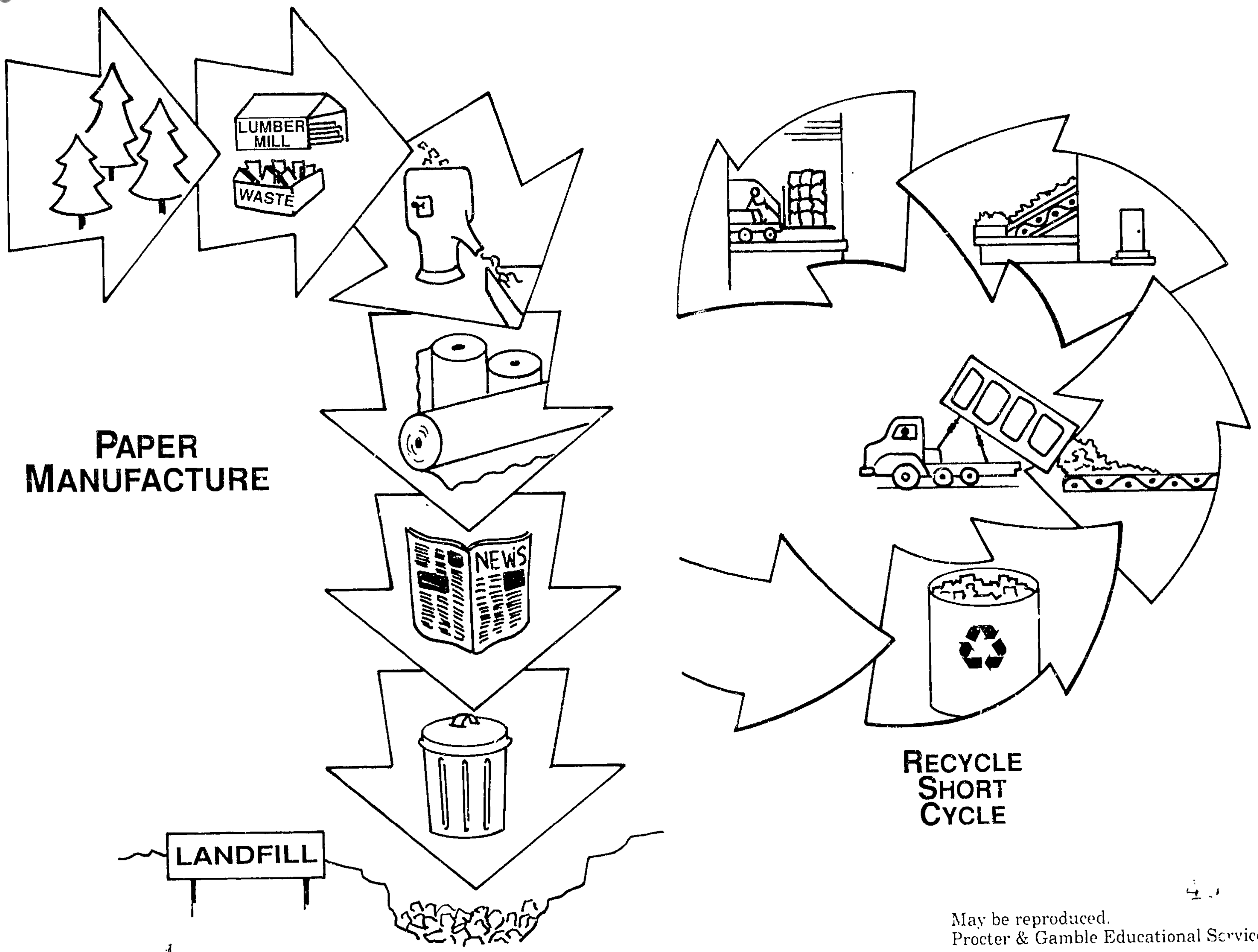
May be reproduced.
Procter & Gamble Educational Services



May be reproduced.
Procter & Gamble Educational Services

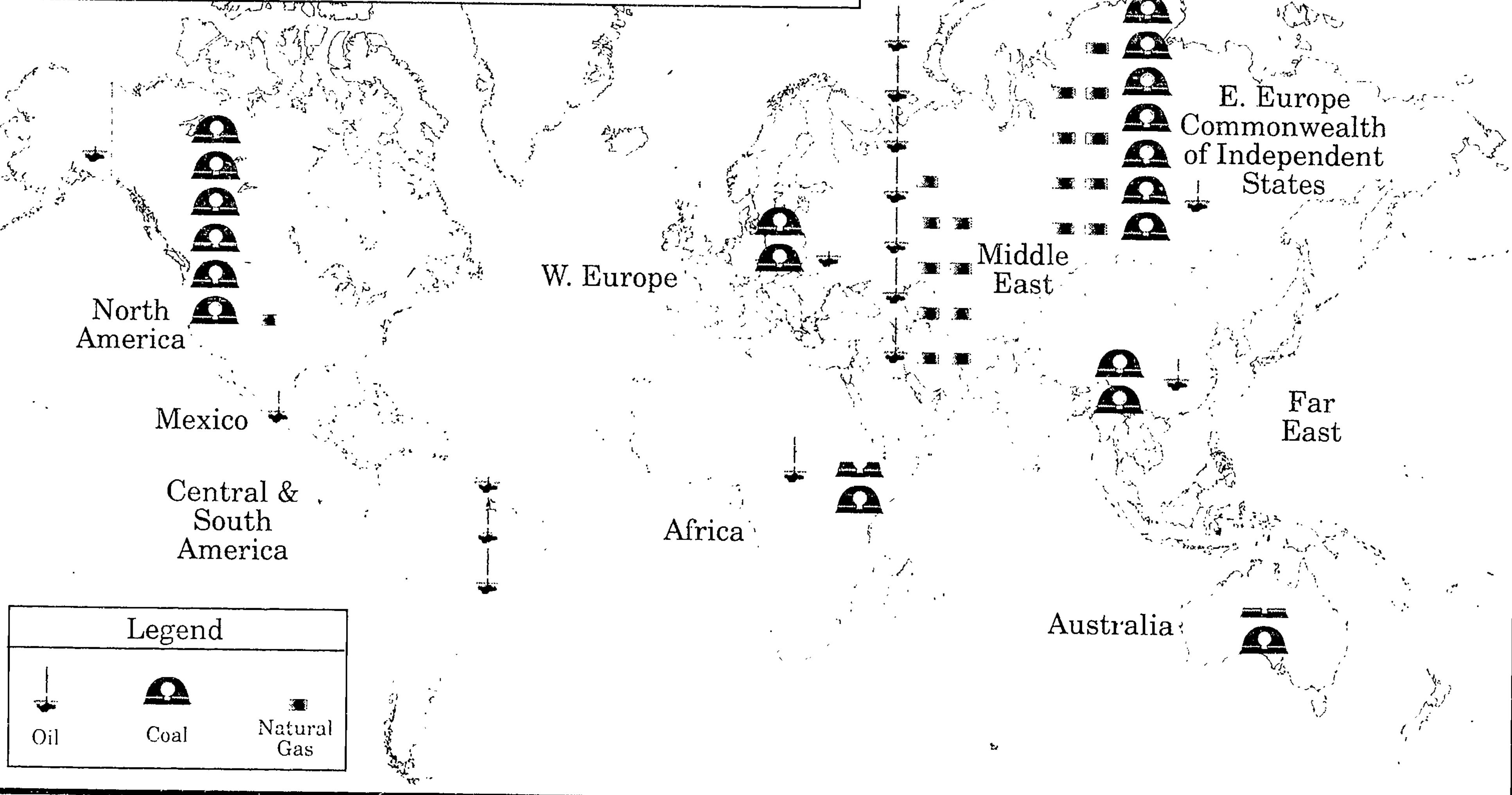


May be reproduced.
Procter & Gamble Educational Services



May be reproduced.
Procter & Gamble Educational Services

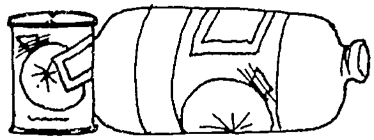
ENERGY RESOURCES: WHERE ARE THEY AND HOW LONG WILL THEY LAST?



Energy Resources	Proven Energy Reserves	1988 Annual Usage Rates	Countries/Regions Holding Greatest Energy Reserves	How Long Will It Last?
Natural Gas (trillion cubic feet)	3936.0	68.4	Commonwealth of Independent States, Middle East, U.S.	________
Coal (short tons)	1,018,000,000,000	5,221,000,000	U.S., Commonwealth of Independent States, E. Europe W. Europe, Australia, Far East, Africa	________
Oil (barrels)	992,000,000,000	23,433,000,000	Middle East, W. Europe, E. Europe, Commonwealth of Independent States, Mexico, S. America, Africa, Far East, U.S.	________

May be reproduced.
Procter & Gamble Educational Services

Source: International Energy Outlook 1990. Energy Information Administration, U.S. Department of Energy, March 20, 1990. Tables C1, C4, C5, figures ES2, figure 3, figure 14, figure 17



SODA: HOW DO WE CONTAIN IT?

Life cycle analysis is a useful tool. It is accepted by experts as an objective way to determine the environmental impacts of product manufacture and use so that ways to reduce these impacts can be identified. The tables below compare the energy usage, emissions and wastes generated for soft drink containers using virgin materials and recycled materials.

Containers Manufactured from Virgin Raw Materials

		Energy (million Btus per 1,000 gals.)	Atmospheric Emissions (lb)	Waterborne Wastes (lb)	Solid Wastes (lb)	Solid Wastes (cu. ft.)
Plastic	16-oz PET	33.89	98.7	16.6	939.7	56.2
	1-L PET	27.35	78.9	13.6	687.9	42.9
	2-L PET	20.09	59.0	10.3	478.9	29.0
	3-L PET	19.72	57.4	10.4	463.8	28.1
Aluminum	12-oz Al	49.97	137.0	44.1	1,938.0	40.4
Glass	10-oz NR	41.97	189.6	20.7	5,725.7	117.4
	16-oz NR	35.09	157.0	16.9	4,721.2	96.9
	16-oz REF (1-trip)	61.71	271.5	24.8	9,066.3	184.4
	1-L NR	37.01	172.1	17.5	5,354.6	110.1

Containers Manufactured from 100 Percent Recycled Materials or Reused

		Energy (million Btu per 1,000 gals.)	Atmospheric Emissions (lb)	Waterborne Wastes (lb)	Solid Wastes (lb)	Solid Wastes (cu. ft.)
Plastic	16-oz PET	22.32	66.9	13.4	363.6	8.5
	1-L PET	18.10	54.6	11.3	232.5	4.9
	2-L PET	13.97	43.0	8.8	176.6	3.7
	3-L PET	13.88	42.5	9.1	173.3	3.6
Aluminum	12-oz Al	15.91	46.3	9.7	198.2	3.2
Glass	10-oz NR	38.69	130.0	17.0	1,198.4	19.4
	16-oz NR	32.39	107.7	13.8	985.2	16.2
	16-oz REF (20-trips)	8.99	37.9	6.4	521.3	8.8
	1-L NR	33.83	102.3	14.0	965.6	13.9

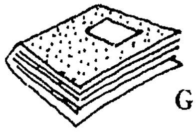
Source: Franklin Associates, Ltd. 1987 data.

While life cycle analysis yields scientific quantitative results, this approach does not provide simple answers. One possible product choice may have fewer atmospheric emissions but more solid waste. Which is more important, cleaner air or minimizing solid waste? These decisions need to involve a consideration of local waste handling infrastructures, economics, geographic conditions, and a host of other factors.

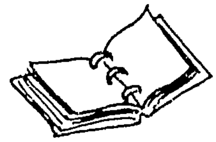
List of Abbreviations

Al — Aluminum
Btu — British thermal units
cu. ft — Cubic feet
lb — Pound
REF — Refillable
l — Liter
NR — Nonrefillable
Oz — Ounce
PET — Polyethylene terephthalate

May be reproduced.
Procter & Gamble Educational Services



GLOSSARY OF TERMS



Ash — Solid material produced from the combustion process.

