Waste in Place

Elementary Curriculum Guide

Waste In Place is an interdisciplinary, supplementary environmental program focusing on litter prevention and solid waste management for educators of kindergarten through sixth grade.

TABLE OF CONTENTS

WASTE REDUCTION

RECYCLING

COMPOSTING

WASTE-TO-ENERGY/LANDFILL

APPENDICES

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"I learned a lot of responsible solid waste management practices that I can start doing in my classroom and at home."

A. Wiley, John Hope Elementary

"I'll never look at garbage in the same way again."

L. Norman, Braelinn Elementary

"What a great way to teach the children, at a young age, the value of choice in keeping our planet beautiful."

C. Rome, 21A Elementary

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A Message from Keep America Beautiful, Inc.

Dear Educator,

It is with much pride that Keep America Beautiful (KAB) presents the fifth edition of *Waste In Place,* a curriculum guide which teaches an integrated approach to the management of municipal solid waste. This edition of *Waste In Place* includes suggestions and improvements made by a team of education professionals from across the country. This curriculum and its secondary component, *Waste: A Hidden Resource,* are distributed by Keep America Beautiful, Inc. (KAB), a national, nonprofit, public education organization dedicated to improving waste handling practices in American communities.

Originally introduced in 1979 and now used by thousands of schools nationwide, *Waste In Place* includes lessons on litter prevention, waste reduction, recycling, composting, waste-to-energy, and landfills. KAB believes that these are all methods of handling waste which must be understood and intelligently utilized if we are to successfully manage the waste we produce. No one approach to managing waste is the answer. Different communities have differing needs and these impact the ways in which waste is managed. It is the goal of this curriculum to make students more aware of the sources of municipal waste, the characteristics of this waste and the various options for handling it.

Waste In Place is interdisciplinary in its approach. It may be used in its entirety as a complete curriculum. It is not necessary, however, to teach all of the lessons in order to benefit from this rich source of information. The activities presented here provide excellent supplements to existing classroom curricula. The lessons in this guide are divided into six sections: Integrated Solid Waste Management, Litter Prevention, Waste Reduction, Recycling, Composting, and Waste-To-Energy/Landfills. It is not necessary to teach the lessons sequentially. Within each section, the lessons are arranged from the most basic to those which are more advanced. Each lesson includes an objective, method, vocabulary pertinent to the lesson, materials necessary for the activity, procedure, student assessments, and suggestions for enrichment activities.

In the appendices of this guide you will find some very helpful information including: parent information and consent letter, a glossary of key terms, and a reprint of the KAB document, *Overview: Solid Waste Disposal Alternatives.* This document can provide you with an in-depth background on solid waste concepts. We strongly recommend that you refer to it often while presenting the lessons included in this guide. Your local KAB affiliate is also an excellent source of current information.

KAB is also proud to introduce the famous Woody Woodpecker of Universal Studios as its official mascot. With the help of Woody and educators like yourself, KAB will continue to promote the development of responsible attitudes and behavior towards the environment. We hope that this new and improved *Waste In Place* will help you and your students develop just such attitudes and behaviors.

Roger W. Powers
President
Keep America Beautiful, Inc.

INTRODUCTION

You have now joined a nationwide team of educators dedicated to teaching *Waste In Place*. This curriculum provides educators and students with an understanding of litter prevention and responsible solid waste management practices. *Waste In Place* reinforces the concepts: litter prevention, waste reduction, reuse, recycling, composting, waste-to-energy (recovery) and landfill as solid waste disposal options, and is designed to be an instructional resource for people who care about their community and the environment.

Activities are organized for students to acquire knowledge, information, and skills to assist them in making informed and responsible decisions toward solid waste disposal and its effect on people, animals and the environment. *Waste In Place* emphasizes the relationship between personal attitudes and solid waste handling practices at the local level. It is based on the same attitude system change process that underlies the Keep America Beautiful behavioral approach to changing attitudes relating to waste handling.

Waste In Place focuses on the five steps to waste reduction: reduce, reuse, recycle, recover, and bury. No one of these ideas is the answer. The solution lies in a combination of some or all of these steps, and in a public that is very much aware of the problem and its alternatives.

The Keep America Beautiful, Inc. SYSTEM, developed from three years of research, is a behavioral-based, systematic approach to changing attitudes and practices related to proper waste handling. The research identified three attitudes that predominate most peoples' thinking about handling litter. They feel it is acceptable to litter:

- where they feel no sense of ownership of the property
- where someone else will clean up after them
- where trash has already accumulated

Research has also identified seven sources of litter:

- Household refuse
- Commercial refuse
- Construction/Demolition sites
- Uncovered loads
- Loading docks
- Motorists
- Pedestrians

The attitude change process, which is the foundation of the KAB SYSTEM, has five steps:

- get the facts
- involve the people
- plan systematically
- focus on results
- provide positive reinforcement

Waste In Place was initiated largely in response to teachers in KAB SYSTEM communities who recognized the need to instill in their students those same positive attitudes toward the role of the individual in community development.

Today, with community programs in over 40 states, KAB is supported by over 300 corporations and receives guidance from a National Advisory Council comprised of 81 civic and professional organizations, and 17 agencies of the federal government. KAB also maintains a network of state and local affiliates.

APPENDICES

The appendices include parent letters, a glossary of key vocabulary terms for use by the instructor, and a reprint of the Keep America Beautiful, Inc. *Overview: Solid Waste Disposal Alternatives*. The reprint of Keep America Beautiful, Inc. *Overview: Solid Waste Disposal Alternatives* provides the teacher with an

in-depth background on solid waste management issues. Teachers needing more information on specific solid waste concepts will find the *Overview: Solid Waste Disposal Alternatives* a valuable resource.

We hope you will find these materials of use. Let us hear from you at any time with suggestions as to how to improve them, requests for additional information and assistance, and any news of your experiences and those of your students as you "Keep America Beautiful."

Keep America Beautiful, Inc.
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AFFILIATED COMMUNITY PROGRAMS

495 affiliated community programs in 41 states

AFFILIATED STATE PROGRAMS

Alabama PALS

Arizona Clean & Beautiful

Keep Florida Beautiful

Clean Tennessee Program

Georgia Clean & Beautiful

Illinois Clean & Beautiful

Keep Arkansas Beautiful

Keep California Beautiful

Keep Mississippi Beautiful—People Against Litter

North Carolina Keep America Beautiful

Keep Nebraska Beautiful

Keep Ohio Beautiful

Keep Oklahoma Beautiful

Keep Texas Beautiful

Kentucky Clean Community Program

Litter Control/Beautification—New Mexico Highway Department

Louisiana Litter Control & Recycling Commission

South Carolina Litter Control

State of Hawaii Governor's Advisory Council on Litter Control

Virginia Division of Litter Control and Recycling

West Virginia KABS

IMPLEMENTATION RECOMMENDATIONS

Keep America Beautiful, Inc. (KAB) offers teachers, school systems, and KAB affiliates the following ideas and suggestions in implementing *Waste in Place:*

TEACHER'S APPROACH

KAB recommends to teachers the following uses of *Waste In Place* in the classroom:

- to meet local and state mandates for an environmental education curriculum
- to teach the essential elements or course of study requirements for each grade level
- as a supplemental lesson when teaching science, social studies, language arts, mathematics, art, and music
- as a unit for an outdoor education field trip (one day or extended overnight experiences)
- as an environmental unit during the spring (Keep America Beautiful Month/April) or fall
- as a special emphasis during Earth Day or National Recycling Month (April)
- as an activity to encourage student participation in the community

SCHOOL SYSTEM'S APPROACH

KAB recommends to school systems the following uses of *Waste In Place:*

- to meet local and state mandates for an environmental education curriculum
- to teach the essential elements or course of study requirements for each grade level
- as a curriculum supplement for most subject areas
- as an inservice training opportunity for teachers
- as a workshop for training teachers in solid waste management issues
- as a continuous training or college credit opportunity for teachers
- as a resource to complement local and state environmental and solid waste education curricula
- as a tool for involving the school system in the local solid waste management efforts

KAB AFFILIATES' APPROACH

KAB recommends to coordinators, board members, education specialists, and volunteers the following uses of *Waste In Place:*

- to meet local and state mandates for an environmental education curriculum
- as a curriculum designed to provide teachers and school systems with activities emphasizing course of study and essential element requirements for each grade
- as the education curriculum program for the local KAB affiliate
- for presentation ideas
- for litter and solid waste special projects and campaigns
- for training teachers on solid waste management issues and activities for students
- as a resource and supplement for local and state environmental and solid waste curriculum programs
- for involving local government and business leaders (local KAB board) in solid waste education programs for students and the community

PLANNING A *WASTE IN PLACE* WORKSHOP

KAB encourages teachers, school systems, and KAB affiliates to provide *Waste In Place* to teachers through workshops. KAB recommends the following workshop formats in designing a local workshop to meet local budgets and teachers' schedules. KAB offers national education trainers for local teacher workshops.

Ideal Training Format:

- 6-8 hour workshop
- 15-25 teachers
- during the school day (plan for substitutes) or an inservice day
- provide *Waste In Place* Guides for each teacher
- offer college credits or continuous education for teachers
- refreshments/meal
- invite a local speaker

Modified Training Format:

- 3-4 hour workshop
- 15-25 teachers
- after school, evenings or weekends (offer a stipend)
- provide *Waste In Place* guides for each teacher (or a least one per school)
- provide refreshments
- invite a local speaker

ACTIVITIES BY SUBJECT

The *Waste In Place* curriculum is interdisciplinary in its approach. Instructional activities within *Waste In Place* are designed for easy integration into school subject areas. Activities are listed by the following subjects: science, social studies, language arts, mathematics, art, music, drama and physical education. Activities are listed by the order in which they appear in the book.

SCIENCE

Integrated Solid Waste Management

Litter Prevention

Waste Reduction

Recycling

Composting

Waste-to-Energy/Landfill

SOCIAL STUDIES

Integrated Solid Waste Management

Litter Prevention

Waste Reduction

LANGUAGE ARTS

Integrated Solid Waste Management

Litter Prevention

(continued)

LANGUAGE ARTS (continued)

Waste Reduction

Recycling

MATHEMATICS

Integrated Solid Waste Management

Waste Reduction

ART

Waste Reduction

Recycling

Waste-to-Energy/Landfill

MUSIC

Integrated Solid Waste Management

Litter Prevention

DRAMA

Integrated Solid Waste Management

PHYSICAL EDUCATION

Recycling

*lesson encompasses more than one subject area

WHAT IS WASTE?

Objectives

Students will compare and contrast characteristics of waste, garbage and trash.

Method

Students will brainstorm and categorize lists of waste.

Materials

no special materials

Vocabulary

garbage, refuse, solid waste, trash, waste

Procedure

1. Background: Waste is any material that is left over and no longer serves its original purpose. Waste can be gas, liquid or solid. Prior to the industrial revolution, solid wastes were organic and biodegradable; however, with industrialization and the creation of synthetic materials, large amounts of nonbiodegradable and nonorganic substances are produced. These materials are essentially permanent in the environment.

