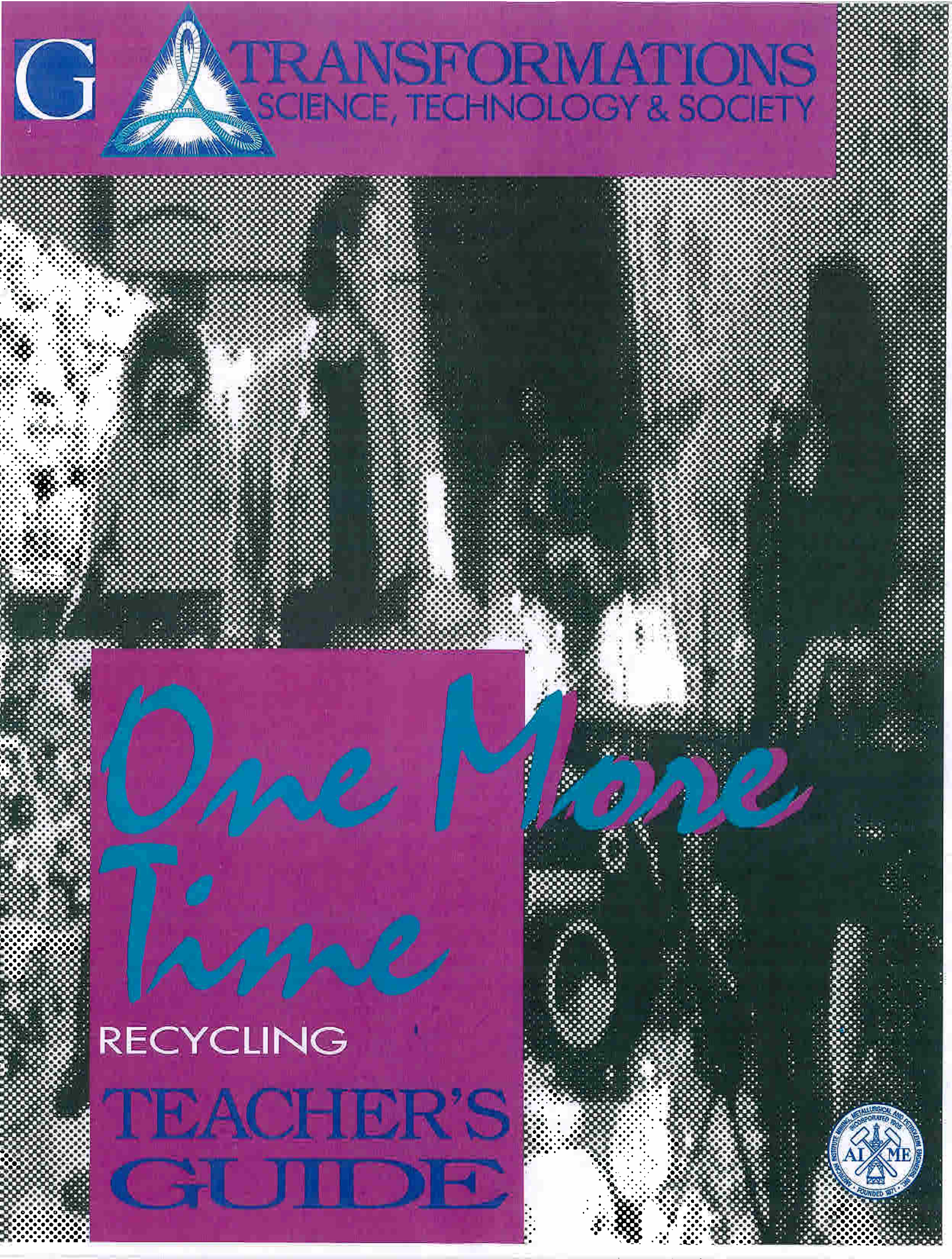
G

TRANSFORMATIONS
SCIENCE, TECHNOLOGY & SOCIETY



One More Time

RECYCLING

TEACHER'S GUIDE

AIME
AMERICAN INSTITUTE MINING, METALLURGICAL AND PETROLEUM ENGINEERS, INC.
INCORPORATED 1905
FOUNDED 1871

TRANSFORMATIONS: Science, Technology & Society

Program Goals

- ▲ to enhance and enrich science instruction in Middle School classrooms
- ▲ to explore ways that technology takes scientific knowledge and applies it to meeting society's needs and solving society's problems
- ▲ to foster among students a spirit of inquiry, encouraging and developing their problem-solving skills
- ▲ to help create citizens who are cricital thinkers, prepared to make informed decisions about complex social/technological issues that will confront them in decades to come

ONE MORE TIME

Recycling

How are technology and society dealing with the fact that each of us produces nearly one ton of solid waste yearly? The problem of waste and the need for recycling and reusing materials are the subjects of this unit; the accompanying video features visits to a couple of recycling facilities. The topics developed in this Guide are

- ▲ Waste Management
- ▲ Resources and the Environment
- ▲ Land Use

Curriculum Connections: Earth Science, General Science, Physical Science, Life Science; a social studies or literature unit on ecology or the environment

Summary of the Video

While trying to practice " Old Friend," the band finds itself overwhelmed by the trash Billy's parents want to recycle. The quartet tackles the pile.