Atmosphere — The blanket of air surrounding the earth.

Biomass — The amount of living matter within an ecosystem.

Capital goods — Tangible commodities used to produce a product or service.

Clear-cutting — An economical method for tree removal that creates habitat for browsers and grazers but may also lead to erosion and depletion of soil nutrients.

Combustion — A burning process in which solid waste is incinerated.

Composting — Converting organic wastes into humus, a rich, soil-like material.

Consumer products (goods) — Tangible commodities produced, purchased and used directly to satisfy human needs or desires.

Decay — Decompose, rot.

Distribution — The movement of raw materials for processing or consumer goods for purchase or use.

Durable — Goods that are expected to last longer than three years; the purchase of these goods often tends to reflect the state of the economy.

Ecology — Study of the relationship between living things and their environment.

Effluent — Liquid discharged as waste, usually from industrial processes or sewage.

Emissions — Airborne waste by-product from manufacturing or waste management processes.

Energy — The ability to do work.

Fossil fuel — A naturally occurring substance of an organic nature that is burned to produce heat or energy.

Heavy metal — A metal of high specific gravity.

Humus — See *composting.*

Landfill — Permanent waste disposal site for most solid and non-hazardous residential, commercial and industrial wastes.

Life cycle — Sequence of stages in the life of an organism or of a consumer product. In this unit, life cycle refers to the sourcing, manufacture, distribution, usage and disposal of a consumer product.

Manufacture — The process of making material products by hand or machine, characterized by a systematic division of labor.

Mineral — A single solid element or compound occurring naturally in the earth's crust.

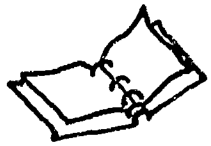
Mining — The process of extracting materials from the earth.

Multifunction product — A single consumer product designed to fulfill more than one purpose. Examples: shampoo plus conditioner; detergent plus bleach.

Municipal Solid Waste (MSW) — Garbage generated by residential households.

May be reproduced.
Procter & Gamble Educational Services

GLOSSARY OF TERMS



Natural resources — A material from the earth that is useful to human beings.

Non-renewable resource — A natural resource that cannot be replaced after use.

Nondurable — Goods that are expected to last less than three years; demand and purchase rate generally parallels population growth.

Organic — Of or from a living thing.

Raw materials — Previously unprocessed material required in the manufacturing process.

Recycled materials — Previously processed material, requiring less energy and producing less waste, re-introduced into the manufacturing process to replace raw, or virgin, materials stocks.

Recycling — A resource recovery method involving the collection and treatment of a waste product for use as a raw material in the manufacture of the same or another product.

Reforestation — A forestry management technique involving the replanting of a harvested area with seedlings.

Renewable resource — A natural resource that can be used and replaced.

Reserves — Deposits of energy fuels or minerals that are economically feasible to remove with current and foreseeable technology.

Resources — Total amount of an energy fuel or mineral known to exist.

Run-off — Downhill flow of water along the earth's surface.

Selective cutting — A forest management method involving only the removal of mature trees.

Shelter-wood cutting — A forestry management method that involves the cutting of "overstory" trees to permit the growth of remaining healthy trees.

Single-purpose product — A consumer product designed to fulfill one specific function.

Source reduction — Reducing the amount of solid waste generated by 1) limiting the use of toxic substances, 2) reducing the size (volume) of products, 3) minimizing the amount of packaging, and 4) improving a product to make it last longer.

Sustainable use — A resource conservation philosophy that prescribes that as development proceeds, resources are available to meet the needs of the future.

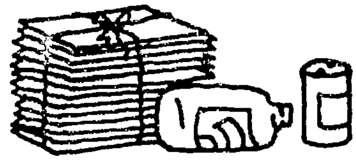
Virgin materials — Previously unprocessed raw material stocks required for manufacturing a product.

Waste-to-energy (WTE) — A solid waste disposal method whereby municipal solid waste is burned to generate steam or electricity.

Water table — An underground zone where the surface of the zone of saturation meets the zone of aeration.

Xeriscape — A landscaping and gardening technique that involves the selection of plants, shrubbery and trees that are drought resistant, and their placement with plants of similar watering needs.

May be reproduced.
Procter & Gamble Educational Services

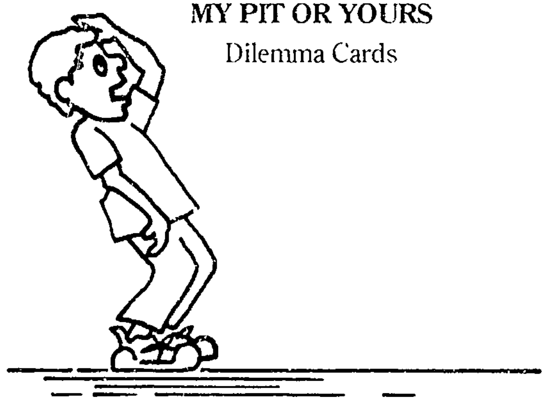


THROW-AWAY JOURNAL

Directions: Record each item you throw away. Indicate the category of material it is made from and whether the item is recyclable or compostable. Use more than one sheet if necessary.

ITEM	PLASTIC	GLASS	METAL	PAPER	TEXTILE	FOOD	YARD WASTE	COMPOSTABLE	RECYCLABLE
TOTAL ITEMS									

May be reproduced.
Procter & Gamble Educational Services



MY PIT OR YOURS

Dilemma Cards

COMMUNITY A

Population: 4,100,000
Total MSW Generated Annually: 4,400,000 tons
Primary Disposal Methods: Landfill (93%); Recycle (5%); Incinerate (2%)
Cost: Landfill - $5.25/ton

Main Industries and Products: Iron, steel, white marble, oil, chemicals and plastics
Geographical Characteristics: 6 major rivers, mountainous to low flatlands of coastal areas
Situation: The state has 107 landfills that will close in less than four years.

Options Being Considered:
- Send garbage to neighboring state. Disposal cost will rise to $30/ton;
- Increase dependence on incinerator plant and recycling efforts.

COMMUNITY B

Population: 12,000,000
Total MSW Generated Annually: 16,000,000 tons
Primary Disposal Methods: Landfill (75%); Incinerate (21%); Recycle/Compost (4%)
Cost: Landfill - $45/ton; Incinerate - $65/ton

Main Industry: Tourism, Agriculture, Cattle, Mining
Geographical Characteristics: Peninsula, sea level, swampy and marshy
Situation: More than 50% of all MSW generated is yard waste. Landfills currently operating will reach capacity in less than 5 years.

Options Being Considered:
- Recycle/compost
- Increase Incineration
- Site new landfill

COMMUNITY C

Population: 4,500,000
Total MSW Generated Annually: 5,200,000 tons
Primary Disposal Methods: Landfill (70%); Recycle/Compost (29%); Incinerate (1%)
Cost: Landfill - $35/ton; Incinerate - $75/ton

Main Industry: Seafood, wood products, agriculture, aircraft and aircraft parts
Geographical Characteristics: Volcanic mountains, coastal lowland, heavily forested timberland, produces 1/5 of nation's hydroelectric power.
Situation: More than 20 years' capacity remaining on 95 existing landfills. Incinerator that was constructed is being grossly under-utilized, and operating inefficiently and at a loss.

Options Being Considered:
- Increase incinerator use at double the cost of landfill disposal.
- Accept garbage from other states for incineration.

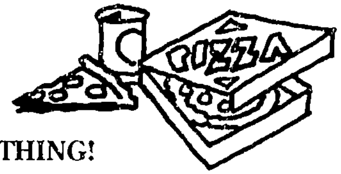
COMMUNITY D

Population: 5,900,000
Total MSW Generated Annually: 6,600,000
Primary Disposal Methods: Incinerate (48%); Landfill (45%); Recycle/Compost (7%)
Cost: Incinerate - $65/ton; Landfill - $65/ton

Main Industry: Shoe and textile manufacturing, electronics and communications
Geographical Characteristics: rocky, sandy, heavily polluted rivers and lakes
Situation: 6 years remaining on landfill capacity. The incinerators are at capacity. Significant levels of air and water pollution.

Options Being Considered:
- Increase recycling to divert materials from landfills to improve incinerator efficiency and increase capacity for combustibles.
- Seek public support to site new incinerator.
- Consider shipping garbage to other states.

May be reproduced.
Procter & Gamble Educational Services

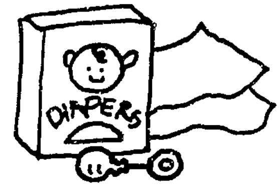


A PIZZA IS STILL A PIZZA, BUT A PACKAGE CAN BE ANYTHING!

Pizza is a popular food with teens. Have you ever thought about how many choices you have when you and your friends get together and somebody says, "Let's have a pizza!" You can have it delivered, make it yourself or have something "in between." Explore the frozen food, dairy case and shelves of your grocery store and see how many consumer product choices you have when you decide to have friends over for pizza.

Product	Net weight (ounces)	Total Price	Price (per ounce)	Servings (per package)	Description of Packaging
1. Chef Boy-ar-dee Box	16 oz.	$1.39	8.5	4	cardboard box, steel can, paper package
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					

May be reproduced.
Procter & Gamble Educational Services



COMPARISON OF DISPOSABLE VERSUS CLOTH DIAPERS[1]

Directions: This table of data compares the environmental effects of cloth and disposable diapers for one child over a one year period. Refer to this chart to answer the questions below:

Environmental Impacts	Cloth Diapers[2]	Disposable Diaper[3]
Number of Diapers Required	3,557.00	1,976.00
Water Consumption (gals.)	9,620.00	2,570.00
Energy (million Btu)	13.58	6.66
Atmospheric Emissions (pounds)	34.00	16.40
Waterborne Wastes (pounds)	21.70	3.00
Industrial and Post-Consumer Solid Waste (cubic feet)	8.10	34.20

1. Refer to the comparison chart and put an X in the column for the diaper product whose environmental impact is greater:

	Cloth Diaper	Disposable Diaper
Water Consumption	____________	____________
Energy	____________	____________
Atmospheric Emissions	____________	____________
Waterborne Wastes	____________	____________
Industrial & Post- Consumer Solid Waste	____________	____________

2. Calculate how many times greater each of these environmental effects is compared to the other diapering system. Do your figuring in the space provided.

3. Discuss the importance of considering these other issues in selecting a diapering method for a baby: Health and Sanitation; Infection Control in Day Care Situations; Time; Cost; Convenience in a range of situations – travelling, illness, visiting, shopping, etc.