   Solid wastes are generated by activities in homes, commercial establishments, institutions, industries, construction sites, agricultural and mining activities. People often use the words "waste," "garbage," and "trash" interchangeably when, for regulatory purposes, they have different meanings to governmental and solid waste agencies.

Solid waste (refuse) is any of a wide variety of solid materials, as well as some contained liquids, which are discarded or rejected as being spoiled, useless, worthless, or in excess.

Waste is anything that is discarded, useless, or unwanted. Trash is waste that usually does not include food wastes but may include other organic materials such as plant trimmings.

Garbage is refuse consisting of food wastes; animal and vegetable wastes resulting from handling, storage, sale, preparation, cooking, and serving of foods.

2. List the words waste, trash, and garbage on the chalkboard as column headings.

3. Ask students to give examples of each and list them in the proper column.

4. There will probably be some confusion about the definitions of these words. Have the students define the words from their own experiences.

5. Read the definitions given in the background information and have the students rearrange the lists into the proper columns.

Assessment

The generated columns

Enrichment

Discuss why we need three words to describe refuse.

Discuss how different cultures perceive waste.

EARTH: THE APPLE OF OUR EYE

Objectives

Students will comprehend that the earth and all its resources are finite. This lesson will motivate students to learn more about resources and human impact on the earth.

Method

Teacher will section an apple to represent the proportions of the earth's resources.

Materials

one clean apple, one sharp knife, cutting board, globe, world map

Vocabulary

finite, natural resources

Procedure

1. Protecting our land resources is very important. Advanced agricultural technology has enabled the world to feed many of its people, but the population continues to expand. A fixed land resource base and an ever-increasing number of people to support cause each person's portion to become smaller and smaller.

2. Instructor may demonstrate using one apple and a sharp knife. Consider that this apple represents the earth.

   - Slice the apple into four quarters, setting aside three. The three quarters represents the oceans of the world.

   - What fraction is left? (1/4)

This fourth quarter represents the earth's land area. Slice this land in half and set aside one of the pieces. The portion set aside represents the land area that is inhospitable to people: polar areas, deserts, swamps, high or rock mountains.

   - What fraction now remains? (1/8)

The remaining piece is land areas where people now live, but not necessarily where they grow foods needed for life. Slice the 1/8 piece into four sections and set three aside.

   - What fraction remains? (1/32)

The 3/32 set aside represents the areas too rocky, wet, cold, steep or where the soil is too poor to produce food. They also contain the cities, suburban sprawl, highways, shopping centers, schools, parks, factories, parking lots and other places where people live, but where they can't grow food.

- Carefully peel the 1/32 slice of the earth. This tiny bit of peel represents the very thin surface of the earth's crust (less than five feet deep) upon which humans primarily depend for food production. (Safely secure all sharp utensils.)

3. Discuss the implications of human dependence on the 1/32 peel of the "earth." What does this say about our relationship with the earth?

   Let students eat the "used" portion of the apple (the *entire apple minus the 1/32 peel*). *Tell the students,* "We ate the portions not suitable for humans. What if we could only consume what is left?"

Enrichment

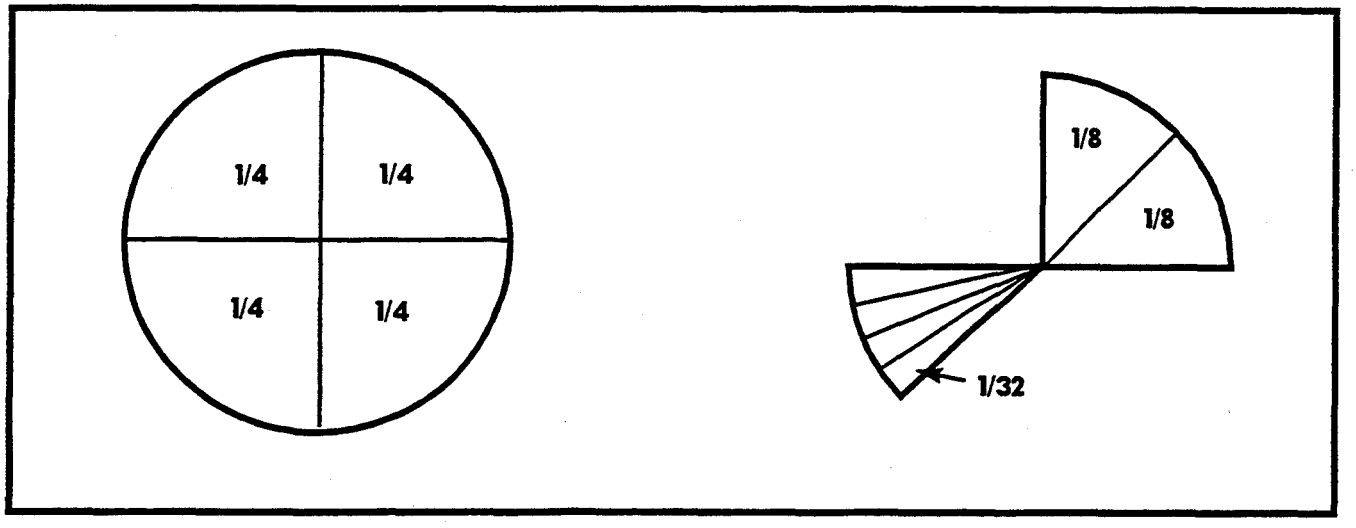
Have students graph or chart the above statistics and research more accurate percentages to identify each portion of the earth, i.e.: oceans, land masses, human inhabited lands, etc.

Discuss the concepts of human population and over population as related to the earth's finite resources.

Note: This activity was adapted from A.H. Brainard's contribution to *Zero Population Growth,* Winter 1988.

Assessment

Our planet is finite. What does this mean to humans? What can we do to help protect the quality of the land, air and water that we all need for survival?



A TRASHY STORY: CITY XYZ

Objectives

Students will be able to recognize the need for cooperation among community members in developing a solution to a solid waste dilemma, and determine that there may be more than one solution.

Method

Students will interact in a cooperative manner to solve a problem.

Materials

four decks of cards that all have the same design on the back

Vocabulary

solid waste

Procedure

1. To initiate the concept that cooperation can be successful, perform the choral reading, "*A Trashy Story*," provided at the end of this lesson.

2. Prior to the class, reorganize four decks of cards to have incomplete suits in each deck. To do this, shuffle four identical decks of playing cards together, so they are thoroughly mixed up. Then divide the entire stack into four piles of 52 cards each.

3. Divide the students into four groups. Each group stands for one of the following:

   Group A: Industry/Business in City XYZ

   Group B: Elected Officials of City XYZ

   Group C: Keep XYZ Beautiful

   Group D: Dedicated Citizens of City XYZ that are not formed as a part of an organized group

4. **Tell the students:** You are all members of the community City XYZ. The community has a current solid waste need (such as siting a new landfill). Because this will directly affect everyone, each group in the community is responsible for making sure that City XYZ finds a solution so that it will continue to thrive and maintain its current quality of life. Your task is to develop and complete a system to create a solution to this landfill dilemma. The solution is represented by one complete deck of cards.

   DO NOT tell the students: The solution may include the entire class making one complete deck of cards from the four, or it may include individual groups deciding to make separate complete decks. Do not give the students precise directions as their response to the first trial will

present a teaching opportunity regarding the dynamics of decision making when many groups work together toward a common goal.

5. Give each group one stack of shuffled cards. At the conclusion of two minutes or when a complete deck of cards is developed, discuss what has occurred. (See discussion questions below.)

   On the first trial, students may not complete a full deck and may even argue about the number of complete decks to make. It is necessary to emphasize the need to try again. Provide students with a second or third trial as needed. They will begin to recognize the need to organize and communicate as a group.

6. **Questions for Discussion:**

   - What did you do first?
   - Did you compete so your group would have the answer?
   - Did you try to trade so you would have one complete deck?
   - Is it possible to have more than one answer? (More than one deck?)
   - How many ways can you think of to cooperate to make complete deck(s)?

7. **Points to Emphasize During Discussion:**

   - We are all members of the same community.
   - Although we have different interests as separate groups, we all need to cooperate and work together for one common goal.
   - The KAB philosophy uses partnerships and cooperation between industry (business), government, and dedicated officials for proper solid waste management. Isolating one's self or group does not help. It may cause friction and defensiveness. Pointing fingers at any one group only damages the entire community and does not allow for the win/win attitude, necessary for healthy problem solving.
   - Cooperation among the groups is better than competition. As stated earlier, each group is responsible for 'A' task to be completed for City XYZ to thrive and maintain its quality of life.

"A Trashy Story"

Divide the students into four groups, giving each group a label: "Everybody," "Somebody," "Anybody," and "Nobody." During the reading, the instructor points to each group on cue. Members of each group call out their name: "Everybody," "Somebody," "Anybody," or "Nobody." They may stand, then sit, each time the teacher points to them and they call out their names.

"A Trashy Story"

(Teacher reads aloud)

There was a big problem to be solved that greatly affected the quality of life in our own community of _____, _____ (state), U.S.A.

Everybody was sure that Somebody would do something about it. Anybody could have done it, but Nobody did. Now, Somebody got angry about this problem because it really was Everybody's job to help solve it. Everybody thought that Anybody could do it, but Nobody realized that Everybody wouldn't do it. It ended up that Everybody blamed Somebody, when Nobody did what Anybody could have done.

In case no one has guessed, the dilemma that we are facing is the way we manage solid waste. Where will we dispose of our waste in the future?

Assessment

Students will name at least four groups who must cooperate to solve a community solid waste dilemma. They will also tell some of the ways these groups can work together effectively to solve problems.

Enrichment

Brainstorm how this activity relates to solving other solid waste dilemmas.

Variation: If you have access to several identical decks of cards (enough for one deck per student), this lesson can be developed as a small group activity. Divide the class into groups with four students per group. Give each group of four students four decks of cards shuffled together. One student in each group will represent one faction of the community. With several groups working simultaneously to achieve the same goal, you may see a greater number of creative solutions in a shorter amount of time.

WHAT'S IN MY TRASH CAN?

Objectives

Students will be able to: 1) identify items disposed in their household trash; 2) categorize and classify items into material type; and 3) describe ways to reduce, reuse or recycle these items.

Method

Students will brainstorm items in their household trash cans, illustrate them and then categorize them according to material type.

Materials

a large sheet of paper or tag board, three large index cards, small index cards (five per student)

Vocabulary

recycle, reduce, reuse, trash, waste, yard waste

Procedure

1. Before class, copy the trash can diagram (provided) onto a large piece of paper or tag board. Mark off the different sections on the trash can as shown. Post the garbage can where everyone can see it. Also, copy each of the following words: REDUCE, REUSE, RECYCLE, onto separate, large index cards.

2. Lead a discussion with your students about the waste that each family throws out every day. List these items.

3. Show the students the trash can diagram you prepared earlier. Discuss with them the different categories of waste found on the trash can diagram: paper, yard waste, glass, metals, food waste,

plastics, other. ("Other" includes things that don't fit neatly into any of the listed categories, such as tires, wood, clothes, old furniture, etc.)