Billy visits a recycling facility in Rhode Island, escorted by Adam Marks, a recycling supervisor. Adam explains that the plant was built with separating equipment to save people who want to recycle time and trouble. Billy watches part of the separating process, which is often quite specific. For example, some plastic used in bottles is recyclable; some is not.

Back in the garage, the band considers the value of recycling. Laurie's sentiment ("What's one plastic bag, more or less?") leads her to meet Bo Vastine, a recycling coordinator. She sees how plastic soda bottles are separated from their non-recyclable plastic bottoms and how the reusable plastic is processed into threads that become carpet fibers, filling for jackets, and other products.

The video ends with the band eating pizza and creating "new" garbage– the cycle continues.

The theme song for this unit is "Old Friends":

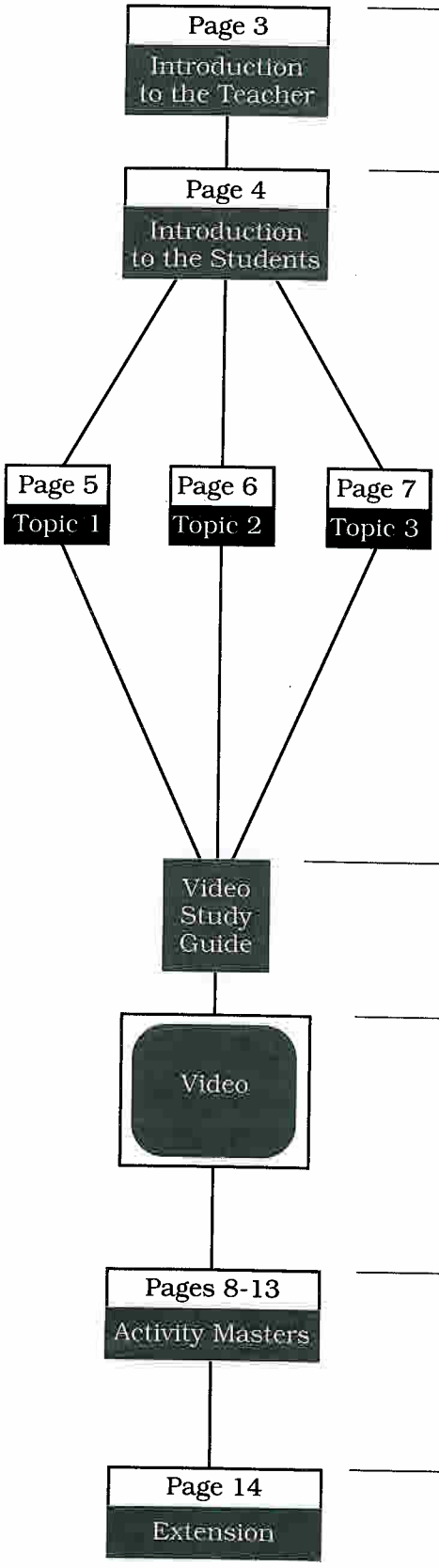
Old Friend
Will you be there to the end?
My old friend.

One way or another
You'll be there like a brother
It's hard to measure what you've meant
You're always something different

To me

My old Friend.

Suggestion for Using Unit G: "One More Time"



Here you will find additional background information on the science and technology presented in "One More Time"

This section gives you material for introducing "One More Time" to your students, including a statement of the purpose of the unit; suggestions for connecting the unit to students' experience; definitions of key concepts and terms; and directions for the Video Study Guide (see below).

These pages focus on the three topics in "One More Time": Waste Management, Resources and the Environment, Land Use. Each page furnishes options for introducing the topic to students and a wide array of ways for students to respond to the topic, including labs that are carried out through the Activity Masters.

Choose any of the topics as your focus, depending on where you are in the curriculum.

You can use the video guide (Activity Master 1) to focus students' attention on and check their comprehension of the video.

Running time for the video is 18 minutes. You may want to preview the video and choose a Stop Point for conducting a discussion, carrying out an activity, or making a comprehension check. The video may also be show straight through.

The first blackline master is the Video Study Guide for "One More Time". The other masters give students hands-on opportunities in the form or activities and labs.