[1] Energy and Environmental Profile Analysis of Children's Disposable and Cloth Diapers, Franklin Associates, Ltd., July 1990

[2] Based on home cloth diapering systems, with an average of 1.79 cloth diapers required per every disposable diaper due to increased changing frequency as well as occasional double diapering

[3] Based on an average of 5.4 disposable diapers per child per day

May be reproduced.
Procter & Gamble Educational Services

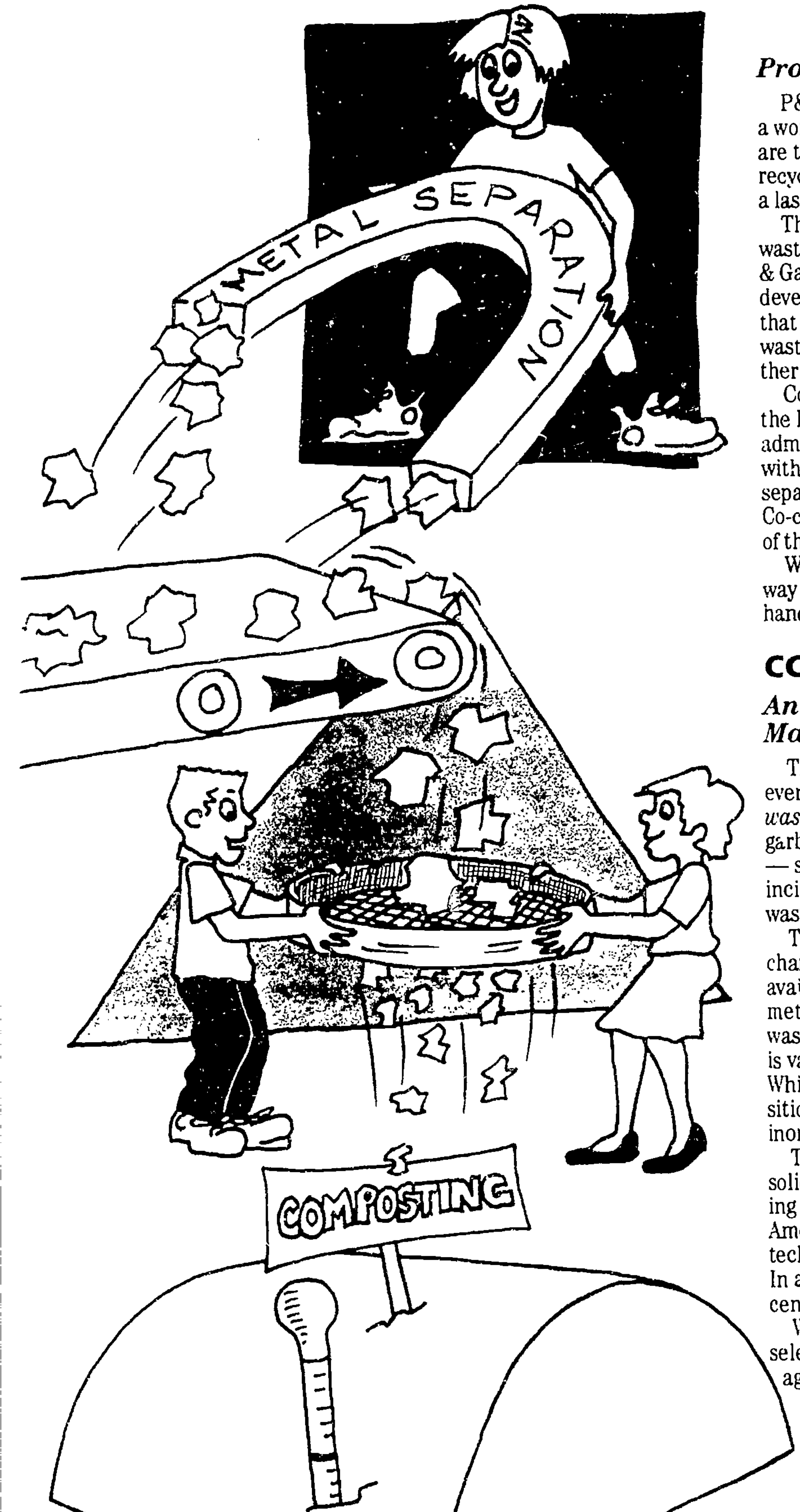
DECISION: EARTH

MUNICIPAL SOLID WASTE COMPOSTING

Teaching Supplement

BEST COPY AVAILABLE

ERIC



Procter & Gamble's Vision

P&G's Environmental Quality Policy is based on the vision of a world in which a bare minimum of products and packaging are thrown away, and what does get thrown away is reused, recycled, composted or incinerated. Landfills are used only as a last resort.

The single largest untapped opportunity for reducing solid waste in landfills is municipal solid waste composting. Procter & Gamble is committed to playing a major role in fostering the development of this new technology. We will focus on projects that demonstrate how composting fits into integrated solid waste management plans, develop compost end-uses and further advance composting technology.

Composting as a solid waste handling method is endorsed by the Environmental Protection Agency, researchers, solid waste administrators and scientists. Dr. Jan Beyea, senior scientist with the National Audubon Society says, "Composting of source separated wastes is the next step beyond traditional recycling. Co-collection of recyclable and compostable wastes is a wave of the future in solid waste management."

We offer this composting supplement to *Decision: Earth* as a way to share information about an increasingly viable waste handling alternative.

COMPOSTING

An Integral Part of Integrated Waste Management

The Environmental Protection Agency (EPA) encourages every community to use a concept called *integrated solid waste management* when considering ways to dispose of its garbage. The EPA's integrated approach include ur methods — source reduction, recycling/composting, waste energy incineration and landfilling — as the hierarchy of preferred waste handling options.

This flexible concept allows each community to consider the characterization — or make-up — of its solid waste and its available resources, and then to choose the waste handling method or combination of methods that will best meet its waste disposal needs. The garbage generated in rural Kansas is vastly different in content from that of urban Massachusetts. While one community's waste may be mainly organic in composition and suitable for composting, another's may be more inorganic and suited to recycling.

Today, nearly 80 percent of our garbage is landfilled, but solid waste experts project that more than half of our operating landfills will close by 1995. The EPA recognizes that America can no longer rely on any single waste management technique to handle *all* of a community's garbage responsibly. In addition, the EPA has set a national goal to achieve a 25 percent recycling rate in 1992 and 40 percent in 1996.[1]

With integrated waste management, each community selects the right combination of complementary waste management methods to fit the community's needs and resources.

1. Source: EPA, The Municipal Solid Waste Dilemma Challenge for the '90s, revised draft, January 23, 1991.

BEST COPY AVAILABLE

Part of the Integrated Waste Management Hierarchy

Composting is something most of us think of as a backyard exercise that puts us in touch with nature and makes us "feel good" about garbage. Composting is a very old method of solid waste management. In the United States, many factors have prompted waste management experts to re-examine composting as a waste handling option:

- skyrocketing landfill costs;
- decreasing landfill capacities;
- increased public opposition to incineration;
- favorable economics of composting;
- increased focus on material recovery by combining recycling and composting; and
- expanded end-use markets for quality compost.

In Europe and the Middle East, where landfill space is at a premium, successful large-scale composting technologies and systems have been in place for about four decades.

What Is Composting?

Mother Nature has been composting for millions of years in a cycle of renewal that breaks down organic matter and returns it to the Earth as oxygen, carbon, hydrogen and nitrogen — the basic building blocks of life. Composting is a natural process that transforms organic material like food waste, leaves, grass and non-recyclable paper products and packaging into a useful soil-like product called humus.

Compost is added to soil to improve its physical, chemical and biological properties. Compost increases the moisture-holding capacity of sandy soils, improves the drainage and aeration of heavy clay soils, increases the soil's ability to hold and release essential nutrients, and introduces microorganisms that are beneficial to plant growth.

RECYCLING AND COMPOSTING

Two Sides of the Same Coin

Just as recycling is a way to recover useful inorganic materials and to reduce our dependence on virgin natural resources, composting is nature's way of recycling useful organic resources. By composting organic materials, we are conserving valuable landfill space.

Americans are currently recycling about 13 percent of all solid waste. If we hope to achieve the EPA's goal of 25 percent recycling by 1992 and 40 percent by 1996, we must double our recycling efforts. Many states and cities have established ambitious recycling goals ranging from 25 – 50 percent. Some communities have already achieved high recycling rates for certain materials, such as aluminum, paper or PET plastic, however, on a national scale these goals will be unachievable without composting. To see why, let's re-examine the materials that make up our waste stream and the EPA's preferred disposal method for each. (Refer to Figure 1.) The total organic matter in our waste stream is nearly three times greater (by weight) than our inorganic recyclables. It's easy to see that composting can be an effective resource recovery and landfill diversion strategy for our organic solid waste.

If you think about it, it seems pretty wasteful to pay $50 – $100 or more per ton to entomb biodegradable material in a landfill.

FIGURE 1.

Material[1]	Percent of Waste Stream	Weight (millions of tons)	Optimal Waste Management Method
Yard Waste	**17.6**	**31.6**	**compost**
Metals	8.5	15.3	recycle
Glass	7.0	12.5	recycle
Plastics	8.0	14.4	recycle
Food Wastes	**7.3**	**13.2**	**compost**
Paper	**40.0**	**71.8**	**recycle, compost, incinerate**
Other (fabric, leather, furniture, etc.)	11.6	20.8	incinerate, landfill
Total	100.0	179.6	

1. Materials in bold type indicate organic fraction of the waste stream.

Although biodegradation can and does occur slowly in anaerobic conditions such as those found in landfills, the air and moisture required for quick degradation to occur are absent.

It is even more wasteful to pay high disposal fees to send yard waste to an incinerator. Consider this. Wet organic material such as yard waste has a low Btu rate when burned. When added to a combustion facility, this material often lowers the furnace temperatures and results in a less efficient system. In combustion systems, a certain temperature level must be maintained to prevent the formation of undesired pollutants. Finally, the ash residue from yard waste burned in incinerators must be disposed of in landfills — the very disposal method we were trying to avoid! Many state and local governments operating incineration facilities now ban yard waste from their incineration plants for these reasons.

Materials such as glass, metal and plastic are eminently suited to recycling. Newspapers and many high-quality papers are also recyclable. However, paper that is soiled and not suited for recycling should be composted rather than landfilled.

Dr. Charles Benbrook of the National Academy of Sciences, says that "experts now predict that an aggressive national commitment to composting and recycling could provide a viable option to landfill disposal for 40 – 60 percent of the total waste stream." In fact a recent study by the National Audubon Society in Connecticut showed that 70% of household trash can be recovered by recycling and composting.

What Is Municipal Solid Waste Composting?

While there are more than 200 municipal solid waste (MSW) composting plants in Europe and the Middle East, there are only 19 such facilities operating in the U.S. MSW composting is an emerging waste management technology in the United States. The number of facilities doubled in 1991, and another 8 facilities are under construction. There are 150 – 200 communities actively pursuing composting as part of their integrated approach to solid waste management.

Composting is a process of degradation by which plants and other organic wastes decompose under controlled conditions. MSW composting programs can be designed to handle many different types of waste: yard wastes; the biodegradable portion of our garbage; agricultural waste products; wastewater treatment sludge; or mixtures of the above.

BEST COPY AVAILABLE

ERIC

How Does Composting Work?

Whether speaking of small-scale or large-scale composting operations, there are several factors that are required to ensure successful composting:

Aeration The bacteria and other microorganisms important in composting require oxygen to metabolize the organic waste. As the organic waste is metabolized, heat is created. These high temperatures help destroy weed seeds and disease-carrying bacteria called pathogens that might otherwise contaminate the compost. Oxygen also prevents foul odors which are generally associated with anaerobic conditions. Aeration is usually accomplished by manual or mechanical means, or by forcing air through pipes into the compost pile.

Moisture Moisture is essential for microbial activity to occur. Typically, water is added throughout the composting process to control moisture to the optimum level for biodegradation. Too much water may lead to anaerobic conditions that slow the decaying process and cause foul odors, while too little water allows the compost to dry out, slowing degradation. A good gauge to judge the correct moisture content of a compost pile is that it be about the dampness of a wrung-out sponge.

Particle Size Microbes, the microscopic organisms that make the composting process work, concentrate on the surface areas of waste particles. The smaller the particle size, the greater the surface area the microbes have to chomp on and the faster the material will decay. Chopping up the material being composted helps the microbes gain access to the waste and turning the compost pile disturbs the particle surfaces and creates new surface areas for the microbes to attack.

Temperature Temperatures within a compost system naturally rise due to the decomposition process. A well-maintained compost system will reach an internal temperature of 130 – 160°F, or about the temperature of hot tap water. Held at these temperatures for three to five days, weed seeds and pathogens are destroyed. Periodically turning the contents of the compost pile exposes the material on the outside of the compost pile to this heating process. As decomposition continues — a period that may last from two to six months — temperatures will drop as an indicator that the process is completed and the compost is ready for use.

What Can You Do With Compost?

For every pound of organics about one-half pound of compost is produced. The other half-pound is converted to carbon dioxide and water. Assuming 50 percent of household garbage is compostable, and composting reduces the amount of solid waste by 50 percent, four pounds of garbage would produce one pound of compost. With nearly 180 million tons of garbage produced annually, that means we could produce about 45 million tons of compost. Are there enough uses for all the compost we could potentially generate?