4. Have the students select five items they listed and write each of these items on a separate index card.

5. Then have the students draw or use magazine pictures to illustrate each item on the flip side of each index card.

6. After the students have finished their illustrations, have them tape their index cards to the trash can in the correct section. For example, comic books would be taped into the paper category. Continue this step with all of the students until all of the "trash" has been "thrown away."

7. Lead a discussion with the students, asking them if they can think of any ways to reduce the items in their trash can.

8. Count the number of items in the "trash can."

9. Introduce the three words: Reduce, Reuse, Recycle. Using the previously prepared three large index cards, have each student come to the trash can diagram and remove a card, stating how to avoid discarding the item. Then tape each card under one of the Reduce, Reuse, or Recycle columns.

10. After each student removes an item from the trash can, sing the following song to the tune of "99 Bottles":

Trash In The Can

35 pieces of trash in the can
35 pieces of trash
Take one out,
Then you can shout:
34 pieces of trash in the can, etc.

11. Ask the students if they think it is possible to reduce, reuse, or recycle everything in their trash at home. (No. There will always be some materials that must be discarded.)

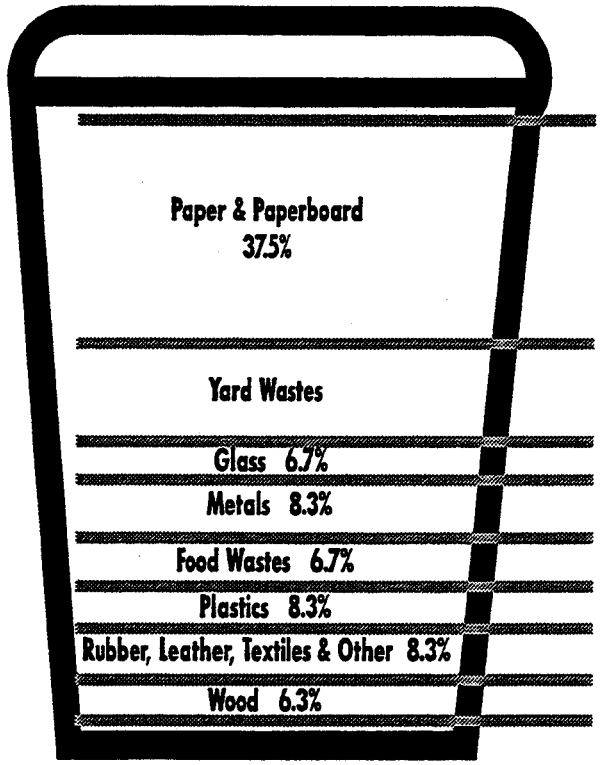
Assessment

Have the students list the major categories of waste disposed in their trash, and cite examples of each.

Enrichment

Have students decide on one way they will make less trash in their homes. Laminate and velcro the trash can and items for a working bulletin board.

What's in Our Garbage?

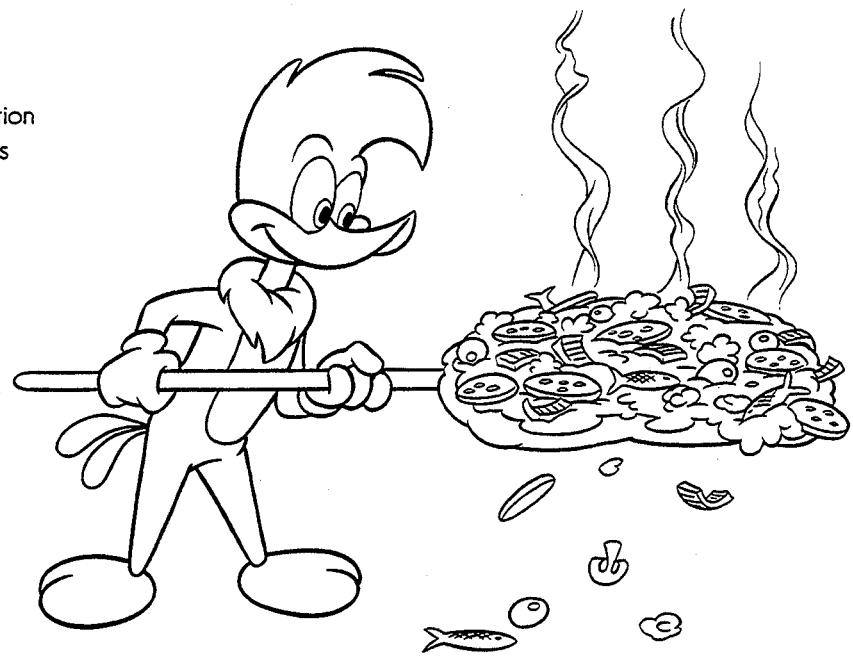


Figures courtesy Franklin Associates, prepared for the U.S. EPA, 1992. MSW by weight.

GARBAGE PIZZA

Objectives

Students will be able to: 1) describe the composition of Municipal Solid Waste (MSW); 2) identify items within each waste category; and 3) visualize the amount of waste and categories of MSW.



Method

Students will construct a garbage pizza (a three-dimensional pie chart), representing all the waste thrown away in the United States, with a slice for each waste category.

Materials

for pizza dough: mixing bowl, spoon, rolling pin, pizza pan, 2 c. flour, 2 c. salt, 1 c. water, oil or shortening.

for pizza "sauce" and toppings: school glue, red food coloring, small paint brush, waste items from these categories: paper, yard waste, wood, metals, glass, food waste, plastics, and other waste (e.g., rubber, leather, textiles, misc. inorganic waste), polyurethane or lacquer (optional)

Vocabulary

garbage, Municipal Solid Waste (MSW), trash, volume, weight

Procedure

1. Before class, have prepared a "Garbage Pizza" crust, using the following recipe: Mix 2 cups of flour, 2 cups salt, and 1 cup water (adjusting water per altitude and/or humidity) until a stiff dough forms. Knead as you would a bread dough. Flatten the dough into a well greased, round 12" deep dish pizza pan, pressing the edges up the inside of the pan. Flatten out slightly until it looks like a pizza pie. Cut the pizza into the same slices or sections to look like the Municipal Solid Waste *by weight*, pie chart template included in this lesson. Using a fork or knife, puncture each slice several times before baking to avoid expanding air pockets. Bake at 350° for 40-45 minutes, or until golden brown. Check the pizza every 10 minutes or so and re-cut the sections. (If you do not cut the pizza before cooking, you will need a chain saw after it is done!) Remove from the oven and let cool completely. Dough should be hard and dry. Mix approximately 4 oz. of white school glue with approximately 2 oz. of red food coloring (adding a drop of blue food coloring will darken the red, but is not necessary for a successful "sauce") until you achieve the desired red tomato sauce look. Apply sauce with a small paint brush (an apron is highly recommended). Allow to dry thoroughly. Label the underside of each slice with the correct type of waste and % it represents. A permanent marker

works well. This makes it easier for students to glue the proper waste on the proper slice.

2. Ask the students to define the words GARBAGE and TRASH. Garbage refers to only the organic or food waste thrown away. Trash represents broken, discarded or worthless things (e.g., rubbish and other forms of refuse which are not food). Brainstorm with students and list on the chalkboard all the waste items thrown away at home or school. Use the following categories: paper, yard waste, metals, glass, plastics, wood, food wastes, and other.

3. Introduce the concept of Municipal Solid Waste (MSW). MSW is made up of trash and garbage from household, commercial, and institutional sources in a community. Ask the class if the items listed on the board would also be found in a community's MSW.

4. Draw a circle on the board. Explain to students that we are going to pretend that all the waste thrown away in the United States will fit into this circle. This circle is filled with waste from all the categories (paper, yard waste, metals, glass, plastic, wood, food waste, and other waste). Show students how much paper is thrown away by drawing a slice for paper (see chart included in this lesson). Repeat this demonstration for all eight categories. Reinforce the fact that the biggest slice, marked "paper," means that there is more paper than any other item in MSW. The next largest slice is yard waste, etc. Ask the students why it might be important to know the amount and kinds of waste thrown away. By knowing what kinds and amounts of things are in MSW, communities can plan better programs to reduce the amount of waste disposed (e.g., office paper recycling, telephone book recycling, yard waste composting), and plan better waste handling options (e.g., waste-to-energy incineration, sanitary landfilling).

5. Announce that the class is going to make a garbage pizza (with garbage and trash). Collect the items you need for the toppings, or have the students bring them from home. For example:
   - paper: newsprint, shredded paper, boxes, wrappers;
   - yard waste: grass, sticks, leaves, potpourri;
   - metals: paper clips, staples, can, small hardware;
   - glass: marbles, sea glass;
   - plastics: foam cup, plastic fork, bread clips, jug lids;
   - wood: tooth picks, building blocks;
   - food wastes: egg shells, pasta, pretzels, dry cereal;
   - other: rubber band, candle

6. Show the students the "pie chart" pizza dough. Glue the waste items onto their corresponding pizza slices with uncolored glue or a hot glue gun. For an added touch after the glue has dried, spray the garbage pizza with polyurethane or lacquer, available at your local hardware store.

7. Share the garbage pizza model with other classes or the entire school. Have students team-up and teach students in other grades about the MSW using the garbage pizza model.

   Note: Keep America Beautiful, Inc. poster "200 Million Tons of Trash" would provide a visual picture of the waste disposal alternatives available. For information on how to receive this poster, contact Keep America Beautiful, Inc., 9 West Broad St., Stamford, CT 06902

Assessment

Set up a table with items from the eight categories of MSW: paper, yard waste, metals, glass, plastics, wood, food wastes, and other. Make signs for each category, and have students separate the waste items into the appropriate piles.