This final section includes suggestions for science fair projects and research topics, ones that build on concepts explored in "One More Time". Also listed are related resources for interested students to pursue, including book titles and organizations to contact.

One More Time: An Introduction for the Teacher

"One More Time" explores how our society is dealing with the enormous amount of solid waste it generates.

Below is a more detailed explanation of concepts presented in the video and developed in this Guide.

Why do we have a solid waste problem?

The United States produces more domestic trash per person (an average of five pounds a day, nearly a ton year) than any other nation in the world. Product packaging makes up about one-third of the household waste in our waste stream. The traditional ratio for trash is 80% going into landfills, 10% incinerated, and 10% recycled.

However, landfills are now closing at a rate of nearly one per day. Some close because they are full, others because they have been found to be leaking into the groundwater. Few new landfills are being developed—land is scarce; people campaign against landfills in their neighborhoods; because of new stringent standards, landfills are costly. As a result, garbage disposal is now an interstate business. Philadelphia, for example, has been shipping its solid wastes to Ohio and southern Virginia for years.

What is a sanitary landfill?

The classic town dump was a foul-smelling, vermin- and disease-infested open pit. The trash brought each day to a sanitary landfill is compacted by heavy machinery and covered with roughly six inches of dirt. This dirt layer reduces odor and keeps lightweight trash from blowing about; the daily layering discourages rat communities from digging tunnels for living and reproducing. In addition, the bottom and sides of the landfill are usually lined with plastic or clay; this liner prevents groundwater contamination.

Newly compacted biodegradable trash begins to decay immediately because aerobic microorganisms are present in the dirt covering. This chemical reaction creates heat, which kills the bacteria and uses up the oxygen. Anaerobes, which flourish in the absence of oxygen, continue breaking down the garbage. During this process, several gases are given off; some 50-60% of this gas production is methane.

Methane can be explosive under certain conditions, but it can also be an asset. Technologies have been developed to collect landfill gas for use in boilers and turbines to generate electric power.

What is a resource recovery plant?

These incineration plants are also referred to as waste-to-energy or trash-to-energy plants. A ton of waste burned here can produce about 500 kilowatt hours of electric power. The residue can produce recyclable ferrous scrap material and other material that can be used in building roads. Ideally, only 50 pounds out of the original ton end up as ash to be disposed of. However, this ash may contain high concentrations of dangerous metals that must then be safely buried in sanitary landfills.

These plants are quite different from the dirty incinerators of the past. Smokestack "scrubbers" remove 99% of the harmful particles and gases before they can enter the atmosphere. Although the plants are expensive, in areas where land is scarce, resource recovery plants may be the most economical choice.

What are the major recycling issues?

"Recycling" includes a series of processes: separating, collecting, processing, marketing, and using material that was thrown away. Most solid waste can be recycled: paper, yard waste, glass, aluminum and other metals, used motor oil, plastics. Recycling reduces our reliance on and costs less than maintaining landfills and incinerators; protects our health and environment by removing harmful substances from the waste stream; and conserves our natural resources (making an aluminum can from an old can requires 90-97% less energy than making a brand new can).

At present, the demand for recycled products in this country does not equal the potential supply. When there is no market for a recycled product, industry will not equip plants to process collected materials, which pile up or are exported to countries where large-scale recycling is well underway. Nonetheless, the EPA aims to increase the recycling proportion in the United States—from 10% of our solid waste to 25%.

ONE MORE TIME: An Introduction for Students

Introducing the Unit

Present the goals of "One More Time" to students:

- to realize why solid waste disposal is a major problem our society faces;
- to see how we are dealing with this problem;
- to understand what is involved in recycling material;
- to appreciate the economic and social factors that affect waste management, including recycling.

They should **not** feel that they must fully learn the process discussed in the video.

Connecting the Exploration to Students' Experiences

Ask students, **"How many things did you throw away yesterday? so far today?"** Point out that the United States produces more trash per person than any other nation on Earth. Ask students to guess how much solid waste, on average, each person adds to the "waste stream" each year

Nearly a ton.

Key Concepts and Terms

Students will be exploring and extending their understanding of the words listed below (in boldface) by topic area. You might write these words on the board and briefly discuss them to determine which are familiar to your students

Topic: Waste Management

- The waste we produce each day and throw away is variously referred to as garbage, refuse, trash, and **solid waste**.
- At a **MRF** (Materials Recycling Facility) solid waste is separated for processing at other plants.
- **Recycling** means separating, collecting, processing, marketing, and finally using material that was thrown away.
- **Recycling plastic** poses a sorting and separating problem. Most centers can handle only one type of plastic, and there are many different types in use, sometimes in the same product.
- Plastic bottles are made into other products; they can't be made into new plastic bottles. But aluminum and steel cans and glass bottles can be recycled to make new cans and bottles—this is **closed loop recycling**.