Municipal solid waste compost produces a useful soil amendment for agricultural, horticultural, land reclamation and beautification projects. Soil erosion on U.S. cropland, for example, is one of our most serious environmental problems. Each year, more than 25 million acres of cropland with the worst erosion problems lose more than 15 tons of soil per acre. If it takes 65 tons of compost to cover one acre of land with an inch of compost, that's a lot of needed compost! A recent study by Battelle Institute estimates over 500 million tons of compost could be used each year. Other potential uses and end-markets for compost that have been identified include:

Commercial — greenhouses, nurseries, golf courses, landscaping and turfgrass operations, industrial parks, cemeteries, agriculture and topsoil amendment

Public — parks, playgrounds, roadsides and median strips, military installations

Land Reclamation and Beautification Programs — landfill cover, strip mine, sand and gravel pits, derelict urban areas

Residential — lawns, vegetable and flower gardens

There are many applications for the MSW compost end-product. Communities first must determine the market or markets to which their compost will be sold. Once that determination is made, communities can select the most efficient preprocessing technologies that will provide a satisfactory end-product for sale. The technologies and processes that exist today to separate out recyclable and other non-compostable materials and to destroy pathogens enable every community to yield high quality, safe, clean compost.

Depending on the method or *combination* of methods selected, several grades of compost could be produced. Each must meet all federal, state and local standards for safety. The grade will be determined by the local market requirements. For example, agricultural applications may require the higher quality compost. Compost quality requirements for landscaping may not be as stringent. For large land reclamation projects such as strip mining or highway construction sites, yet another grade of compost would be acceptable. In each of these and other possible uses, the mixed organics in solid waste can be beneficially reused.

How Does MSW Composting Work?

Know Your Garbage

For years, farmers and gardeners have known and understood the benefits of composting. More than 1500 communities now compost their yard and leaf waste, using much the same low-level technology as has been used in the barnyard and backyard. Depending on the size of the community, its location, and the time of year, yard waste composting programs can divert from 20 – 35 percent of the waste stream from landfills.

The management of composting systems becomes much more sophisticated when other organic materials in the waste stream are added. Mixed organics composting programs have the potential for handling up to 50 percent of a community's solid waste.

Communities that are considering composting the mixed organics in MSW must carefully examine and analyze the materials in their garbage. Contaminants can come from seemingly innocuous sources such as wastewater treatment sludge that may contain industrial wastes or metal-based printing inks used in paper and packaging. The quality of a community's compost will vary with the relative per entages of inorganic ma rial introduced into the composting system and the levels of heavy metals and other contaminants.

States need to set standards for compost quality to ensure protection of public health, safety and the environment. For example, Minnesota and Florida have led the way in setting safe levels of metals (such as lead, cadmium, mercury, copper, nickel, zinc, and chromium) which are common contaminants in solid waste.

Processing MSW to Produce Compost

The key to minimizing contamination of the mixed organics compost product is extensive preprocessing as early in the composting operation as possible. [Refer to the poster, The MSW Composting Process.] This preprocessing is a separation task applying technologies developed for recycling and certain types of waste-to-energy operations to remove bulky items, recyclables, hazardous materials, known sources of heavy metals and toxic organic chemicals and non-compostables. Additionally, communities are choosing to separate compostable and non-compostable or recyclable materials at the curbside. The important point is that these materials must be separated prior to composting the mixed organic portion of the waste stream.

Diagram A.

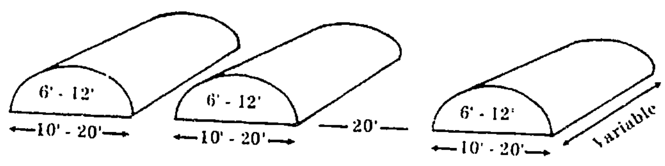
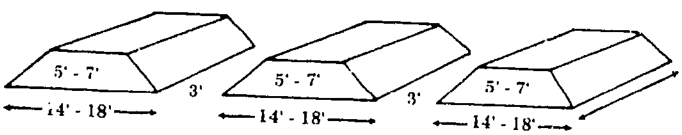


Diagram B.



Self-propelled windrow turning machine that straddles windrow

Another preprocessing step important for any waste management option is the removal of hazardous material such as pesticides, paint thinners and batteries.

The compostable portion of MSW is further separated using a rotating screen called a *trommel*. Once separated, the organic materials are shredded to a uniform particle size and moisture is added to aid the composting process.

There are three types of controlled composting systems for handling mixed organics:

In-vessel system These are large enclosed or semi-enclosed chambers which use forced aeration and frequent mechanical turning to accomplish the accelerated composting stage in three to four weeks. After this initial phase is complete, the material is transferred to windrows for another four to six weeks to finish composting at a slower rate, stabilize and cure.

Windrow system (*Diagrams A and B*) A windrow is a narrow elongated pile of compost, usually 6 – 10 feet high, 10 – 20 feet wide, and as long as the site can accommodate. Windrows are carefully formed, and mixing and aeration are accomplished mechanically, sometimes with special machines designed to run between the rows. High-tech in-vessel and windrow systems are expensive to operate, but provide a high-quality end-product and produce fewer odors than static pile systems.

Aerated Static Pile (*Diagram C*) In this system, a compost pile is built on top of a network of perforated plastic pipes through which air is forced by exhaust fans or blowers. Pipes are positioned over a foundation of wood chips or other porous material.

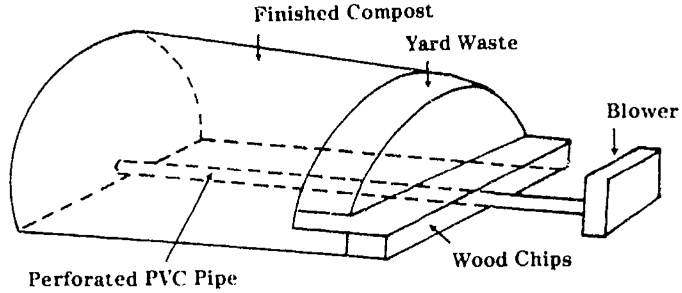


Diagram C.

The windrow and in-vessel systems are most frequently used for programs that co-compost sludge with yard waste, municipal solid waste or other hard-to-manage materials.

Compost is cured and ready for use when the internal temperature reaches that of the surrounding air. This is an indication that the decomposition process is completed. After the compost has cured, material may again be screened and then "custom blended" to achieve just the right mix or grade for its intended market.

The best composting method for a community will require decisionmakers to consider existing collection and recycling programs, appropriate markets for the compost material, financial resources, other waste management options available to the community, and a variety of factors that may be unique to an area.

Health and Safety Issues Surrounding Composting Operations

Careful monitoring of both the material being composted and the compost product itself is very important. Because of the variety of uses for the compost end-product, contamination could pose certain health and environmental threats. These threats are easily minimized by following the simple quality control procedures of removing hazardous materials, presorting waste, proper turning and sufficient composting time.

Water Impacts Although composting is a natural process, yard waste and agricultural composting facilities do prevent runoff from entering streams. High nitrogen materials such as grass clippings and manures should be mixed with wood chips or leaves to prevent nitrates from infiltrating groundwater. At MSW composting facilities, the effects of leachate on surface and ground water are minimized by building retention ponds and using liners or pads.

Land Impacts Any harmful effects of acid, organic or metal contamination can be controlled with careful preprocessing to remove potentially hazardous materials from the facility as early in the composting process as possible and through testing to ensure the compost is safe for land applications.

Health Impacts Drinking water contamination, toxics in the finished product and pathogens form the primary health concerns surrounding compost. The EPA considers all of these risks to be minimal when proper composting conditions and procedures are used.

The Compost Message

Composting is becoming an increasingly popular waste management alternative to divert organic waste from landfills. Yard waste composting operations can be low-cost, low-tech ways to handle large portions of a community's waste stream. Successful mixed organics composting operations will be used along with recycling and certain waste-to-energy operations to handle a significant portion of a community's waste stream. By combining composting with other waste management options, communities will benefit environmentally and economically.

Further Resources

Bottle Biology. Resources Network, University of Wisconsin - Madison, 1630 Linden Dr., Madison, WI 53706.

Environmental Protection Agency. *Decision Maker's Guide to Solid Waste Management.* November 1989.

"Fungus Among Us," *GrowLab, Activities for Growing Minds*, Jay Cohen and Eve Pranis, p. 210–213, National Gardening Association, 180 Flynn Avenue, Burlington, VT 05401.

Goldstein, Nora. "Solid Waste Composting in the U.S., 1989 Project Survey," *BioCycle*, November 1989.

Logsden, Gene. "New Sense of Quality Comes to Compost," *BioCycle*, December 1989.

Marinelli, Janet. "Composting, From Backyards to Big Time," *Garbage*, July/August 1990.

Richard, Thomas L., et al. *Yard Waste Management, A Planning Guide for New York State*. Cornell Cooperative Extension, NY State Energy Research and Development Authority, and NY Dept. of Environmental Conservation. June 1990.

Rosen, Carl, et al. "Composting and Mulching: A Guide To Managing Organic Yard Waste," Minnesota Extension Service. No date.

Rodale, J.I. *The Complete Book of Composting*. Rodale Books. Emmaus, PA. 1971.

Solid Waste Composting Council. *Potential U.S. Applications for Compost*. November 1991.

ACTIVITY ONE

Composting: A Symphony Composed — And Decomposed — By Mother Nature

Objectives

Define composting.

List and explain the four factors required for successful composting.

Distinguish between compostable and noncompostable materials.

Materials

Copy Master, "What Makes Composting Work?"

Composting Glossary of Terms

Approximate Time Required: 1 class period

Procedure

1. Introduce the concept of composting through guided class discussion. (Refer to the background information provided in the sections titled **What Is Composting?** and **How Does Composting Work?** on pages 2 and 3 of this booklet.) Copy and distribute the Composting Glossary of Terms. Discuss any terms that are new to students.

2. Ask students to give examples of composting that occur in nature. Do any of their families compost? What goes into their compost pile? Are there any materials that should not be composted? That will not compost? Why?

3. Copy and distribute "What Makes Composting Work?" Review each of these factors and query students on what biological principles are at work with each. Do these factors apply to both organic and inorganic material? Why would they not apply to inorganic material? What kinds of organic materials would seem most suited to composting? Refer students to the list of organic materials on "What Makes Composting Work?"

4. Discuss with students whether they think these same principles of composting that work in your backyard and in nature would work on a very large scale. Why or why not?

ACTIVITY TWO

From Backyard to Big Time

Objectives

Identify and calculate the percentage and weight of the organic, compostable portion of the waste stream.

Identify municipal solid waste composting as a way to reduce by up to 60 percent the amount of solid waste that is landfilled or incinerated.

Identify and explain the major steps in a municipal composting system.

Materials

Wall Poster, Municipal Solid Waste Composting Process

Approximate Time Required: 1–2 class periods

Procedure

1. Introduce the concept of municipal solid waste (MSW) composting. Solicit student responses to the idea of MSW composting. In *Decision: Earth*, we studied the life cycle of consumer products and examined what ultimately happens to many of them. We have also talked about where we'll be putting these consumer products and the rest of our garbage when there is no more landfill space. How much garbage can we realistically expect to recycle? (Share the information in Figure 1 on page 2 with students or reintroduce the pie chart, "What's In The Garbage," from the overhead transparency master included in this package.)

2. Ask students to classify each category of waste material as compostable or noncompostable. List them on the board in two columns. What percent of the waste stream does each material comprise? What is the tonnage of each? Have students compare the percentages and weights of the organic and inorganic materials in the waste stream.

3. On a national scale, what do we do with most of our garbage today? (Landfill - 80%) From the figures on the board, how much of our garbage is recyclable? How much is compostable? How much could be either recycled *or* composted? Have you ever thought of composting as recycling? Can composting be considered a form of recycling? Why or why not?

4. In Europe and the Middle East, composting is considered an effective way to manage large volumes of garbage. Why is composting not yet as popular in the United States? Introduce, through guided class discussion, the MSW composting process, referring to information provided in **How Does MSW Composting Work?** on pages 3-4 of this booklet. Use the wall poster for visual reference.