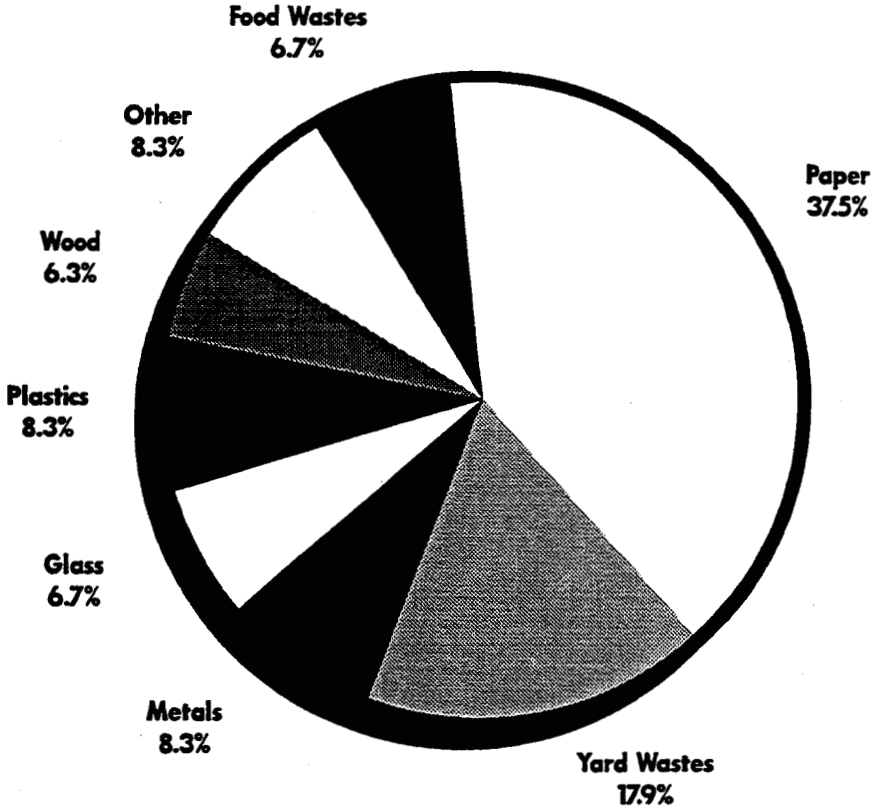
Enrichment

For more advanced students, discuss the difference(s) between MSW measured by weight and volume by making two pizzas: one using statistics for % by weight (as used in this lesson), and one using statistic for % by volume. Discuss the advantages of weight reduction of garbage (less energy to transport, less expensive to deposit at a landfill) vs. volume reduction (less landfill space required).

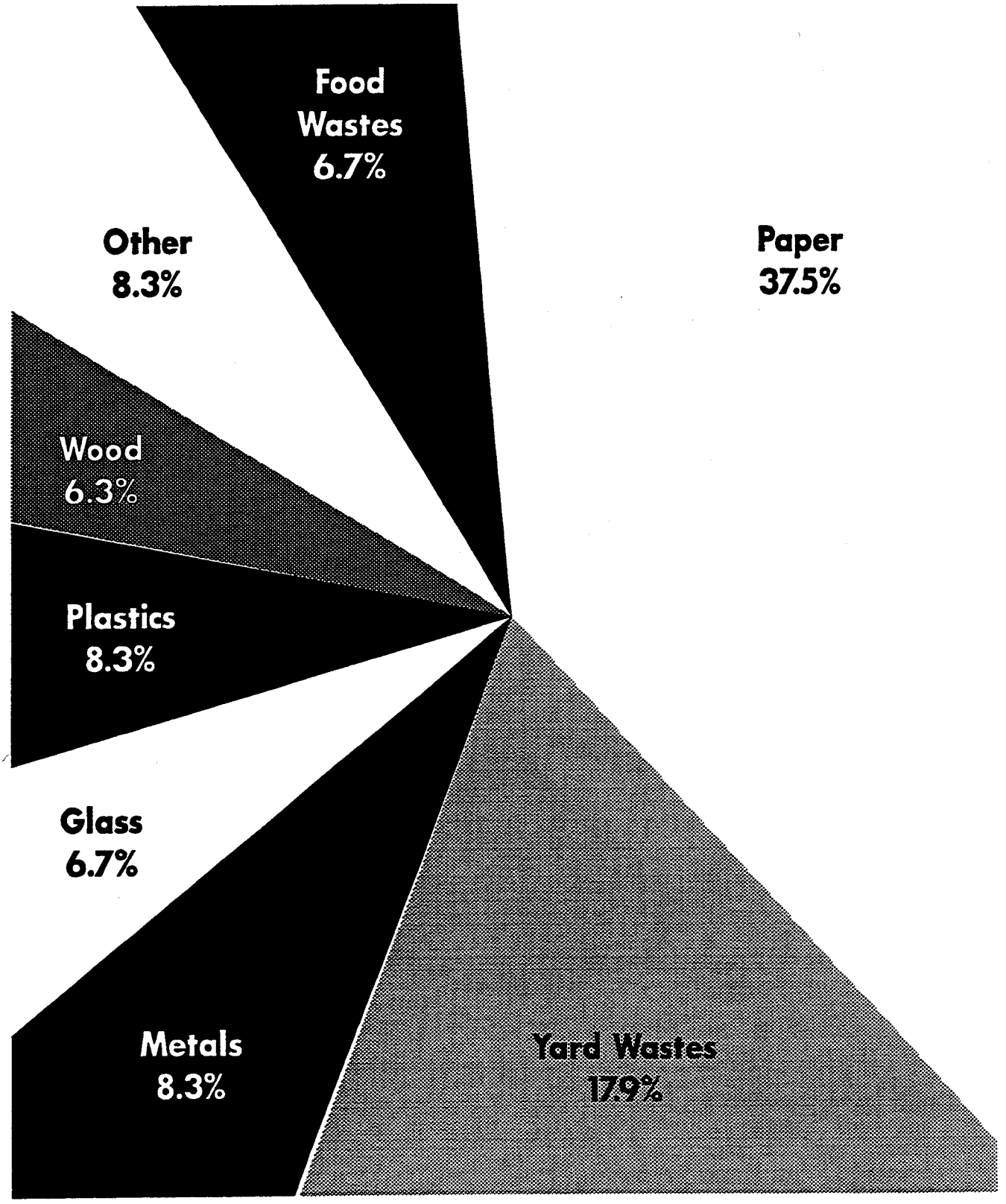
Ask students to look through magazines for pictures of items from each MSW category. Have each student draw a garbage pizza on poster board and glue the pictures on the appropriate sections. Display the posters in the cafeteria.

Plan a classroom project to reduce the amount of paper in MSW. Discuss ways students could reduce paper use and waste at school (e.g., don't waste paper, use both sides of paper, start a reuse box for all kinds of paper, start a paper recycling program, ask the principal if the school uses recycled paper, etc.).

Characterization of Municipal Solid Waste, 1992 Update



Municipal Solid Waste by Weight, U.S. EPA



TIMELY TRASH

Objectives

Students will be able to: 1) order information concerning environmental events; and 2) determine causes and effects of waste.

Method

Students will develop a 2,500 year history of trash by recording waste related events on a time line.

Materials

tape or string (enough for a timeline to represent 2,500 years), meter stick (or other measuring device), cellophane tape, a copy of the list of time line information included in this lesson

Vocabulary

recycling, sanitary landfill, waste-to-energy incineration

Procedure

1. Background: Down through history humanity has always had to deal with waste. Early man discarded his waste in the most convenient manner by leaving it wherever it fell. As man's need for community living evolved, he continued to "dump" his waste, leaving debris wherever he wanted, until it became a health hazard. The threat of disease made disposal a public priority and the search for new ways to dispose of waste began. However, there are no new ways of dealing with waste that haven't been tried before. People have tried reusing it, recycling it, burning it, dumping it, and burying it. People have been able to improve on the health and safety aspects of these waste handling methods, but the fact is that we still make trash.

2. Discuss the history of trash by brainstorming important "trash" events. (You may choose to list these and include them with the dates included here, especially if they are local events that have influenced your students/community.)

3. Have students decide on a convenient length for the time line.

4. Divide the time line into appropriate segments, such as B.C./A.D., by centuries and/or decades.

5. Copy the time line information provided in this lesson. Cut the entries into separate strips. Using those entries appropriate to the students' level of understanding, distribute the strips of dated information among the students and have them attach their information to the most accurate location on the timeline. Allow time for the students to either

read each piece of information as they attach them to the time line, or allow several days for students to read the time line on their own.

6. Back to the Future of Trash. Students will discuss what they would change if they could change one event on the time line (either add, delete, or change) and the possible consequences of that change.

7. Have the students complete one of the following:

   a. Students will illustrate selected pieces of information from the time line events for a pictorial time line.

   b. Students will act as reporters and interview the personification of garbage and its history. Students could work in pairs, with one student acting as reporter and the other student acting as the personification of garbage.

   c. Students will write an essay as if they were archaeologists uncovering artifacts from trash dumps (and later, landfills) from the time of their grandparents' birthdays, their parents' birthdays, and their own birthdays. Where would they likely find waste? What types of items would they be likely to find? Compare and contrast artifacts.

Assessment

The students' time lines, essay, interviews, or collages are excellent assessment tools.

Enrichment

Students could research time lines of other countries.

Students could create a time line highlighting their own community's waste history and display it for entire school viewing.

Waste Time Line

The first people made tools out of organic material and left it after its use.

circa 1500 B.C. Citizens of Troy dumped waste on floors and streets. Charles Gunnerson calculated that the city rose 4.7 feet per century above the previous foundation due to the accumulation of debris on the ground.

500 B.C. Citizens of Athens, Greece, designated a dump outside city walls.

1492 A.D. Columbus arrives in America.

circa 1600 A.D. Colonial Americans used corralled pigs to eat garbage.

1690 A.D. Philadelphia paper mill recycled waste paper and rags.

1700 A.D. New business developed around trash hauling called "Rubbish Carters."

1849 A.D. The U.S. Department of the Interior is established.

1857 A.D. New York's Central Park, the first city park, was commissioned. Frederick Law Olmsted thus introduces landscape architecture to the U.S.

1872 A.D. First national park is established in Yellowstone, Wyoming.

1875 A.D. First incinerator in the U.S. is built on Governor's Island in New York.

1891 A.D. Forest Reserve Act enacted, which allows public land to be set aside as forest preserve (precursor of the national forests).

1895 A.D. "Apostle of Cleanliness," Colonel George E. Waring, Jr., pioneered the first comprehensive system of refuse management in New York City. Waring, the Street Cleaning Commissioner, had a staff of 2,000 uniformed employees called "White Wings" who cleaned the streets and hauled it to dumps, incinerators and the Atlantic Ocean.

1897 A.D. New York City's rubbish was delivered to a "picking yard" where it was separated into paper, metal, carpet, bagging, twine, rubber and horsehair.

1904 A.D. Aluminum recycling began on a large scale in Chicago and Cleveland.

1908 A.D. Chlorination was first used extensively at U.S. water treatment plants.

1908 A.D. National Conservation Commission was appointed to inventory natural resources.

1908 A.D. President Roosevelt hosted the first Governors' Conference on Conservation.

1914 A.D. World War I began.

1916 A.D. National Parks Service was established.

1917 A.D. World War I ends.

1928 A.D. Hoover Dam was authorized to provide irrigation, flood control and electricity.

1933 A.D. Tennessee Valley Authority was formed.

1933 A.D. Civilian Conservation Corps was formed which employed over 2 million people.

1936 A.D. National Wildlife Foundation was formed.

1939 A.D. World War II began. Recycling was essential for war efforts so tanks, ships, guns, ammunition, and clothing could be made. The recycling lists included nylon and synthetic stockings, rags, scrap tires, raincoats, garden hoses, lard, dead animals, and old phonograph records.

1940 A.D. Sanitary Landfills introduced layering organic wastes with dry rubbish to reduce odors but still had leachate problems.

1945 A.D. World War II ended.

1948 A.D. Federal Water Pollution Control Law was established to help solve waste disposal problems.

1956 A.D. Water Pollution Control Act authorized first federal money for water treatment plants.

1953 A.D. Keep America Beautiful was founded.

1963 A.D. First Clean Air Act authorizes $95 million to local, state, and national air pollution control efforts.

1965 A.D. Solid Waste Disposal Act created funds for states and municipalities for research, planning, and developing waste disposal programs.