Topic: Resources and the Environment

- A **natural resource** is a valuable material that occurs in nature.
- The terms **renewable** and **nonrenewable** are used to categorize natural resources. Resources like sunlight (readily available) or trees (which grow quickly) are renewable. Resources like oil are nonrenewable because they are produced so slowly that they cannot possibly be replaced as quickly as they are used.
- **Nonrewable natural resources** need to be recycled or conserved to insure future availability.

Topic: Land Use

- In a **landfill**, trash is buried, not left exposed as in a dump.
- A **sanitary landfill** is one where steps have been taken to reduce potential dangers: The bottom and sides are lined with plastic or clay to prevent leakage; each day's waste is compacted and buried under a dirt layer to reduce odor, keep trash from blowing about, and to discourage rats and other pests.
- A product that is **biodegradable** can decay easily, broken down into simpler substances by microorganisms. **Nonbiodegradable** products, like most plastic items, may take thousands of years to decompose.
- Wastes buried in a landfill **may not biodegrade** as quickly as they could, since there is little or no air or sunlight present to encourage decay.
- Some solid waste can first be sent to a **resource recovery (trash-to-energy) facility** where it is burned to produce electricity; the leftover ash takes up much less space in a landfill.

VIDEO STUDY GUIDE

To focus or direct students' viewing of the video, distribute Activity Master 1, the Video Study Guide. You might have your students work individually, or small groups could each be responsible for a particular section of the Study Guide. Allow time—stopping the video at various points or after the video is over—for students to discuss their responses.

ONE MORE TIME: Waste Management

Introducing the Topic: Options

- Ask students to think back and identify what they "consumed" yesterday (threw away or bought). Would it qualify them as an "average" American, responsible for five pounds of garbage a day?
- Materials needed: **plastic bag with 5 pounds of assorted garbage.** Include recyclables, such as plastic soda bottles and aluminum cans. Try to include some "stable" organic waste, such as an orange peel. Bring the bag to class and dump the garbage out onto a table. Explain that this represents, by mass, the amount of solid waste each person is responsible for creating each day. Have students identify the sources of the garbage and decide: Which materials could be recycled? Which items could be burned?
- Materials needed: **overpackaged item, such as a new compact disk,inside a paper or plastic bag.** Remove the CD from the plastic or paper bag, and remove its cellophane wrapper. Open the cardboard sleeve, and remove the small plastic CD container. Open this, and hold up the CD—which is the item you were really buying. What is the purpose of these other materials? Is all of it necessary?

STUDENT INVOLVEMENT: OPTIONS

- Indicates an activity that would take less than a class period.
- Indicates an activity that could take most of a class period.
- Indicates an activity that would go beyond the class period.

Discuss the Video

Video Guide notes can be used to help students answer these and other straight forward questions:

- The recycling plant was built with separating equipment. What does this equipment do? How does this encourage recycling?

  Sorts the trash; makes recycling easier and more convenient.

- Bo Vastine, the recycling coordinator, explains how they recycle plastic soda bottles. What is the problem involved in handling a plastic soda bottle?

  Made of 2 different plastics—the base cup plastic is not reusable but it's glued too tightly to pull off.

- How does the reusable plastic look when it is last seen at the recycling plant? What will happen to it next?

  In threads; made into geotextiles, carpet, furniture padding, pillow stuffing, fiber fill.

- Why does Laurie say, as the band eats pizza and drinks soda, "we're right back where we started"?

  They've just gotten rid of the trash, and now they're creating new trash.

Group Discussion: Possible Topics

- America has been called "the throwaway society." Does this name fit? Why?
- In the next few years, the Environmental Protection Agency wants to raise the amount of solid waste we recycle from 10% to 25%. Do you think this is possible? Why or why not?

Brainstorming: School Suggestions

Have students work in groups to think of the types of solid wastes generated at school. Ask them to come up with ways to reduce the school's waste stream. For example, what types of trash could be recycled? (*e.g.*, copier paper, newspaper) What items might be eliminated or replaced with reusable items? (*e.g.*, disposable foam cafeteria trays; teachers using mugs instead of paper cups for beverages) If any suggestions seem feasible, students might start a school-wide campaign to make the suggestion a reality.

Activity: How Much Garbage Is That? (Activity Master 2)

Before students begin, explain that the 5 pounds per day average includes waste you didn't handle directly—some was made getting an item you bought that day into your hands. After students complete the sheet, have them compare responses and share the images they came up with to demonstrate the amount of garbage their town generates in a year.

Answers: 1. 5x7=35 lb.; 2. 5x 365=1825 lb.; 3. number in family x 1825; 4. number in class x 1825; 5 . town population x 5; x 365; 6. divide #5b by 2.2; 7. divide #6 by 500; 8. multiply #5b x 110; 9. examples will vary.