5. Query students on the importance of each step in the MSW composting operation: Why are presorting and separation important steps in the composting process? (Removes noncompostables, valuable resources and potentially hazardous material that may contaminate the compost product or reduce its quality later on.) Where would presorting, separation and recycling operations be most likely to occur? (Curbside, waste-to-energy and composting facilities.) Why do temperatures

rise during the composting process? (Biological heat from the decomposition process.) What happens when the compost pile heats up? (Weed seeds and pathogens are destroyed.) What is the purpose of "curing" compost? (To further insure the effects of the completion of the biological decomposition process.)

ACTIVITY THREE

To Rot Or Not To Rot

Objectives

Develop familiarity with the biodegradation process that takes place in a composting system.

Design, plan and construct a composting system.

Determine appropriate materials for composting.

Materials

Composting information for your area may be obtained from most local County Extension Offices or Agents.

Graph paper, rulers, pencils.

Compost construction materials (optional) will vary, depending on the system students select.

Approximate Time Required: 1–2 class periods

Procedure

1. Does composting *really* work? The best way to find out is to try composting! There are many different types of composting systems and ways to compost. Some are more efficient than others. Contact your County Extension Office for information about composting. The composting information you obtain from your County Extension Office will be geared to composting in your community.

2. If you plan for students to conduct a full-scale composting experiment, first prearrange with your school principal and grounds maintenance staff to set aside space to do so. (Suggest that the end-product be used for beautification projects around the school.)

3. Review the composting informatior. ordered from your County Extension Office. Copy and distribute the information to students. Consider inviting your Co inty Extension agent to speak to the class about composting in your area, or arrange for a field trip to see composting in process. Many County Extension facilities maintain a compost system and welcome visitors.

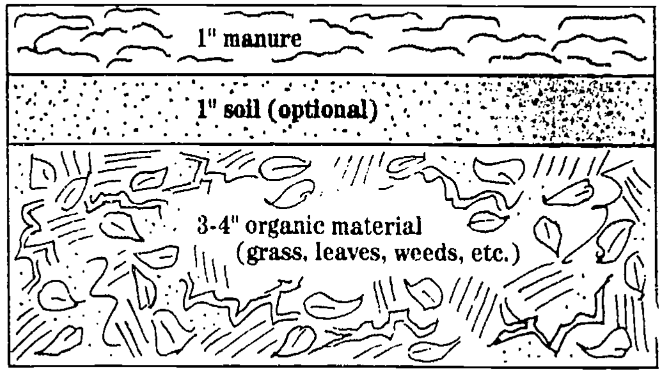
4. Students may work independently or in groups, at your discretion, to design, plan and build a compost system. Remind students that there are many factors to consider in the selection and design of composting systems. Have students draw and plan their system design on graph paper, and determine all the necessary building materials they will need. As part of their design process, encourage them to use *recycled / reused* materials. Final projects should include a scale drawing of their system, a listing of all building materials needed, estimated cost to construct, provisions for reducing the particle size of compostable material, aeration and turning mechanisms, and a list of compostable materials.

5. Have students present their designs on poster board and have the class vote on the system they will construct, maintain and monitor.

Extension

Arrange with student volunteers (or the Industrial Arts teacher as a cooperative learning activity) to construct the class' compost system. Supervise the selection of organic matter that will be composted and student preparation of the compost materials and the layering process. Refer to Figure 2 and the worksheet, "What Makes Composting Work?"

FIGURE 2 Layering the Compost Pile



Moisten each layer as you build your compost pile.

If space permits, consider constructing more than one compost system to encourage comparing different combinations of materials, systems or other control factors that may affect the rate of decomposition and the end-product. If this is not possible, students with a high interest level may wish to start their own backyard compost system and conduct an independent study to contrast their results with those of the class.

ACTIVITY FOUR

Up Close and Personal

Objectives

Maintain a compost system.

Use the scientific method to monitor the compost system.

Use scientific equipment and tools to conduct and monitor the composting experiment.

Use scientific equipment to observe and properly identify organisms and microorganisms present in a compost system.

Materials

Copy Master, "Composting Data Sheet"

Copy Master, "Up Close And Personal" (organism and microorganism ID chart)

Shovel, hoe (to turn the compost pile)

Looseleaf data notebook

Compost sample testing kit:

- Clean baby food jars for collecting compost samples
- Water (preferably distilled)
- Candy or meat thermometer
- Moisture gauge (available in garden shops for under $3.00)
- Measuring tape
- Paper and pencil
- Cardboard box to hold all of the above

Microscope and slides or Berlese funnel* and hand lens

* Instructions on constructing a Berlese funnel can be found in many Biology textbooks.

Approximate Time Required: 20 – 25 minutes, twice weekly for rotating teams of 2 – 4 students.

Procedure

1. If you are conducting this ongoing composting experiment as a class project, have students, working in teams of two or four, take turns gathering data and monitoring the compost system. Set up a sample testing "kit". See materials list above. To ensure consistency and ease of use, you may set up your notebook in two sections: "Composting Data Sheet" and "Up Close And Personal" (for drawing of organisms and microorganisms observed by each team). Review with students at the start of the experiment the importance of accuracy and consistency in recording data.

2. Twice each week, when student teams turn the compost, they will record internal temperature and moisture level of the compost pile, take a physical measurement of approximate volume, and collect a small (one tablespoon) sample of composting material in the jar for observation.

3. Depending on your available equipment, each team will use the Berlese funnel and hand lens or prepare a slide of compost material to observe microorganisms under a microscope. Student teams will draw the organisms they observe and note the date they appeared. They will also make observations about the physical appearance of the composted material to the naked eye in terms of color, texture and apparent rate of materials decomposition.

4. At the conclusion of the composting experiment, students will review and analyze data and draw conclusions. Did they note any patterns in the decomposition process that might be linked to certain factors such as temperature, type of material being composted, presence of certain organisms or microorganisms only at certain times, etc.? In what sequence did they appear? What conclusions can students make about the food chain and these microorganisms?

5. Did some materials decompose better or faster than others? To what do they attribute this — the type of material, to particle size, other?

6. What would the class conclude about the viability of composting as a way to handle large quantities of organic municipal solid waste?

Extension

If it is not possible for your school to find an outdoor space that will accommodate a full-scale composting experiment, contact Bottle Biology or the National Gardening Association for small-scale composting experiments using 2-liter soda bottles and clear plastic bags. They are listed in the **Further Resources** section on page 5 of this Teacher's Guide.

ACTIVITY FIVE

You Can Never Have Too Much Compost

Objectives

Identify applications for compost product.

Calculate the weight of compost required for various uses.

Use compost for extended classroom experiments or for a school beautification project.

Approximate Time Required: 1 class period

Procedure

1. In guided class discussion, introduce the applications — or uses — for compost. Refer to **What Can You Do With Compost?** on page 3 of this booklet. List the applications on the board and solicit examples of each from students.

2. Explain that there may be several grades of compost, depending on its intended use. Why would compost used for agricultural purposes, such as growing food, need to be of a higher quality than compost used in strip mine reclamation? (Because any soil enhancement used in agriculture may end up in the food chain.)

3. A compost plant that serves a community of 500,000 is estimated to produce about 300 tons of finished compost a day. Who could possibly use that much compost? To give students an idea of the amount of compost needed to meet the demands of agriculture and industry, present these math problems:

a) Soil erosion on American croplands is a serious environmental problem. Each year, on the 25 million acres of American cropland with the worst erosion problems, more than 375 million tons of soil are lost. If it takes 65 tons of compost to amend one acre of cropland with an inch of compost, how many tons of compost will it take to amend 25 million acres? ANSWER: 1.625 billion tons.

b) In the next 4 years, 2,000 landfills, each averaging 9 acres in area, are expected to close. These landfills will be covered with 2 feet of dirt. If compost is substituted for the dirt, how much compost will it take to cover each landfill when 1 inch of compost per acre equals 65 tons? ANSWER: 14,040 tons per landfill.

Extension

1. If you have generated a large quantity of compost, donate it to the school's grounds maintenance department, or to the agriculture department if your school has one. If you have planned the timing of your composting experiment carefully, consider bagging up your compost to sell during Recycling Month, at a Recycling Fair; or use the compost to complete a school or neighborhood beautification project.

2. Use the compost as a growing medium for flower seeds. Give a potted flower to each teacher to decorate classroom windowsills. Donate plants to your school's grounds maintenance staff for beautification.

Printed on recycled paper.

ERIC

Compost Glossary

Aerated static piles	—	A composting technique in which the organic portion of garbage is formed into piles that are mechanically aerated. The piles are placed over pipes which are connected to a blower that supplies air for the aerobic (oxygen-loving) organisms that turn wastes into compost. The controlled air supply makes possible the construction of large piles, decreasing the amount of land needed.
Aeration	—	The process of exposing bulk material, such as compost, to air. *Forced aeration* refers to the use of blowers in compost piles.
Aerobic	—	A biochemical process or condition occurring in the presence of oxygen.
Anaerobic	—	A biochemical process or condition occurring in the absence of oxygen.
Co-composting	—	Simultaneous composting of two or more diverse waste streams.
Compost	—	The relatively stable decomposed organic material resulting from the composting process. Also referred to as humus.
Composting	—	The controlled biological decomposition of organic solid waste under aerobic conditions.
Curing	—	The final phase of composting. Microbial activity continues, but at a slower rate. As the compost cures, less heat is generated by the microorganisms, and the pile begins to cool down. Curing can take from several days to months.
Heavy Metals	—	Hazardous elements including cadmium, mercury, and lead which may be found in the waste stream as part of discarded items such as batteries, lighting fixtures, colorants and some inks.
High Grade Paper	—	Relatively valuable types of paper such as computer printout, white ledger, and tab cards. Also used to refer to industrial trimmings at paper mills that are recycled.
Humus	—	Organic materials resulting from the decay of plant or animal matter. Also referred to as compost.
Inorganic waste	—	Waste composed of matter other than plant or animal (i.e., contains no carbon).
In-Vessel Composting	—	A composting method in which the compost is continuously and mechanically mixed and aerated in a large, contained area.
Microorganisms	—	Microscopically small living organisms that digest decomposable materials through metabolic activity. Microorganisms are active in the composting process.
MSW Composting	—	Municipal Solid Waste Composting — The controlled degradation of the organic fraction of municipal solid waste including some form of preprocessing to remove non-compostable inorganic materials.
Organic Waste	—	Waste material containing carbon. The organic fraction of municipal solid waste includes paper, wood, food wastes, plastics, and yard wastes.
Pathogen	—	An organism capable of causing disease.
Refuse-Derived Fuel (RDF)	—	Product of a mixed waste processing system in which certain recyclable and non-combustible materials are removed, and the remaining combustible material is converted for use as a fuel to create energy.
Sludge	—	A semi-liquid residue remaining from the treatment of municipal and industrial water and wastewater. Often used in co-composting operations.
Windrow	—	A large, elongated pile of composting material which is turned and aerated to provide optimum conditions for biodegradation to occur.

··Y BE REPRODUCED

"WHAT MAKES COMPOSTING WORK?"

Requirements for Composting

Decomposition of organic material in the compost pile is dependent on maintaining microbial activity. Any factor which slows or halts microbial growth will also impede the composting process.

Aeration: Oxygen is required for microbes to decompose the organic wastes efficiently. Mixing the pile once or twice a week will provide the necessary oxygen and significantly hasten the composting process. A well mixed compost pile will also reach higher temperatures which will help destroy weed seeds and pathogens.

Moisture: Adequate moisture is essential for microbial activity. Water the pile periodically to maintain a steady decomposition rate. Enough water should be added to completely moisten the pile. Excess water can lead to anaerobic conditions which slow down the degradation process and cause foul odors. Avoid overwatering.

Particle size: The smaller the size of organic wastes, the faster the compost will be ready for use. Smaller particles have much more surface area that can be attacked by microbes. In addition to speeding up the composting process, shredding will reduce the initial volume of the compost pile.