1970 A.D. Resource Recovery Act provided funds to construct waste/disposal facilities and was the first Federal legislation to encourage recycling.

1970 A.D. The first Earth Day was celebrated on April 22.

1972 A.D. U.N. Conference on the Human Environment. Representatives of 113 nations gathered to develop a plan to protect the world environment.

1976. A.D. National Academy of Sciences reported that chloroflurocarbon gases from spray cans are damaging the ozone layer.

1976 A.D. Resource Conservation and Recovery Act empowered EPA to regulate the disposal and treatment of municipal solid and hazardous wastes.

1976 A.D. Resource Conservation and Recovery Act mandated that all open "dumps" close by 1983 and that EPA was to draw up guidelines for "sanitary landfills," develop waste reduction strategies and identify hazardous wastes.

1978 A.D. Love Canal, New York was evacuated after it was discovered that it sat on top of a chemical waste dump.

1978 A.D. Rain with a Ph of 2 fell in Wheeling, West Virginia. This was 5000 times more acidic than normal.

1980 A.D. Comprehensive Environmental Response, Compensation, and Liability Act legislation was passed, requiring EPA to supervise and regulate abandoned toxic waste site cleanups.

1986 A.D. Dioxin contaminated Times Beach, Missouri, leading to evacuation and buy-out by EPA.

1986 A.D. Rhode Island became the first state in the nation to issue a mandatory recycling law for newspaper, glass, plastics (HDPE & PETE) aluminum and tin.

1987 A.D. A Long Island garbage barge, the MOBRO, searched for a place to dump its trash, symbolizing the nation's waste problems.

1987 A.D. The Montreal Protocol was signed by 24 countries. It dealt with reducing the production of chloroflurocarbons.

1988 A.D. Plastic Pollution Research and Control Act banned ocean dumping of plastic materials.

1988 A.D. Beaches were closed on the East Coast, Lake Michigan, and Lake Erie due to medical waste contamination.

1988 A.D. Legislation banned the dumping of wastes in the oceans.

1989 A.D. Oil tanker VALDEZ ran aground and spilled 11 million gallons of oil.

1990 A.D. Earth Day celebrated its 20th anniversary with renewed public interest.

1991 A.D. President Bush established an advisory group to improve environmental protection without harming the economy, called the President's Commission on Environmental Quality.

1992 A.D. Earth Summit was held to discuss the state of the planet.

TRASH TRIVIA

Objectives

Students will be able to demonstrate knowledge of litter, recycling and solid waste management facts.

Method

Students team-teach trash facts to the rest of the class, and then compete in a trivia game.

Materials

trash trivia fact sheets, writing materials, scissors (optional), timer or watch with a second hand

Vocabulary

litter, biodegrade, packaging, disposable, reduce, reuse, recycle, trash, waste, renewable, nonrenewable, sanitary landfill, organic, composting, waste-to-energy, NIMBY syndrome, recyclable

Procedure

1. Divide the class into three teams. Assign one of the three trash trivia fact sheets (Litter and Waste; Reduce, Reuse, Recycle; or Managing Solid Waste) to each team. Give each team member a copy of the fact sheet. Each fact sheet contains ten questions and answers about an area of solid waste (the sheets can be cut into question cards, if desired). Tell students that these questions will be the basis of a trash trivia game, so they should not let other groups see or hear their questions.

2. Instruct the teams to prepare a presentation of not more than 30 minutes to teach the rest of the class the facts on their sheet. The presentations must include all of the facts listed on the sheet (in any order), but they should be surrounded by other information so that the actual questions are not obvious. In other words, teams should not "give away" the questions and answers in their presentation. Teams also need to write two questions of their own in the assigned subject area (for a total of 12 questions). Give the teams ample time to research their topics and plan their presentation. All team members must participate in the teaching.

3. Have teams teach their trash trivia to the rest of the class. It might work best to have team-teaching for 30 minutes, three days in a row, rather than all on one day. Students are allowed to take notes during the presentations.

4. Hold a trash trivia study session. Teams should study their notes from the presentations and drill each other on facts.

5. Hold the trash trivia competition according to the following rules:

- Each group asks all of their questions as a set. The order of the groups should be decided randomly.
- Questions are directed to the remaining two teams on an alternating basis.
- A team has 30 seconds to discuss the question before they are required to give an answer (there should be some sort of official timer, whether it is a student watching the clock, a mini-hourglass, etc.).
- One point is awarded for a correct answer.
- The team with the most points wins. Tie-breaker questions should be used in the case of a tie.

6. After the game is over, ask students to name the trivia facts they felt were most important. List these on the board and discuss them in more detail.

Assessment

Ask students to name two important facts about litter, recycling, or managing solid waste.

Enrichment

As a class, develop a board game based on solid waste concepts. Put the game in the library so other students may play and learn from it.

Create a list of terms that are significant to the field of solid waste. Break the class up into two teams and play a version of the game "Win, Lose or Draw" by having students illustrate the concept/term while teammates guess. If the team does not guess the correct term within a certain time frame, the other team can earn the points if they guess the word.

The questions and answers from this game make great work-station or independent desk activity work when the questions and answers are copied separately, laminated and used as matching flash card sets.

Litter & Waste Trivia Questions

TRASH TRIVIA **Q.** People litter more in places where trash has already accumulated. True or false?	**TRASH TRIVIA** **Q.** Littering at a football game is an example of which reason why people litter?
TRASH TRIVIA **Q.** Biodegradability significantly decreases the volume of a sanitary landfill. True or false?	**TRASH TRIVIA** **Q.** It is O.K. to throw an apple core out the car window because it is biodegradable. True or false?
TRASH TRIVIA **Q.** Packaging accounts for approximately what percent (by weight) of the municipal solid waste stream?	**TRASH TRIVIA** **Q.** Commercial waste represents between 30 and 40% of a community's waste stream. True or false?
TRASH TRIVIA **Q.** Littering is unlawful only if it is done on purpose. True or false?	**TRASH TRIVIA** **Q.** How many tons of trash are generated each year in the U.S.?
TRASH TRIVIA **Q.** KAB has identified seven sources of litter. Name two.	**TRASH TRIVIA** **Q.** The largest item in the MSW stream (by weight) is what?

Litter & Waste Trivia Answers

They think someone else will pick it up.	True, people will litter where trash has accumulated.
False. It is still littering and, though it will biodegrade eventually, it will be litter in the meantime.	False, biodegradation requires moisture, oxygen, light and microbes, none of which are present in a Sanitary Landfill.
False, commercial wastes represent between 50 and 70% of the MSW stream.	32.7%
The U.S. generates more than 200 million tons of trash each year.	False, ignorance of the law does not justify breaking it.
Paper and paperboard (32.3% by weight)	Accept any of the following: pedestrians, motorists, uncovered trucks, loading docks, improperly contained household trash, improperly contained business waste, construction sites.

Reduce/Reuse/Recycling Trivia Questions

TRASH TRIVIA **Q.** Using washable plates instead of disposables is an example of what?	**TRASH TRIVIA** **Q.** New glass containers can be made of 100% used glass. True or false?
TRASH TRIVIA **Q.** Recycling includes three steps. Name them.	**TRASH TRIVIA** **Q.** Name one thing made out of two-liter pop bottles.
TRASH TRIVIA **Q.** The U.S. recycles what percent of its trash?	**TRASH TRIVIA** **Q.** It takes the same amount of energy to make two aluminum cans from recycled aluminum, as one aluminum can from bauxite ore. True or false?
TRASH TRIVIA **Q.** Name one thing made out of recycled newsprint.	**TRASH TRIVIA** **Q.** Name three materials that can be recycled.
TRASH TRIVIA **Q.** Name three major sources of pulp used for making paper.	**TRASH TRIVIA** **Q.** All new steel has recycled content. True or false?

Reduce/Reuse/Recycling Trivia Answers

True, glass can be made from 100% recycled content.	Reusing plates, reducing waste
Possible answers include: • fiberfill for coats, sleeping bags and pillows • bath tubs and shower stalls • insulation • sailboats	Recycling includes the following steps: 1) collection and separation, 2) reprocessing and remanufacture, and 3) buying back a recycled content product.
False, it takes the same amount of energy to make 20 cans from recycled aluminum.	The U.S. recycles 17% (6% of what is recycled comes from homes and 11 % from commercial establishments).
Possibilities include: aluminum, paper, plastics, glass, brass, iron and steel, tires, motor oil, textiles, copper.	Possible answers include: hydromulch, particle board, insulation, newsprint, toilet paper.
True, steel has been recovered for recycling for over 150 years. All new steel contains recycled content.	Three major paper pulp sources are: recycled and recovered paper, tree farms, and lumber scraps.

Managing Solid Waste Trivia Questions

TRASH TRIVIA

Q. Municipal solid waste (MSW) is waste generated by commercial establishments (businesses), institutions (e.g., schools), light, industry and what?

TRASH TRIVIA

Q. What percent of the trash in the U.S. is landfilled?

TRASH TRIVIA

Q. What is the controlled process of degrading organic matter by microorganisms?

TRASH TRIVIA

Q. Burning solid waste to produce electricity or steam is called what?

TRASH TRIVIA

Q. What percent of MSW is combusted or burned to produce energy?

TRASH TRIVIA

Q. The NIMBY syndrome is a big reason why it is hard to build new landfills. NIMBY stands for what?

TRASH TRIVIA

Q. The best solution to managing our MSW is to recycle everything.

True or false?

TRASH TRIVIA

Q. An open site where waste is deposited is called what?

TRASH TRIVIA

Q. Collecting and disposing of wastes in America costs approximately 6 million dollars each year.

True or false?

TRASH TRIVIA

Q. Name three waste items which can be composted.

Managing Solid Waste Trivia Answers

67%	Households
Waste-to-energy	Composting—3% of the MSW stream is recovered for composting.
Not In My BackYard! (People are often opposed to a sanitary landfill being built in their neighborhoods.)	As of 1994, 125 Waste-To-Energy plants burn16% of MSW to recover energy, and 26 municipal waste incinerators combust 1% of MSW.
An illegal dump (or open dump)	False. Not everything is recyclable.
Accept any of the following: grass clippings, leaves, wood ash, food wastes (egg shell, banana peel, etc.), hedge clippings, weeds, manure	False, it costs more than 9 billion.

LINGO BINGO

Objectives

Students will 1) identify vocabulary used on consumer packaging relating to solid waste issues; and 2) gain a better understanding of the meanings of this vocabulary.

Method

Students will collect consumer packages containing a variety of vocabulary relating to solid waste issues. They will then use these packages to play an interactive bingo game. Follow up discussion will define all of the terms used in the game.

Materials

empty consumer packages, copies (one per student) of the blank bingo card (included in this lesson), bingo prizes (optional), pencils or pens

Vocabulary

biodegradable, photodegradable, post-consumer content, pre-consumer content, recyclable, recycled

Procedure

1. Instruct students to collect and bring into the classroom a variety of consumer packaging which contains information about the environmental impact of the product or the packaging. Many products now contain such labels. Younger students may need a list of suggested vocabulary to search for.