Activity:The Price of Packaging (Activity Master 3, 2 pp.)

This master is set up to be done outside the classroom, with students checking items in a food store or in their pantries. You may prefer to bring several items into class for students to use instead. After students have compared their responses, you may want them to actually design the packaging they describe in question 5.

ONE MORE TIME: Resources and the Environment

Introducing the Topic: Options

- Have students come up with a working definition for **natural resources, renewable** and **nonrenewable** (presented on Guide page 3). Work with them to create two webs—one for renewable natural resources and one for nonrenewable.
- Lead the class in a discussion of the relationship between natural resources and the environment. Here are some points to consider: Is the supply of natural resources unlimited? What determines who uses which natural resource? Because a resource is natural, does that mean its effect on the environment is always positive?
- Materials needed: **manufactured item with several parts, such as a flashlight.** Take the item apart in front of students, and ask them to identify the materials used to make the parts. Which came from renewable natural resources?

STUDENT INVOLVEMENT: OPTIONS

Indicates an activity that would take less than a class period.

Indicates an activity that could take most of a class period.

Indicates an activity that would go beyond the class period.

Discuss the Video

Video Guide notes can be used to help students answer these and other straightforward questions:

- Some material sent to the recycling plant Billy visits goes to the landfill next door. Why?

  Plant doesn't recycle it—lacks the technology or the potential market.

- What happens to aluminum cans when they are recycled? Why does Adam Marks, the recycling supervisor, say they are the most valuable material?

  Recycled into new aluminum worth $1000/ton, taking only 5% of the energy needed to make aluminum from ore.

- Why does Laurie say, as the band eats pizza and drinks soda, "we're right back where we started"?

  They've just gotten rid of the trash, and now they're creating new trash.

Group Discussion: Possible Topics

- Is sending something to a waste-to-energy plant (see Guide page 3) a form of recycling? Why?
- Virtually all gold is recycled and much steel. Only a small amount of newsprint is actually recycled. Why?

  Points to consider: market and profitability, the fact that there is a large paper/forest-based industry in this country, trees are renewable resources.

- The U.S. has 6% of the world's population but uses 40-50% of the world's nonrenewable resources. Why? Is this fair to the rest of the world?

Debate: Mandatory Recycling

The U.S. recycles only about 10% of its trash. Japan has mandatory (required) recycling that reuses 50% of its trash, and several European countries have had similar results with mandatory recycling. Invite students to debate this statement: The United States should have mandatory recycling.

Activity: From Nature to You

Divide students into brainstorming groups, and challenge them to come up with a common object composed of several materials made from various natural resources. (A 21-speed bicycle could be used as an example, if needed.) Students should list the materials in the object, categorizing them as renewable or nonrenewable natural resources and noting which materials are recyclable. Bring the groups together to compare the results of their brainstorming.

Activity: Estimating Trash

Have students estimate the amount of trash the school throws out each day. They could begin by collecting a day's worth of classroom trash and, if no scale is available, compare the mass to a stack of textbooks. They multiply this weight by the number of classrooms in the school, adding an extra classroom to account for trash contributed by the administration. How much garbage is produced each day? Week? School year? Have students use the formula for the volume of a cylinder to find the volume of trash per school trashcan. How much trash is created by volume each day? Week? School year?

Homework: A Fluid Tale

Remind students that water is a renewable resource. Have them write a short story that follows a molecule of water from the time it falls in a raindrop onto a mountaintop until it evaporates from the ocean.

ONE MORE TIME: Land Use

Introducing the Topic: Options

- Explain that in the old days, when people wanted to dispose of trash, they threw it in the town dump. Have students comment on why such a practice no longer makes sense.
- Have students explore what it means to "throw something away" by coming up with possible scenarios for what happens to a candy wrapper after it has been thrown into a wastebasket.
- Divide students into brainstorming groups, and ask them to develop a list of problems involved in disposing of solid waste. Ask them to create a corresponding list of ways to help solve each problem. Bring the groups together to compare lists.

STUDENT INVOLVEMENT: OPTIONS

Indicates an activity that would take less than a class period.

Indicates an activity that could take most of a class period.

Indicates an activity that would go beyond the class period.

Discuss the Video.

Video Guide notes can be used to help students answer these and other straightforward questions:

- The recycling plant Billy visits was built with separating equipment. What does this equipment do? How does this encourage recycling?

  Sorts the trash; makes recycling easier and more convenient.

- Some material sent to the recycling plant goes to the landfill next door. Why?

  Plant doesn't recycle it—lacks the technology or the potential market.

- Why does Laurie say, as the band eats pizza and drinks soda, "we're right back where we started"?

  They've just gotten rid of the trash, and now they're creating new trash.