Temperature: An actively decomposing compost pile will reach 130°–160°F in the middle. Turning the pile exposes seeds, insect larvae and pathogens to these lethal temperatures. When temperatures in the center begin to cool, turn the pile to introduce oxygen and undercomposed material to the center to regenerate heating. The composting process is complete when mixing no longer produces heat in the pile.

What can go into the backyard compost pile?

- vegetable peelings and seeds
- fruit peelings and seeds
- coffee grounds
- tea leaves
- eggshells
- nutshells
- hay or straw
- grass clippings
- leaves
- wood ashes
- sawdust
- wood chips
- garden weeds
- tree and shrub clippings
- shredded paper

DO NOT ADD ANY FOOD SCRAPS THAT COME FROM ANIMALS, SUCH AS MEAT, BONES, OIL OR FAT, OR ANY DAIRY PRODUCTS SUCH AS BUTTER OR CHEESE. THESE MAY ATTRACT VERMIN.

Troubleshooters Guide

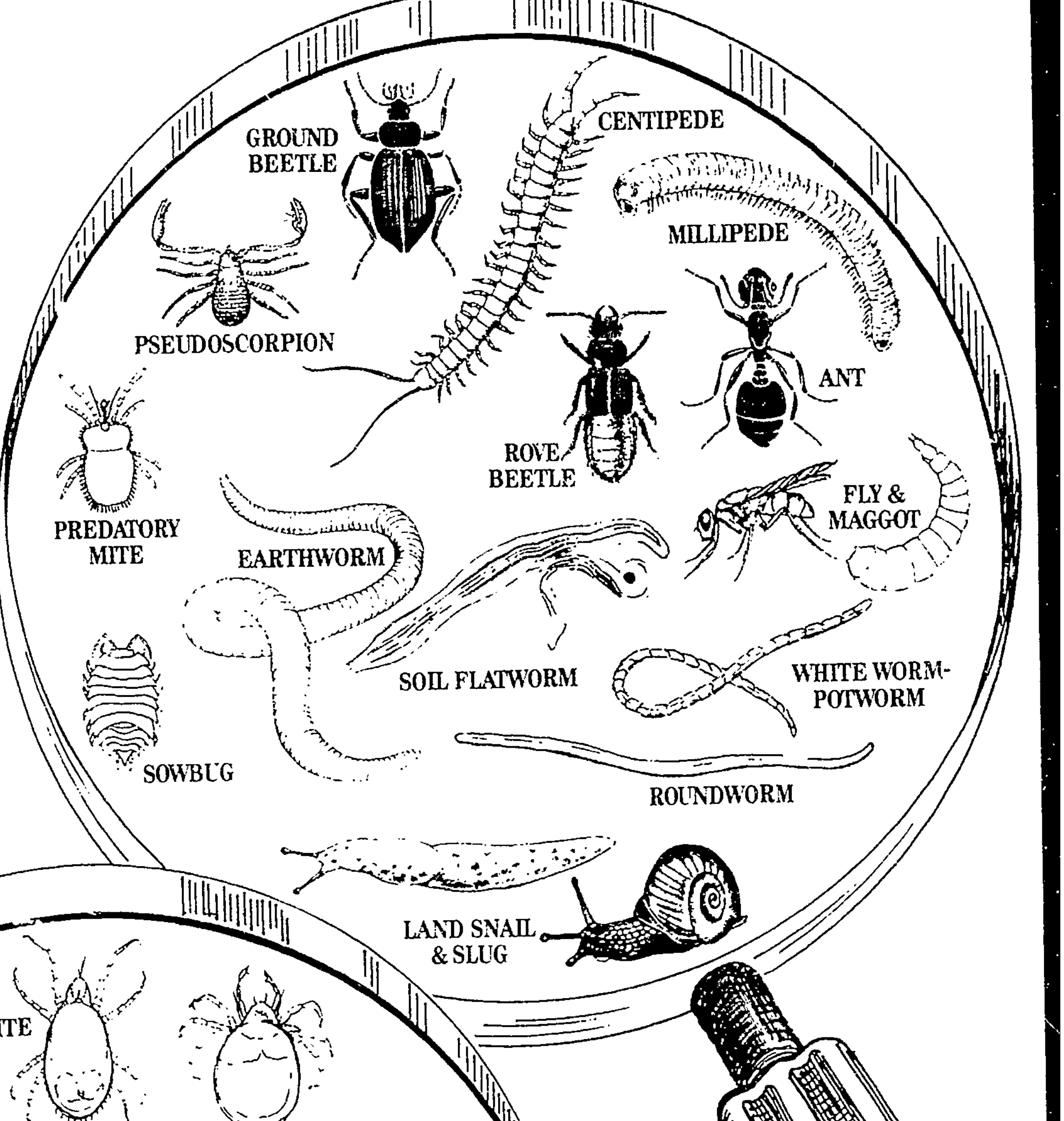
SYMPTOM	CAUSE	WHAT TO DO
Anaerobic odor (smells like rotten eggs, vinegar, or rancid butter)	Excess moisture	Turn pile; add straw, sawdust or wood chips; provide drainage
	Pile too large	Make pile smaller
	Temperature greater than 140°F	Turn pile
	Compaction	Turn or reduce pile size
	Excess nitrogen	Add straw, sawdust or wood chips
Low temperature	Pile too small	Add more compost materials
	Pile too dry	Add water while turning
	Poor aeration	Turn pile
Moist but will not heat up	Insufficient nitrogen	Add grass clippings, manure or other nitrogen source
High temperature	Pile too large	Reduce size
	Compaction	Turn pile
Rats and other animals	Presence of meat or other animal products	Remove garbage, or use rat bait; enclose pile

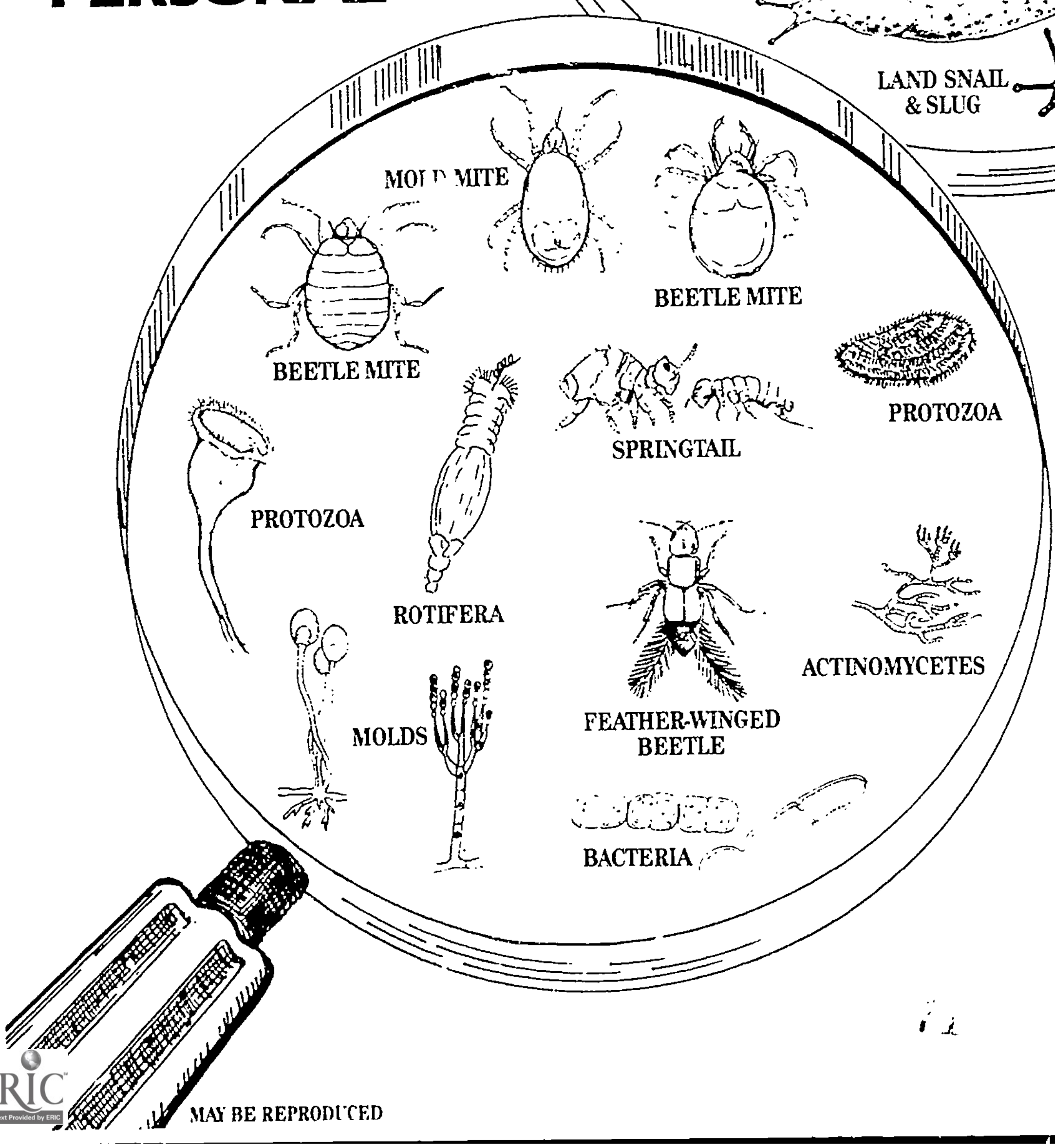
COMPOST DATA SHEET

DATE	AMBIENT TEMPERATURE	COMPOST TEMPERATURE	MOISTURE LEVEL	DIMENSION OF PILE	TYPES/MICRO-ORGANISMS	NOTES	INITIALS

BE REPRODUCED

"UP CLOSE AND PERSONAL"





MAY BE REPRODUCED

THE PROCTER & GAMBLE CO.

Now it's time to give the school a test!

As a result of learning about life cycle assessment, students should be capable of identifying waste that is generated and wasteful behaviors they observe. For the Clean S.W.E.E.P. (Schools with Excellent Environmental Practices) contest, students put their new knowledge to work by conducting a waste audit to observe and evaluate energy usage, solid waste generation and wasteful behaviors at school. Then, they can recommend specific plans for their school to become more environmentally responsible. This activity will help reinforce the idea that everyone can play a role in defining and implementing solutions.

Contest entries will be judged by a panel of experts including representatives from the Partnership for Plastics Program, the Solid Waste Composting Council, The National Science Teachers Association, the National Council for the Social Studies, Chemical Education for Public Understanding Program and Keep America Beautiful, Inc. A total of nine winning classes will be selected. Three cash prizes will be awarded at each grade (7-9) level to help students put their plans into action.

Clean S.W.E.E.P. Prizes

Three Grand Prizes	**$500 each**
Three First Prizes	**$250 each**
Three Second Prizes	**$100 each**

Total Prizes $2,550

Judging will be based on creativity, appropriateness to environmental issues and effective use of materials submitted. Students are encouraged to use any medium which best represents current practices and demonstrates the recommendation for improvement.

Official rules, an entry form and instructions are in this brochure.

Clean S.W.E.E.P. Contest

Official Rules

WHO CAN ENTER THE CONTEST

This contest is open to 7, 8 and 9 grade classes as of August 1, 1992, in schools located in the 50 United States and the District of Columbia. Contest is void where prohibited by law. All federal, state and local laws and regulations apply.

HOW TO ENTER THE CONTEST

Each class' submission must include a separate official entry form, a photocopy of the form or plain piece of 8½" x 11" paper on which the following information is provided (hand printed or typed only):

School's name, complete address and phone number.
Teacher's name, class subject and grade level.
Teacher's signature.

WHAT THE CLASS NEEDS TO DO TO ENTER THE CONTEST

Each class will work together to conduct a waste audit for their school and then make a recommendation for improvement. The recommendation should describe a current practice, then recommend how it could be changed to be more environmentally sound.

The class should submit an essay of no more than 1,000 words (two–three double-spaced typewritten pages, six–eight handwritten pages) and may accompany it with photographs, videos or other illustration to communicate their ideas.

All entries will be judged on practicality, originality and thoughtfulness, rather than the visual polish of the presentation.