2. When a sufficient number of containers have been collected (at least one per student) use the blank bingo card to produce a master card. Choosing from the available packaging, copy one phrase or term into each square of the card. Be sure to include all of the terms listed in the vocabulary section above since these are some of the most commonly found and least understood terms. Terms which are similar may be used. For example, 100% recycled paper and 100% recycled fibers could both be used on the card. Duplicate one card for each student. All the cards will be identical.

3. When ready to play Lingo Bingo, distribute the containers and bingo cards among the students. Each student needs one container and one card. Instruct students to circulate around the room searching for the person who has the packaging containing each term. The students keep their own package throughout the activity. When a student locates a particular term, the product contained in the package and the name of the student holding the package are written in the appropriate square. Play continues until someone

fills one row of squares either vertically or horizontally. The game may be played several times allowing a number of students to win.

4. After students have completed the game portion of the activity, follow up with a class discussion. Have students take turns holding up their containers and identifying the appropriate terms or phrases. With the class, define each term. Be sure to clarify commonly confused terms such as recycled and recyclable. The glossary of this manual is a good reference for finding correct definitions of most terms.

Assessment

In place of the weekly spelling or vocabulary test, have students spell or define the terms covered in this lesson.

Enrichment

Have students create their own solid waste dictionaries using the vocabulary from their bingo cards.

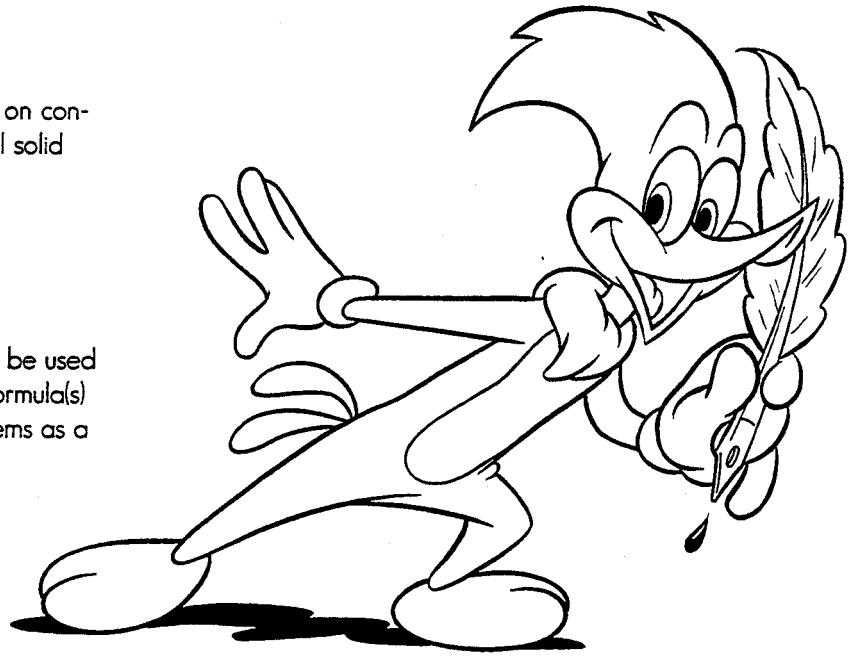
Use the containers collected by students to construct a bulletin board display. Students mount their packages with the vocabulary highlighted. Next to each package place an index card with the definition of the appropriate term.

L	I	N	G	O
		FREE		

POETRY IN MOTION

Objectives

Students will be able to write poetry based on concepts learned during their study of municipal solid waste issues.



Method

Students will brainstorm topics and words to be used in a creative writing assignment. Following formula(s) presented by the teacher, they will write poems as a class and individually.

Materials

poetry formulas, paper, writing instrument(s)

Vocabulary

poetry vocabulary listed in this lesson only

Procedure

1. After students have spent some time studying the integrated approach to solid waste management (waste prevention, recycling, composting, incineration, and landfills), have them brainstorm words they associate with certain topics. Ask one student to act as the class recorder at the chalkboard or overhead. Then give the class one word. For example, the word may be landfill. Instruct the class to make as many free associations for this term as they can. As each word or thought is called out, it is recorded on the board. Remember, there are no right or wrong answers in brainstorming. The purpose of a brainstorm is to generate as many ideas as possible. Encourage students to share whatever comes to mind and not to pass judgement on one another's answers. Once a lengthy list has been compiled or the storm dies down, tell students that they are now going to use this list as a word bank for their poetry writing.

2. It is often helpful to write one or two poems as a class before assigning individual work. Following are several common styles of formula poetry and examples.

   ACROSTICS: In an acrostic poem, the key word or phrase is written vertically on the page. Each letter of the word then becomes the first letter of a word or phrase relating to the key word.

   ***L**ife's refuse*
   ***a**lready used*
   ***n**o longer wanted*
   ***d**iscarded*
   ***f**inds*
   ***i**ts*
   ***l**asting rest*
   ***l**ayered under ground*

HAIKU: This well known Japanese form of poetry consists of three lines which do not rhyme. Each line has a set number of syllables: five in the first and third lines, seven in the second line.

Have a garage sale
Share, repair, reuse, reduce
That's waste prevention.

DIAMONTE: This style of poetry takes its name from the diamond shape resulting from the form of the poem. The poem is composed of seven lines as follows: line one is a noun, which is the title of the poem; line two, two adjectives; line three, three "ing" verbs; line four, four nouns; line five, three more "ing" verbs; line six, two adjectives; line seven, one noun, usually a synonym for the title.

Litter
ugly, dirty
cluttering, damaging, ruining
parks, beaches, streets, playgrounds
blowing, rusting, rotting
sad, unnecessary
litter.

SYNTU: Syntu is a five line form of poetry. Line one names the subject or title of the poem. Line two gives information about the subject. Line three expresses an emotion or feeling about the subject. Line four is more information on the subject. Line five is a synonym for the title.

Compost
organic matter breaking down
wonderful cycle of life
changing leaves and banana peels into
soil helpers.

3. You may wish to have students write just one poem or you might assign one of each type of poem per student. Each student could then compile and illustrate his/her own poetry collection.

Assessment

Student poetry should be evaluated to see that they have fully grasped material presented on related topics. The poems should also follow the correct formula for each style of poetry.

Enrichment

Student poetry can be collected into a class poetry anthology and displayed in the school library.

Poems could be submitted to local newspapers for publication in special environmental sections.

If students have made recycled paper, their poems can be copied onto the paper and displayed.

READ THE LABEL

Objectives

Students will be able to identify important product information by reading the package label.

Method

Students will identify important product information and design a poster to include the information found on the products' labels.

Materials

copies of the handout "Labels" (provided), poster board, color markers, clean empty household cleaning containers

Vocabulary

hazards

Procedure

1. Background: Since cleaning products are in our homes everyday, we need to know what the product is, how to use it properly and what the necessary safety precautions are. By reading and understanding the labels, we can make informed choices about which products suit our household cleaning needs and satisfy our concerns.

   Effectiveness is a main reason for selecting a product. By using the label as the source of information, we can use the product properly and achieve the desired results.

   With manufacturers continuing to formulate new and better products, for example, the "ultra" laundry detergents which require a much smaller amount used, it is particularly important for consumers to follow the label directions to achieve good results.

Safety is an important issue with household cleaning products, just as it is with any product we bring into our homes. Since even safe products can cause injuries if used in ways other than intended, we need to know about specific hazards. That's why household cleaning products are labeled with human safety information.

The presence of cleaning products in the home creates the possibility of accidental exposure of eyes, skin, and respiratory tract and possible ingestion by small children.

Accidental exposures are not unique to household cleaning products. There are hazards associated with specific events or exposure to almost any item, and labels are intended to provide the appropriate warnings. For example, because an otherwise safe hair dryer becomes a hazard

when dropped in water, its label warns you of this possibility.

2. Before beginning this lesson, collect samples of clean, empty household cleaner containers with the labels on (five or more would be a good start).

3. **What's on a label?** We often take labels for granted. By taking a closer look, we can find important information about the product we've chosen. There is certain information which may be found on a typical label. Not all of this information will be found on every household cleaning product. The information given for a specific product depends on the specific formulation of the product and the information appropriate for that formulation.

   Product name identifies the product.

   Product type indicates what kind of product it is. For example, is it an all-purpose cleaner, laundry detergent, disinfectant cleaner, hand dishwashing detergent, etc?

   Directions for use provide key information to ensure that the correct results are achieved. For example:

   What is the proper method for using the product?

   How much of the product should be used?

   What fabrics/dishes/surfaces/should it be used on?

   What fabrics/dishes/surfaces should it *not* be used on?

   Ingredients listing tells what the product is made from. For disinfectants, the active ingredients (disinfecting or anti-microbial ingredients) *must* be listed. For other cleaning products, it is not required that any ingredients be listed; however, many times they are. Unlike packaged food labeling, the order of the ingredient listing does not necessarily represent the relative amounts of each ingredient in the product.

   Human safety information provides CAUTION/WARNING or DANGER statements, as well as precautionary statements and emergency treatment information.

   Storage and/or disposal information provides special guidelines for properly maintaining a product and getting rid of it if necessary. For example, it may need to be stored in a cool, dry location; the package may need to be rinsed out before recycling or disposing in the trash.

   EPA Registration Number (for disinfectants) indicates that the product meets the U.S. Environmental Protection Agency's (EPA) criteria for disinfectants. A disinfectant is a product that destroys harmful bacteria. A product that is labeled "disinfectant" is required by law to list the EPA Registration Number on the label.

   Environmental information for the product and/or the container provides special facts or instructions pertaining to the environment. The package may be recyclable, or may contain recycled materials. Certain ingredients may be biodegradable. Not all companies provide this information even though their package or product may warrant such claims. Industry is presently working with the Federal Government to develop national uniform environmental labeling guidelines so consumers have a clear understanding of the use of environmental terms.

   Manufacturer's name and address and/or a toll-free number are often included. This enables consumers to contact the maker with any questions, comments or problems.

   Net weight or volume shows the amount of product in the container. This is often helpful in comparing prices for different sized packages or competitive products.

4. **Reading the Label: Human Safety Information**

   Human safety information is one of the most important features on the labels of household

cleaning products. The Federal Hazardous Substance Act governs how household cleaning products are labeled for human safety. This Act defines the term "Hazardous substance" and provides test procedures and labeling guidelines to assist manufacturers in developing labels.

The **degree of hazard** is explained by a **signal word,** which is the first and largest word of the statement. Signal words are:

CAUTION or WARNING

DANGER

For household cleaning products the words CAUTION or WARNING are interchangeable. For other products, such as pesticides, the words may not be interchangeable.

Following the signal word, the human safety statement includes:

The **specific hazard** of the product. For example, it may be an eye or skin irritant; it may be harmful if swallowed; it may be flammable; there may be products it should not be mixed with.