Group Discussion: Possible Topics

- Discuss biodegradation (see Guide page 3)—do items in a landfill biodegrade? What problems are caused in landfills by biodegradation? Why are disposable diapers a waste disposal problem?
- How does nature recycle? Can society uses naturally recycled products? (example: Organic matter decomposes through bacterial action; so does metal, with rust returning iron the the soil. However, the material left over is unlikely to ever be used again in a manufactured product.)
- Whose responsibility is the disposal of an item—the user's? the producer's? the government's? all three? Should the cost of recycling or disposal be part of the item's purchase price?
- Discuss the phenomenon of NIMBY (not in my backyard)—with society calling for new landfills and citizens fighting the development of landfills near their neighborhoods. What issues are involved? Can they be resolved?

Activity: A Model Landfill (Activity Master 4)

Materials for each group: **rectangular box, metric ruler**. Before students begin, you might review what makes a landfill qualify as a sanitary landfill (see Guide page 3). Then have students work in cooperative pairs or lab groups to complete this activity.

Activity: Locating Landfills

Materials needed: **topographic map of your community.** Have students locate any existing landfills in your area. Why, do they think, was the landfill located there? How close is the nearest group of houses? Where could a new landfill be located? Have students work in teams to pick what they feel is the best site and come up with arguments to suport their choice. Whose arguments does the class find most compelling?

Homework: Town Waste–Present and Future

Have students use the 5-pounds-of-trash-per-person-per-day figure and the current town population in their calculations. Ask them to create a bar graph showing the amount of solid waste produced in their town this year and then to project that figure 10 years into the future, 20 years into the future. Have them assume a 10% increase in population every 10 years.

VIDEO STUDY GUIDE

This guide is designed to help you get the most out of the video for "One More Time." Look over the questions below before you watch the video. Use the space under the questions to take notes. What does the video tell you in answer to each question?

1. Some of the material sent to the recycling plant Billy visits will be sent to the landfill next door. Why?

2. This recycling plant was built with separating equipment. What does this equipment do? How does this encourage recycling?

3. What happens to aluminum cans when they are recycled? Why does Adam Marks, the recycling supervisor, say that they are the most valuable material?

name: _____ **class:** _____ **date:** _____

VIDEO STUDY GUIDE, continued

4. Bo Vastine, the recycling coordinator, explains how they recycle plastic soda bottles. What is the problem involved in recycling a plastic soda bottle?

5. How does the reusable plastic look when you last see it at the recycling plant? What will happen to this plastic next?

6. Why does Laurie say, as the band eats pizza and drinks soda, that "we're right back where we started"?

7. What parts of the video did you like best? Why?

name: _____ **class:** _____ **date:** _____

HOW MUCH GARBAGE IS THAT?

On average, each person in the United States is responsible for producing five pounds of solid waste every day. Is five pounds per day all that much? Answer the following questions, using the 5-pound average in your calculations. Be prepared to discuss your responses in class.

1. How much solid waste do you make every week? _____
2. How much solid waste do you make every year? _____
3. How much waste does your family make every year? _____
4. How much waste does your class make every year? _____
5. Find the population of your town. How much waste does your town make every day? _____
   Every year? _____

6. Convert your yearly-town-garbage figure from pounds to kilograms (divide by 2.2) _____
7. If each cubic meter of solid waste placed in a landfill has a mass of 500 kilograms, how many cubic meters of garbage does your town bury each year? _____
8. The U.S. population increased by 10% from 1980 to 1990. Assume the population of your town also increased 10%. If this rate of growth continues, how much solid waste will your town make per year ten years from now? (Hint: multiply by 110)
   _____
9. Come up with an image that demonstrates the amount of garbage your town makes each year. For example: "Our town makes enough garbage to bury a football field in 20 feet of trash."
   _____
   _____
   _____

name: _____ **class:** _____ **date:** _____

THE PRICE OF PACKAGING

Thirty percent of our solid waste comes from packaging. Most of the items you buy in a food store are packaged. They may come in boxes or bags—that may also be covered with plastic. At the checkout counter, all the packages are put in yet another package of paper or plastic.

You will be exploring packaging in the two sections on this master. You may complete Part 1 on your own, but you will need to visit a food store or check your family pantry to complete Part 2.

PART 1: THE PURPOSE OF PACKAGING

What reasons do manufacturers have for packing their products? Below are a list of factors to consider. Write down how each might influence packaging.

Safety/protection: _____

_____

Convenience (for shipper, warehouser, consumer): _____

_____

Marketing Appeal: _____

PART 2: COMPLETE A DATA TABLE ON PACKAGING

Go to a food store or to your pantry to find ten packaged items that you can compare by filling out the Data Table on the next page. Some things to keep in mind:

- ▲ Examine the package carefully, BUT DO NOT OPEN IT!
- ▲ You can figure out unit price by dividing total volume or total weight by the cost of the product.
- ▲ Try to find 2 or 3 examples of the same item packaged differently (OK if sizes are different). This gives a good indication of how much you are paying for the packaging.