To get started, turn to page 3 which gives instructions for the waste audit.

WHERE TO MAIL COMPLETED ENTRY

All entries should be mailed to: "Clean S.W.E.E.P." Contest, P.O. Box 4008, Blair, NE 68009. Entries must be postmarked between September 1, 1992 and December 29, 1992 and received by January 4, 1993. Procter & Gamble and D.L. Blair assume no responsibility for lost, late or misdirected mail.

JUDGING AND CRITERIA

Preliminary judging will be conducted under the supervision of D.L. Blair, Inc., an independent judging organization whose decisions are final on all matters relating to this contest. Entries must be original and not previously published. Judging will be based on the following criteria: creativity - 30%; appropriateness to environmental/recycling issues - 50%; practicality - 20%. Final judging to determine nine prize winners will be accomplished by a panel of experts under the supervision of D.L. Blair, based on the above criteria. All entries become the property of Procter & Gamble and will not be returned.

PRIZES

All nine prizes with a total value of $2,550 will be awarded as follows: 3 Grand Prizes (one for each grade level) - $500 each. 3 First Prizes (one for each grade level) - $250 each. 3 Second Prizes (one for each grade level) - $100 each. Limit one prize per class. No substitution of prize permitted. In case of ties, duplicate prizes will be awarded. All prizes will be awarded to the winning class' school. All federal, state and local taxes (if any) will be the responsibility of the winning school.

WINNER NOTIFICATION

Winners will be determined and notified by D.L. Blair on or about April 1, 1993. Potential winners may be required to execute an affidavit of eligibility within 14 days of notification. Noncompliance within this time period will result in disqualification and an alternate will be selected.

For the names of winning schools, send a separate, self-addressed, stamped, #10 envelope to: "Clean S.W.E.E.P." Winners, P.O. Box 4011, Blair, NE 68009. Requests must be received by April 30, 1993.

OFFICIAL ENTRY FORM

Clean S.W.E.E.P. Contest

P.O. Box 4008
Blair, NE 68009

Please type or print the following information and return it with your entry to the address above. Entries must be postmarked between September 1, 1992 and December 29, 1992 and received by January 4, 1993. Be sure to include enough postage.

Name ____________________

Address ____________________

City ____________________ State __________ Zip __________

School Phone Number (____) ____________________

Teacher's Name ____________________

Teacher's Signature ____________________

Subject Taught ____________________

Class Grade Level (check one) 7______ 8______ 9______

INSTRUCTIONS TO THE TEACHER

PROCEDURE

1. Arrange with your principal and other staff members for teams of students to conduct waste audits for: the cafeteria; the administration offices; the library; teacher lounge; the grounds and building maintenance operations, and what is going into the dumpsters or garbage cans.
2. Students can consider: all the waste generated requiring disposal and make specific recommendations on ways to reduce waste in each of these areas; how to improve efficiency by reducing the amount of energy used or materials required to accomplish a task; what alternative materials or behaviors could be used or implemented that are more environmentally responsible; whether any source reduction or recycling measures are being used or could be improved.
3. Copy and distribute the "Clean S.W.E.E.P." Audit to students. Each team will share their findings with the entire class. Ideas are combined, amplified or eliminated until the class has agreed on their contest entry.

ERIC

Clean S.W.E.E.P. Audit

(Schools with Excellent Environmental Practices)

This is your opportunity to give your school a test instead of the other way around. And, your class can win a cash prize for recommending excellent environmental practices! You will be conducting a school waste audit. An audit is simply an examination of a particular problem. In this audit, you will work in teams to observe what waste is being generated and how it is being disposed; how energy is being used and whether the amount used can be reduced; and whether source reduction or recycling measures currently in use could be improved.

The list of questions below provide general guidelines to help you direct your thinking while you are conducting your waste audit. Don't be discouraged if people don't know all the answers.

1. Does the school or school district have any environmental guidelines?
2. How much paper is used weekly, monthly, yearly? Are both sides of the paper used? How much is recycled? Is it made from recycled paper?
3. How does the artroom dispose of mineral spirits and solvents? How do the photography classes dispose of processing chemicals?
4. Do the arts and crafts classes make projects from recycled materials?
5. What kinds of packaging and food storage containers are used in the cafeteria's kitchen?
6. Is any of the organic waste composted?
7. Is there a place at school where a compost system could be set up for organic cafeteria waste?
8. Do you use disposable or washable serving plates, eating utensils and lunch trays? Why?
9. Do the kids who bring their lunches carry them in paper bags or reusable containers?
10. Do you have a microwave oven at school? How is it used in meal preparation?
11. Are the school grounds landscaped to reduce soil erosion and to provide shade?
12. How much water does the school use each year? Do the gym showers have water-restrictors? Can the toilets be adjusted to use less water per flush? Can xeriscaping be planned to reduce the amount of water used for grounds maintenance?
13. How much energy is used each year? Does maintenance use energy-saving fluorescent bulbs? Do people turn off lights when no one is in the room?
14. How many students ride the bus to school? Car pool? Bike? Walk? Is there a car-pool system that could get people who need rides in touch with each other?
15. What does the grounds maintenance staff do with grass clippings? Tree and shrub trimmings?
16. Does your school have an adequate number of trash cans? Are they conveniently located to encourage usage?

There may be other questions that come to mind as you conduct your audit. The secret to a good audit is to look beyond the obvious to spot potential "hidden" instances of waste that may be occurring.

Procter & Gamble Educational Services
MAY BE REPRODUCED.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 5899 NEW YORK, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE

ATTN DECISION EARTH
MODERN TALKING PICTURE SERVICE
5000 PARK STREET NORTH
ST. PETERSBURG FL 33709-9905

ERIC

Dear Educator:

Thank you for sharing **Decision: Earth** with students and colleagues. Please take a few minutes to complete and return this evaluation card. Your comments will help Procter & Gamble in the development of free curriculum units in the future.

Check the components you used and rate their effectiveness.

	Low				High
☐ Poster	1	2	3	4	5
☐ Teacher's Guide	1	2	3	4	5
☐ Overheads	1	2	3	4	5
☐ Student Worksheets	1	2	3	4	5
☐ Composting Supplement	1	2	3	4	5

My students plan to enter the contest. ☐ Yes ☐ No

Student behavior and school practices have changed as a result of using **Decision: Earth.** ☐ Yes ☐ No

Did you share these materials with other teachers? ☐ Yes ☐ No

If yes, how many? ________

With how many total students was the unit used? ____________

Name ______________ Subject _________ Grade _____

School ________________________________

Street Address ________________________________

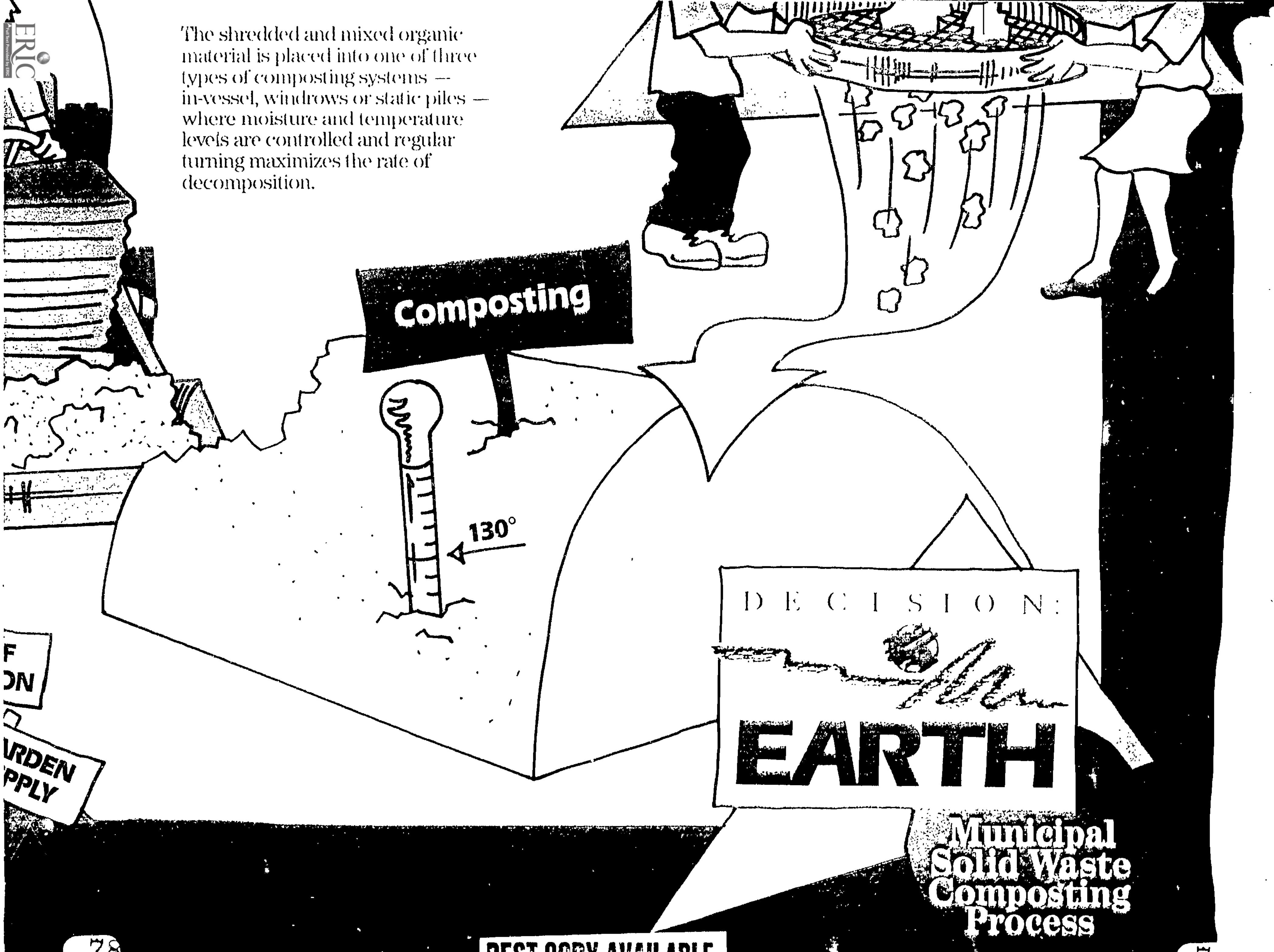
City ____________________ State _____ Zip ________