The **precautionary measures** describing actions to be taken or avoided. For example, it may explain how to treat if the product is splashed in the eyes or swallowed; maybe the product should be used in a well-ventilated area; or perhaps the user should wear rubber gloves for protection.

The **statement** "KEEP OUT OF THE REACH OF CHILDREN" or its equivalent.

Appropriate handling, storage and disposal instructions are included if they are relevant to the hazard. For example, maybe the container should not be reused, or the product may need to be stored away from heat or out of direct light.

The CAUTION/WARNING or DANGER statements on labels are for human safety only. They have no relationship to the environmental safety of the product. The testing that is done to determine how a product is labeled for human safety indicates whether accidental exposures to high concentrations of the product will damage the eyes, skin or internal organs. This testing does not predict the quantity or the effects of ingredients released into the environment.

5. Reading the Label: Degrees of Human Hazard

When examining the human safety information on a label, we may wonder what those "signal words" in the hazard warning statement mean, and which is the more serious of the terms.

Many household cleaning products do not include any hazard warning statement. This means that no major harm would be done by being exposed to or by swallowing small amounts of the product. Many non-aerosol furniture polishes, window cleaners, fabric softeners and some hand dishwashing detergents fall into this category.

The words **CAUTION** or **WARNING,** which are interchangeable, indicate the mildest hazard warning—and the most common. They mean that the product is not likely to produce permanent damage as a result of exposure, if appropriate first aid is given. Labeling for products always depends on their specific formulation. This is why you may see slightly different labeling for products within a category such as hand dishwashing detergents, etc.

With a CAUTION or WARNING indication:

The eye or skin could become inflamed or adverse effects, such as dizziness, upset stomach, etc., could occur if the product is swallowed. Almost all laundry and automatic dishwashing detergents fall into this category because they can cause eye or skin irritation.

The word **DANGER** indicates a greater human hazard. It is used less frequently on household cleaning products and is seen most often on

products intended for tough jobs, such as cleaning the oven or opening clogged drains.

Accidental exposure of the eye or skin to the undiluted product could produce tissue damage; swallowing the undiluted product could produce consequences, such as damage to the mouth, throat and stomach; or the material could ignite if exposed to an open flame.

The word **POISON** is the strongest indication of hazard, and it is used only for the most severe hazards. It is rarely used on household cleaning products, but may be found on household lye; some car care items, such as antifreeze, that may be stored in the home; or on insecticides and rodenticides.

6. Reading the Label: Other Safety Points

In addition to the human hazard information, we need to be familiar with other safety precautions when using household cleaning products. You may find these precautions included in the label information.

Avoid product vapors.

Vapors are often released when using household cleaning products. Since many cleaning products that release small amounts of vapors are used in confined areas, such as bathrooms, products may also be labeled "Use in well-ventilated areas" or "Do not use near open flame or in areas where sparks may be generated." Products with these labels should be used with windows open, or in areas that have ample air circulation or away from possible heat sources.

Do not mix products.

Products which are safe when used alone can sometimes become dangerous if they are mixed with other products. When some household cleaning products are mixed, they can result in the release of dangerous gases which can cause coughing, dizziness or nausea. The label will indicate if this is a possible hazard. For example, in some cases, a specific agent such as chlorine bleach (sodium hypochlorite) may be mentioned.

In general, never mix chlorine bleach or any product containing chlorine bleach (tub and tile cleaners, mildew removers, some all-purpose cleaners, automatic dishwashing detergents) with:

AMMONIA—including products which contain ammonia or ammonia-containing compounds (some hand dishwashing detergents or window cleaners) or

ACIDIC PRODUCTS (toilet bowl cleaners, rust removers)

If it is hazardous to mix a product with another type of product, this will usually be stated on the label. Check the label to see if chlorine bleach or sodium hypochlorite is listed as an ingredient. This will help determine whether or not the product can be mixed with other products.

7. Reading the Label: Emergency Treatment

No matter how familiar we are with the hazards of accidental exposure that are explained on the label, an accident or unforeseen exposure can sometimes occur. In this case, the label should be the first source of information for emergency treatment.

If accidental exposure has occurred, follow the label instructions carefully! First aid instructions for different products vary significantly, so it is crucial to read and follow the specific instructions for the product involved. For example, for some products, vomiting should NOT be induced, while for other products, vomiting is not harmful.

Next, if warranted, call your local poison control center or hospital emergency room for the best advice for the specific situation. They'll be able to help you with the quickest and best first aid advice. In fact, most manufacturers provide information about their products to poison control centers for just this type of emergency. The phone

number for your local poison control center is often found on the inside front cover of the telephone directory or in the section for emergency numbers. Many poison control centers have toll-free numbers.

8. Divide the class into groups, assigning one household cleaning product to each group. Distribute to each group a copy of the handout, "What's on a Label?"

9. Have students research their assigned product and identify the information using "What's on a Label?" as a guide.

10. Ask each group to make a poster with their research findings and then choose one person from each group to present their poster to the class.

Assessment

Have students identify several or all of the ten specific pieces of information found on a label:

product name
product type
directions for use
ingredients
human safety information
storage and/or disposal information
EPA registration number
environmental information
manufacturer's name, address, and/or toll-free number
net weight and/or volume

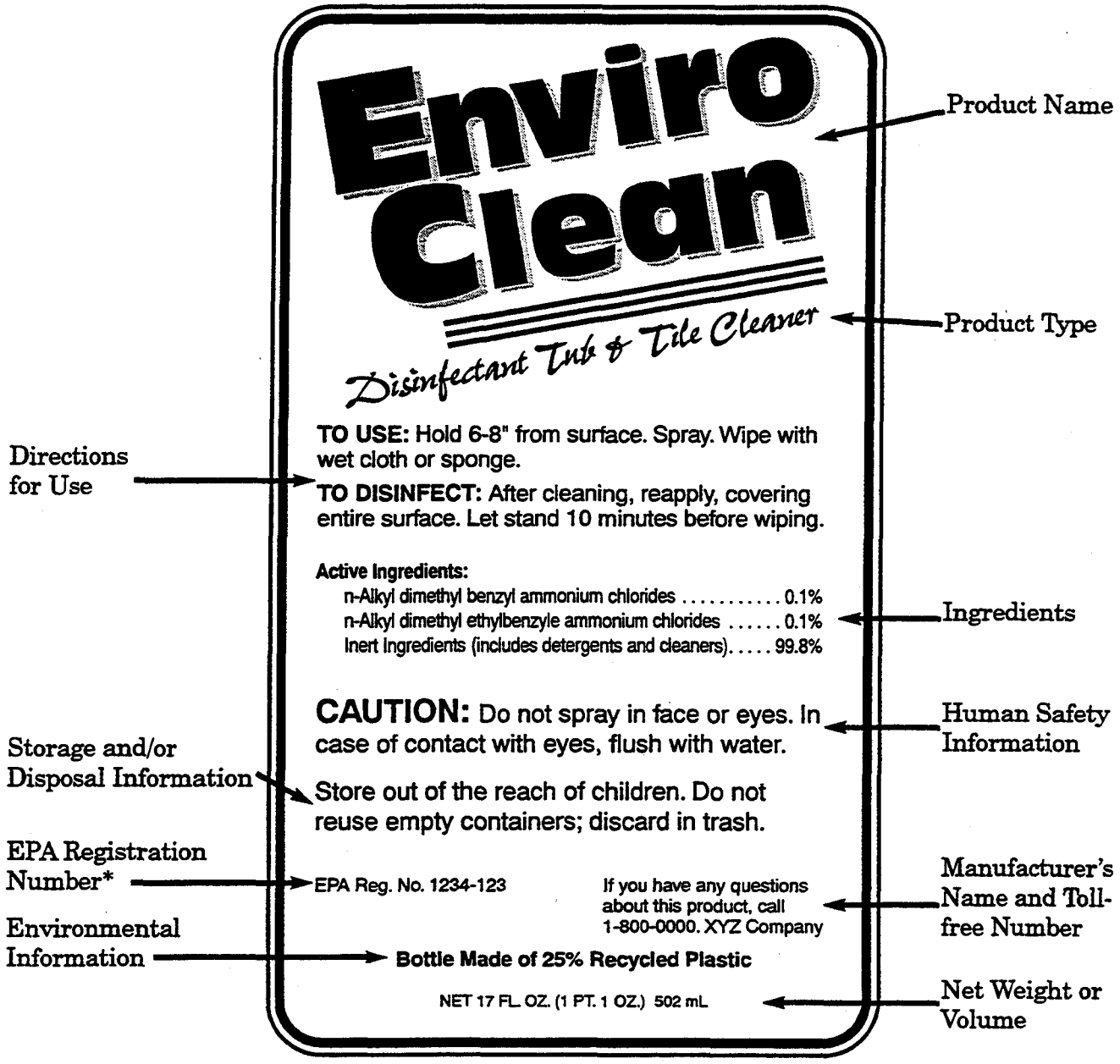
Enrichment

Students may contact (by letter or telephone) a product manufacturer. Using the list provided in this lesson as a guide, prepare a list of questions or request information not provided on the product label.

Adapted from SDA's *Cleaning Products...In Our Homes, In Our Environment* videoconference. Used with permission.

READ THE LABEL

This sample label shows ten types of information that may be found on household products. Not all of this information is found on every product label.



*Only given for disinfectants. If a product claims to have disinfectant properties, it must have an EPA Registration Number.

CHARTING THE COURSE

Objectives

Students will be able to: 1) identify opportunities to prevent waste in the classroom; and 2) evaluate their waste prevention solution(s).

Method

Students will brainstorm ways to prevent waste in the classroom and evaluate these ideas using a critical thinking chart.

Materials

writing materials, copies of the critical thinking chart, "Charting the Course" (provided)

Vocabulary

prevention, source reduction

Procedure

1. Lead a discussion with the students on how the class might prevent waste in the classroom. Use the following questions to assist:

   - What are some ways we might prevent waste or trash in our classroom?
   - Would it be easy or hard to do these things? Why or why not?
   - What behaviors would be used or changed in the process of preventing waste?
   - Do you think we may have to change some attitudes or habits? Would this be easy or hard? Why?

   - Would we be able to do these things for free? If we needed money to prevent waste, how would we get it?

2. Divide students into groups of four. Assign the following roles to each group:

   Checker: checks to be sure that all members agree on a group answer and can fully explain it

   Recorder: fills out the chart as members dictate

   Coach: checks to be sure that everyone agrees with the instructions and that everyone participates

   Encourager: gives praise and encouragement for each person

3. Have the groups first brainstorm as many different ways as possible to prevent waste in the classroom. The recorder should write down a list. Explain to the class that when you are brainstorming, every answer is considered. This is not the time to evaluate each answer; that will occur later.

4. After about 15 minutes of brainstorming, ask the groups to now select five answers on which they all agree.

5. Using the critical thinking charts they have been given, students are to rate each of their solutions with the given questions and ratings scale. (See the Critical Thinking Chart). After rating each solution, students should total their results for each solution.