Two samples have been filled out in the Data Table to show you how an entry looks and to provide an example of 2 identical items that are packaged differently. Use the completed table to answer the questions that follow.

name: _____ **class:** _____ **date:** _____

THE PRICE OF PACKAGING, continued

ITEM	PACKAGING DESCRIPTION	PACKAGE CHARACTERISTICS*	CONTENT AMOUNT	TOTAL COST	UNIT PRICE
Orange juice	wax-covered paper	B, RR, NR	64 oz.	$2.00	$0.313/oz.
Orange juice	glass	♻	64 oz.	$2.29	$0.358/oz.

* KEY: ♻ = RECYCLABLE; B=BIODEGRADABLE; RR= RENEWABLE RESOURCE; NR=NONREWABLE RESOURCE

1. What kind of packaging characteristics are most common?

   _____

2. Which packaging do you consider to be necessary? Why?

   _____

3. Which packaging do you consider to be wasteful? Why?

   _____

4. Is the least expensive packaging necessarily the **best** packaging? Explain?

   _____

5. Pick an overpackaged item—one from your table or one you have bought before. Tell how you could repackage it using less material and/or more recyclable material.

   _____

   _____

name: _____ **class:** _____ **date:** _____

A MODEL LANDFILL

Today's solid wastes often end up in a sanitary landfill. Unfortunately, suitable locations for these landfills are getting harder and harder to find. At the same time, old landfills are closing at a rate of nearly one per day. As a result, we have only one-fifth the number of landfills today that we had 12 years ago—and we have more people.

What landfill does your town use? How quickly is it being filled? The following activity will give you a sense of how quickly landfills can be used up.

Pretend your box is a model of your town's landfill. Use its dimensions—with 1 millimeter on the model standing for 1 meter in the landfill—to answer the questions below.

MATERIALS NEEDED

- A rectangular box,
- A metric ruler

1. What is the length of your town landfill? _____ meters

2. What is the width of your town landfill? _____ meters

3. How deep is your model? How deep would that make your town landfill? _____ meters

4. The volume of a solid is **length x width x depth.** What is the volume of your landfill? _____ cubic meters

5. Assume that each person in your town adds 2 cubic meters of trash to the landfill each year. How many cubic meters does the whole town add each year? _____ cubic meters

6. At that rate, how many years will it take for your town to use up your landfill? _____ years

name: _____ **class:** _____ **date:** _____

ONE MORE TIME: Extension

Interested students may wish to pursue ideas and concepts raised by this unit. You could direct them to the suggestions and resources listed on this page.

Possible Research Topics

- ▲ Find out about your town's recycling program. If there is none, are there organizations working to create one?
- ▲ Water is a renewable resource. Find out what happens to your water after it goes down the drain or toilet.
- ▲ Go to the library or interview older relatives and neighbors to learn about the national recycling program implemented during World War II.
- ▲ Call or visit an automobile "junkyard" to discover which car parts can be reused and what happens to the rest of the car. Have there been any changes over the years in car components that affect recycling?
- ▲ Find out where your town's solid waste is taken for disposal. To a landfill? If so, what is its life expectancy? Does your town have any plans for future waste management?
- ▲ Design a hand-me-down chain in your school, neighborhood, or community for as many reusable items as possible.
- ▲ Make a list of household hazardous wastes that can be replaced with common products that will not damage the environment.

Suggested Science Fair Projects

- ▲ What are the effects of different kinds of organic materials in a compost pile?
- ▲ What is the effect of shooting UV light sources at biodegradable products?
- ▲ Test various packaging materials for their biodgradability.
- ▲ What is the most efficient way to harness natural gas (CH_4)?
- ▲ What is the effect of humidity on different kinds of paper?

Resource Center

Books to recommend:

Blueprint for a Green Planet by J. Seymour and H. Girardet (Prentice, 1987)

Earthworms, Dirt, and Rotten Leaves: An Exploration in Ecology by Molly McLaughlin (Macmillan, 1986)

50 Simple Things Kids Can Do to Save the Earth by Earth Works Group (Earth Works Press, 1990)

The Future for the Environment by Mark Lambert (Bookwright, 1986)

Going Green: A Kid's Handbook to Saving the Planet by John Elkington, Julian Haikes, Douglas Hill, and Joel Makower (Puffin, 1990)

The Recycler's Handbook by Earth Works Group (Earth Works Press, 1990)

Restoring Our Earth by Laurence Pringle (Enslow, 1987)

The Throwaway Society by Sally Lee (Watts, 1990)

Water for the World by Franklyn M. Branley (Crowell, 1982)

Periodical:

Garbage: The Practical Journal for the Environment. Published bi-monthly.