Phone ________________________________

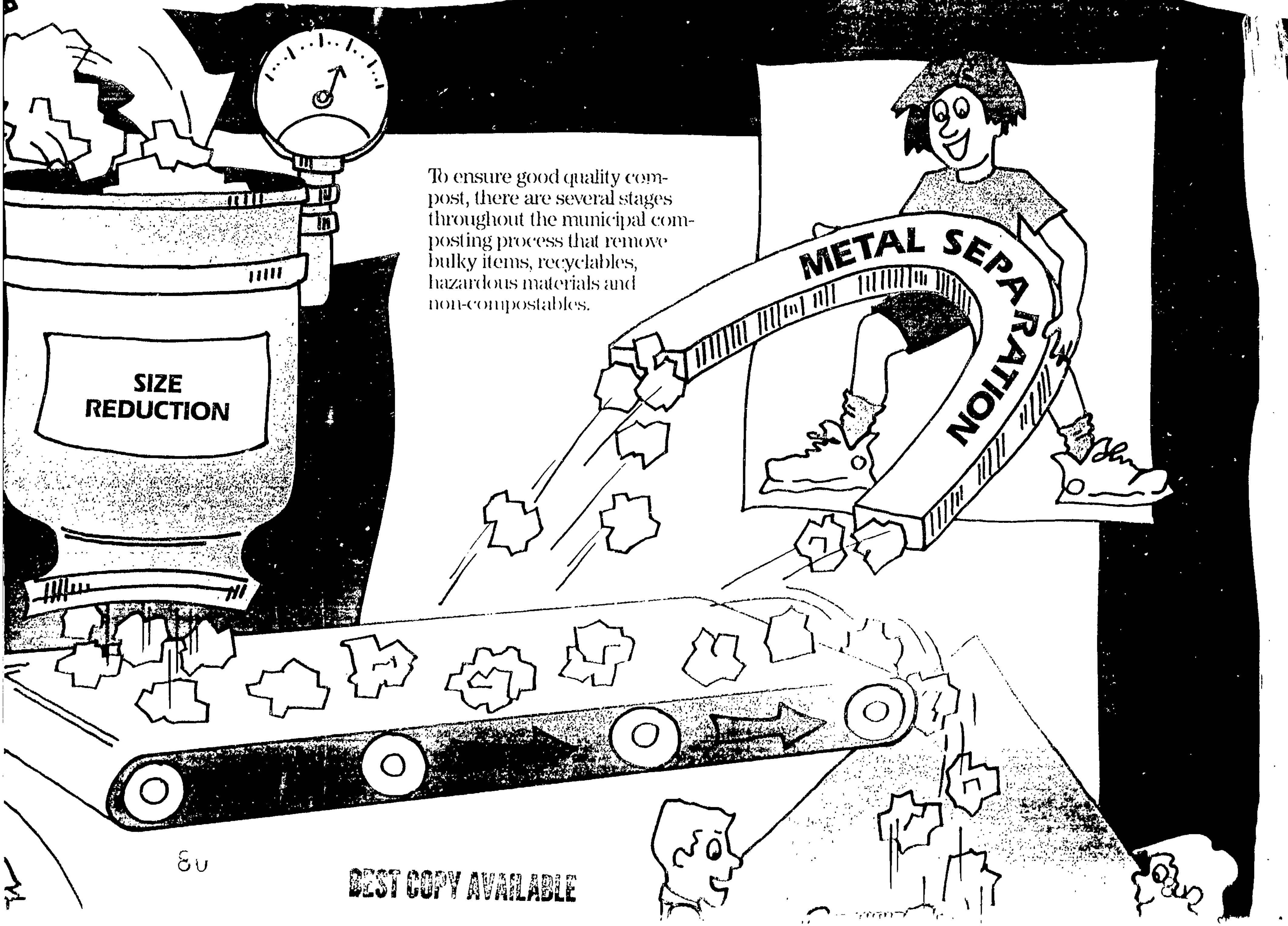
D E C I S I O N:

EARTH

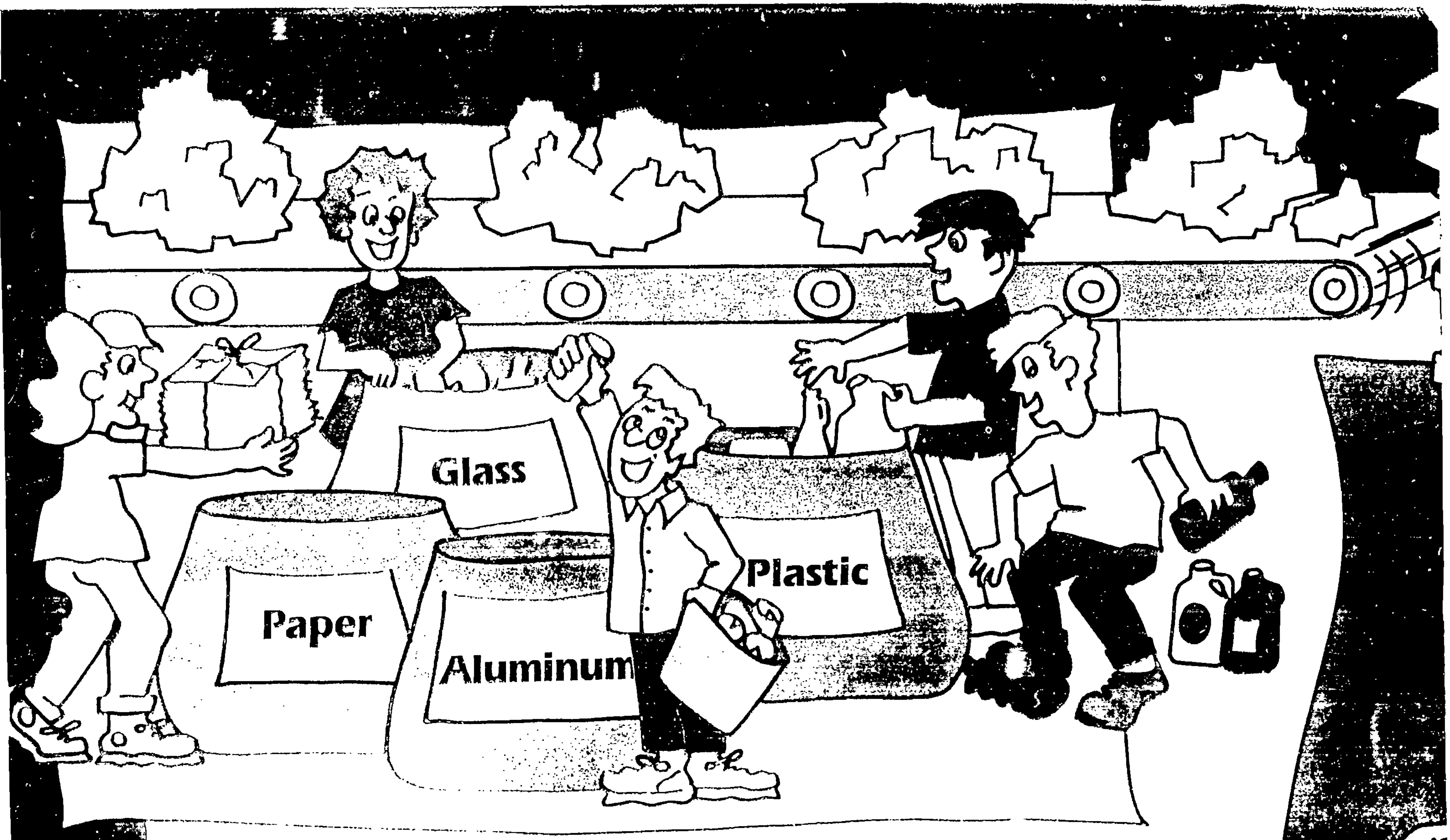
The shredded and mixed organic material is placed into one of three types of composting systems — in-vessel, windrows or static piles — where moisture and temperature levels are controlled and regular turning maximizes the rate of decomposition.



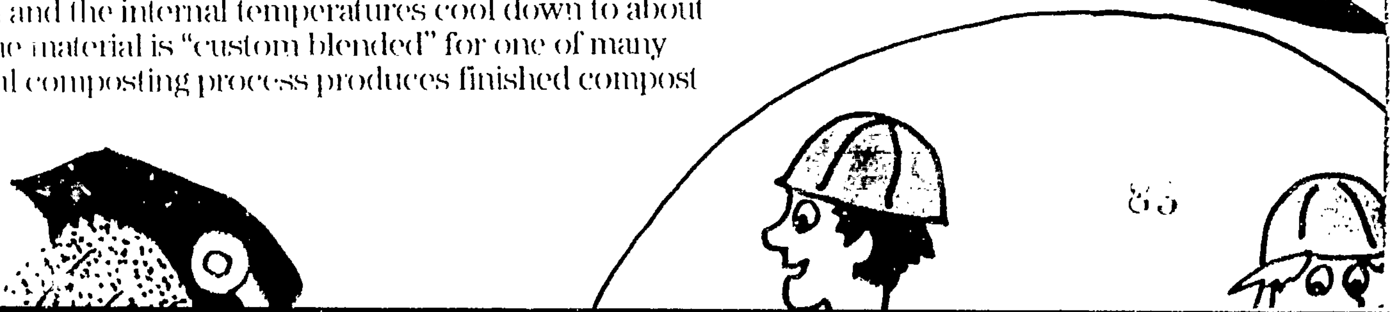
BEST COPY AVAILABLE

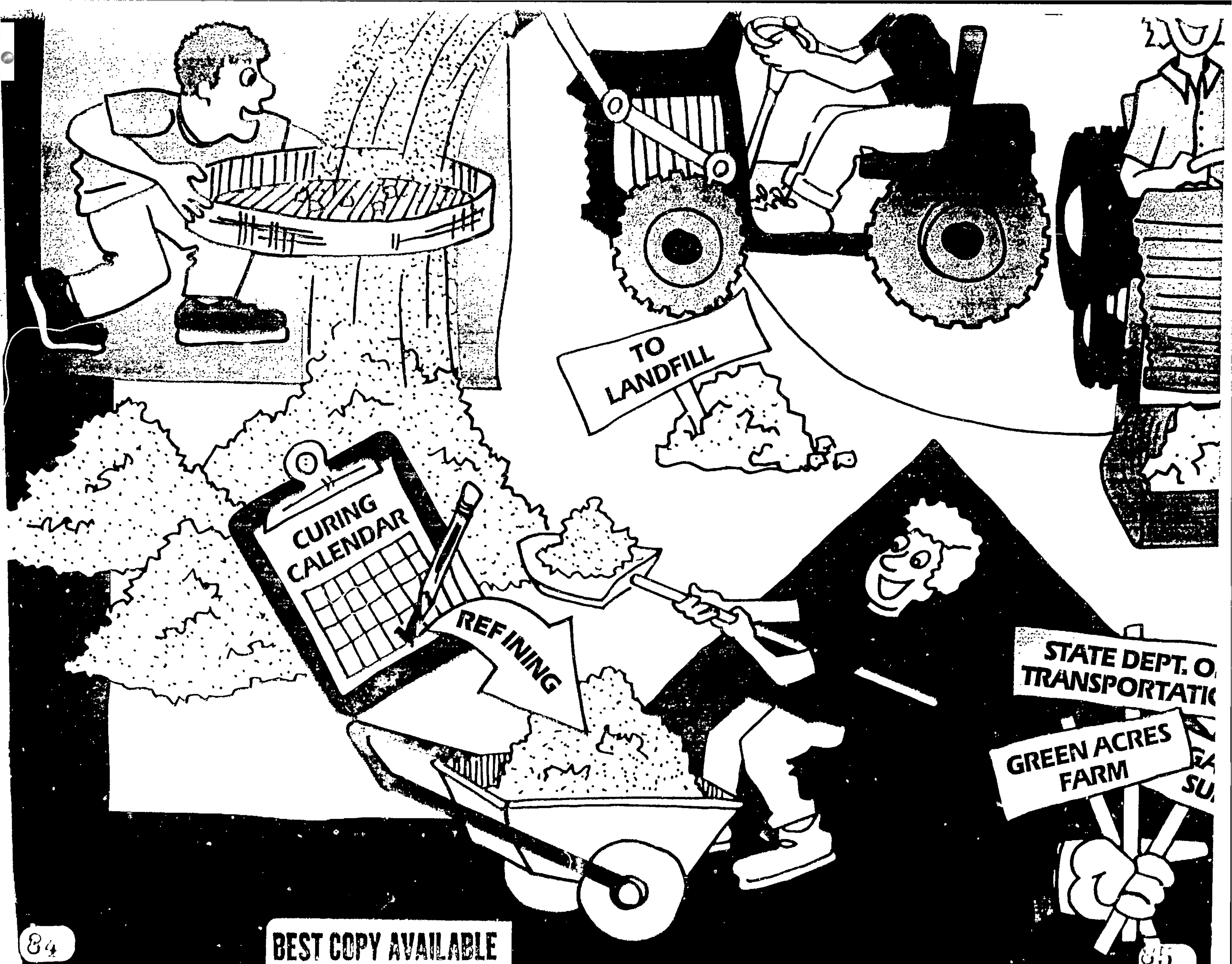


BEST COPY AVAILABLE



After the initial composting process, further screening removes traces of non-recyclables to the landfill. Compost material is "cured" when the organic material is fully degraded and the internal temperatures cool down to about 60 degrees. Sometimes the material is "custom blended" for one of many uses. The entire municipal composting process produces finished compost in about 90–180 days.





BEST COPY AVAILABLE

Procter&Gamble

EDUCATIONAL SERVICES

P.O. Box 599, Cincinnati, Ohio 45201

Printed on recycled paper.