Organizations to contact:

EPA (Environmental Protection Agency)
Hotline: 1-800-426-9346. Call to find out how to contact the recycling coordinator in your area.

Office of Public Affairs
U.S. Department of the Interior
Bureau of Land Management
Washington, DC 20240

Office of Solid Waste
U.S. Environmental Protection Agency
401 M Street SW
Washington, DC 20460

To order additional sets of TRANSFORMATIONS

The set of eight videotapes and matching Teacher's Guides is available for $75.00 plus $5.00 postage and handling. Checks or money orders payable to TRANSFORMATIONS should be sent to TRANSFORMATIONS, PO Box 1205, Boston, MA 02130. Purchase orders can be sent to the same address or faxed to 617-323-8687. For more information, call 1-800-433-AIME.

CREDITS

TRANSFORMATIONS is sponsored by **AIME**, the **American Institute of Mining, Metallurgical and Petroleum Engineers Inc.,** a national professional society dedicated to advancing the knowledge of engineering in the fields of minerals, metals, materials and manufacturing and energy resources, and to undertaking programs addressing significant national needs, including education.

TRANSFORMATIONS is a project of the AIME Public Issues Committee.

Frank Nolfi, Chairman
David Donohue
John Hammes
John Healey
Richard Klimpel
Ravindra Nadkarni
Arthur Nedom
Louis Kuchinic, Sr.
Gerald Roe
John Stubbles

PROJECT TEAM:

Project Director ..... **Lee Richmond**
Senior Consultant ..... **Jerry Murphy**
Marketing Director . **Joanne Van Voorhis**
Project Coordinator ..... **Etienne Martine**
Teacher Consultants ..... **Bill Jones**
Ron Barndt
Joe Pignatiello
Bill Rockwell
Evaluator ..... **Barbara Flagg**
Project Managers ..... **Judy Downes**
Mark Irwin
Teachers Guide Editor .. **Joanne Fedorocko**

AIME STAFF SUPPORT:

Robert Marcrum, Executive Director
Melissa Leggieri

G "ONE MORE TIME"

Producer/Director ..... **Lee Richmond**
Scriptwriter ..... **Louis Gudema**
Composer ..... **Mark Spencer**
Lyrics:
"Transformation" ..... **Lee Richmond**
"Old Friend" ..... **Louis Gudema**
Line Producer...Polly van den Honert
Casting ..... **Collinge/Pickman**

CAST

A.J. ..... **Anthony Ruivivar**
Billy ..... **Jonathan Deily**
Laurie ..... **Eisa Davis**
Simone ..... **Linda Balaban**
Mass. CRINC
Recycling Supervisor ..... **Adam Marks**
Wellman, Inc.
Recycling Coordinator ..... **Bo Vastine**

LOCATION CREW

Director of Photography ..... **Dean Gaskill**
Sound Engineer ..... **Mike Pfeiffer**
Script Supervisors ..... **Etienne Martine, Linda Balaban**

STUDIO CREW

Director of Photography ..... **Bestor Cram**
Sound Engineer ..... **Chris O'Donnell**
Video Engineer ..... **Eliat Goldman**
Gaffer ..... **Ken Perham**
Key Grip ..... **Jack McPhee**
Set Designer ..... **Frank Gaide**
Wardrobe ..... **Carlene Lee**
Props ..... **Fairlie Myers, Carlene Lee**
Makeup ..... **Marleen Alter**
Script Supervisor ..... **Eve Wrigley**
Instrument Mix ..... **Rob Scott**
Audio Playback ..... **Tim Lay**
2nd Camera (film) ..... **Mike Majoris**
Assistant Camera ..... **Mary Anne Jenke**
Grips ..... **John Maliscewski, Arnold Brown**
Carpenters ..... **Larry Batherwitch, Terrance Gaide**
Electric ..... **Mark Bialas, Jeff Hanel**
Production Assistants ... **Sharon Hibbert, Jimmey Frieden**

POST-PRODUCTION & PRINT

Editor ..... **Mark Fish**
Animator ..... **Mark Frizzell**
Sound Mixer ..... **Ken French**
Teacher's Guide ..... **Joanne Fedorocko, Andrew Amster**
Designer ..... **David White**
DesktopPublisher **SullivanCreativeServices**

TRANSFORMATIONS was created and produced by
Galileo Studios, 50 Hunt Street, Watertown, MA 02172 (617) 923-0912

TRANSFORMATIONS: Science, Technology and Society © 1991 was produced under the auspices of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc.

345 East 47th Street
New York, NY 10017
1-212-705-7677