6. Lead a class discussion on the best solution with the highest rating from each small group. Create a master chart using the solutions that received the highest total from each group. List these in order, from highest rank to lowest. If any solutions have the same total, take a class vote to break the tie.

7. Ask the class if they agree or disagree with any of the solutions. Then ask:
   - Could we actually implement these five solutions? Why or why not?
   - As a Class, are we prepared to do all five solutions, or should we begin with one or two?
   - Do we need approval and/or cooperation from others in this building to make these strategies work?

8. Select one or more of the waste reduction solutions to begin implementing immediately.

Assessment

Students explain how charting information can help in the decision making process.

Enrichment

Set target dates and track the volume of trash the class is generating without implementing the solutions. Then attempt the solutions and track the volume of trash.

Invite another classroom to join the efforts of preventing waste.

Talk with custodial personnel and administrators about the cost of waste hauling for your school and school district.

Have each student write a proposal to the principal describing the best solution to preventing waste.

Charting the Course

Directions:

1. In your group, brainstorm five ways to reduce waste use in your classroom. Write each solution in the chart.
2. Using the scale below, rate each solution according to how you would answer the question in the chart.

   0 1 2 3 4 5
   (no ..... maybe ..... yes)

3. Add the ratings for each solution to find its total. The highest total indicates the best solution.
4. On the back of this sheet, write a proposal to your teacher. In the proposal, desribe your best solution. Tell why you think that your solution will reduce waste in your classroom.

SOLUTIONS	Will it be easy to do?	Will it have a low cost?	Will it not interfere with learning?	Will it be effective?	TOTAL
1.					
2.					
3.					
4.					
5.					

WHEN THEY'RE GONE, THEY'RE GONE

Objectives

Students will be able to: 1) distinguish nonrenewable natural resources from renewable resources; 2) identify the consequences of burying waste and suggest alternatives that save nonrenewable resources; and 3) explain the uneven distribution of natural resources among countries of the world.

Method

Students will take part in a simulation activity about the distribution of finite resources around the world. Students will discuss how the simulation activity represents international competition for resources.

Materials

craft beads: 400 red, 104 blue, 31 pink, 12 green, 1 orange, 1 yellow, 1 purple, 1 clear; 6 plastic cups; writing materials, chart "Nonrenewable Natural Resources," copies of the pre-test and post-test, one large bag of puffed rice or polystyrene packing peanuts

Vocabulary

natural resources, renewable, nonrenewable, sanitary landfill, recycle

Procedure

1. Before class, hide beads throughout the classroom when students are out (some in easy to find places on the floor and others in more difficult places up higher).

2. Discuss the following statement with the class: As countries become more industrialized and

developed, they consume more NATURAL RESOURCES. Natural resources are a source of material wealth within a country, such as timber, fresh water, or mineral deposits that occur in nature, e.g., iron and bauxite. Give students the pre-test, telling them you want to see what they already may know about natural resources and waste.

3. Explain to students the difference between RENEWABLE and NONRENEWABLE resources. A renewable resource is a natural resource which can be regenerated by natural ecological cycles or sound management practices, e.g., trees and water. Make a list on the board of renewable and nonrenewable resources. (Examples of renewable resources include cotton, wool, silk, trees, etc., and non-renewable resources include metals, petroleum products, water, etc.) Then proceed to explain the activity. Beads of different colors have been selected to represent nonrenewable resources. The number of beads reflect a mineral's relative estimated total abundance,

not that mineral's ease of extraction or potential availability (see table next page)

4. Reproduce the first three columns of the chart on the board. Tell students that these beads will be used in an activity later in the day.

5. Divide students into teams representing countries. To show increased potential in exploring for resources, vary the size of each group (USA 6, Commonwealth of Independent States 5, Iran 4, Japan 3, South Africa 2, Malaysia 1, etc.)

6. Give teams time to explore for resources. Have them collect beads in the plastic cups. First, give them two minutes to search around the room and then return to their group. Repeat search again, but this time for only one minute. After each exploration, students should separate and consider results based on beads they have accumulated in their cups. These can be compared on the chart to the actual reserves in each country.

7. Discuss the greater difficulty in finding resources during the second period of exploration. (Competition becomes more intense for fewer resources.) Discuss real life examples of countries competing for resources.

8. Beads in the plastic cups represent natural resources which are eventually thrown away in the form of products which people discard. Some natural resources are used for many years, while other natural resources are used for a very short time only and end up in SANITARY LANDFILLS. Discuss the future mining of sanitary landfills for natural resources. To illustrate "mining" sanitary landfills, mix one "country's" cup of beads into a larger container filled with puffed rice or polystyrene packing peanuts. Discuss how to recover the non-renewable resources (beads) from this landfill (container of puffed rice or polystyrene packing peanuts).

9. Ask students what they can do to extend the life of nonrenewable resources (RECYCLE). What are the advantages of extending the life of resources? (More resources available in the future, lessening international conflict, etc.) Ask the students to work in groups (by "country") to answer the following questions:

   - Did you use a product made from a renewable resource today? If yes, what?
   - Did you use a product made from a nonrenewable resource? If yes, what?
   - What can you do to conserve natural resources?

Assessment

Have students complete the post-test and compare their answers to the pre-test. Answers: 1. c; 2. b; 3. a; 4 c; 5. a; 6. c; 7. b; 8. c; 9. a.

Enrichment

Research the population of each country used in this activity. Then, repeat this activity using the population of each country for the ratio of students in each group and the beads that are collected as the amount of nonrenewable resources consumed by the people. Record the results on the board beside the previous results from the original activity and discuss the reasons for the changes in amounts of beads.

Research the renewable resources which are ending up in sanitary landfills, e.g., food, yard waste. Repeat this activity using the beads to represent various renewable resources. Discuss ways to reduce the consumption of renewable resources, and alternative disposal methods.

Allow a short time for students to "barter" for various resources as countries do now. Discuss results.

When They're Gone, They're Gone

Color	Beads	Finite Resources	1994 Estimated World Resources
Red	400	Iron in Ore	230 Billion Tons
Blue	104	Bauxite (aluminum ore)	55 to 75 Billion Tons
Pink	31	Chromium	11 Billion Tons
Green	12	Copper	2.3 Billion Tons
Orange	1	Lead	1.4 Billion Tons
Yellow	1	Tin	4.3 Million Metric Tons
Purple	1	Silver	10.8 Billion Troy Ounces
Clear	1	Platinum	100 Million Kilograms

Metric Ton=2,200 pounds Troy Ounce=31.103 grams

Source: *Mineral Commodity Summaries 1994*. U.S. Department of the Interior, Bureau of Mines.

"WHEN THEY'RE GONE, THEY'RE GONE" PRE AND POST TEST

DIRECTIONS: Answer the questions below by putting the letter of the one best answer in the blank.

1. An example of a renewable natural resource is a _____.
   a. metal b. fossil fuel c. plant

2. A nonrenewable natural resource _____.
   a. can be replaced b. cannot be replaced c. should be wasted

3. When a product is made, natural resources are _____.
   a. used b. conserved c. increased

4. When we throw away products after they are used, most of these items end up _____.
   a. being burned b. in the ocean c. being buried in the ground in a landfill

5. One way to conserve nonrenewable resources is to _____.
   a. reduce the amount of solid waste we produce
   b. increase the amount of waste we produce
   c. close down landfills

6. To reduce solid waste, we could buy products that are _____.
   a. used once, then thrown away b. made of plastics c. recyclable

7. Recycling means to _____.
   a. clean up litter b. make new products from old materials c. burn solid waste

8. When we bury trash and garbage in a landfill, we are also burying _____.
   a. new products b. things we should burn c. natural resources

9. Because nonrenewable resources are scarce, _____.
   a. countries compete with each other to acquire resources
   b. every country has all the resources it needs.
   c. countries do not have to trade for resources

Nonrenewable Natural Resources
World Reserves, U.S. Percentage Metals Recycled

Resource	World Resources*	1994 Countries or Areas with Highest Reserves		U.S. Percentages Metals Recycled
Iron in Ore	230 billion tons	USSR	34%	
		Australia	12%	
		Brazil	6%	
		Canada	11%	
		India	4%	
		USA	11%	
Bauxite	55 to 75 billion tons	South America	33%	
		Africa	27%	
		Asia	17%	
		Oceana	13%	
Chromium	11 billion tons	South Africa	95%	Chromium— 18% from stainless steel scrap
Copper	1.6 billion tons	Chile	28%	Copper— 44% of supply
		USA	14%	
		USSR	12%	
		Philippines	6%	
		Zambia	16%	
Lead	1.4 billion tons	Australia	16%	Lead— 784,000 tons from scrap batteries in 1992
		USA	16%	
		Canada	9%	
Tin	4.25 million metric tons	Malaysia	17%	Tin— 14,000 tons recycled in 1993
		Bolivia	17%	
		Brazil	23%	
		Thailand	13%	
Silver	10.8 billion troy ounces	USA	11%	Silver— 200 metric tons recovered from scrap
		Australia	10%	
		Canada	13%	
		Mexico	13%	
		Peru	9%	
Platinum	100 million kilograms	South Africa	90%	Platinum— 51,000 kilograms
		Russia	10%	
		USA	less than 1%	

*Source: *Mineral Commodity Summaries 1994*. U.S. Department of the Interior, Bureau of Mines.

DAILY ENVIRONMENTAL TIMES

Objectives

Students will be able to: 1) describe how newspapers and magazines increase or decrease awareness of environmental issues; 2) evaluate and analyze the various components of a newspaper or magazine; and 3) participate in the decision making process for an environmental challenge.

Method

Students will evaluate current newspapers and magazine articles about solid waste issues.

Materials

paper, pencils, markers, environmental articles from newspapers or magazines, newspaper

Vocabulary

newspaper vocabulary included in this lesson only; solid waste related vocabulary listed in glossary

Procedure

1. Background: Historically, newspapers have played an important role in social issues. On almost any given day, there are references in the newspaper to environmental issues. Citizens are becoming more concerned about the environment every day. If the solutions to environmental problems were simple, then all the problems would have been solved by now. It's not as simple as making a choice between right and wrong or good and bad. Making decisions means balancing all points of view for everyone today and tomorrow.
2. Before beginning this lesson, collect an ample supply of environmental articles from newspapers and/or magazines for students to select from for their assignment.
3. Bring in a current newspaper and discuss the various components of the page(s) using the vocabulary and diagram included in this lesson.
4. Have each student select an article from the teacher's collection of environmental articles. Ask students to read the lead paragraph. Have the students write who, what, where, when, why and how. If the article has a photograph, have the students describe in as much detail as possible what is happening in the photograph without reading the cutline.
5. Have the students identify the type of article. (Is it from a newspaper or a magazine? Is it a short story, editorial, etc?) Discuss with students how the type of article effects the environmental content.

6. Now have the students focus on the content of each article and answer the following questions:
   - How does this article make you feel?
   - Do you believe this article? Why or why not?
   - From whose point of view is this article written? How can you tell?
   - Does this article present information from many different sides or perspectives? How do you know?
   - Is the article biased or balanced? Explain how you can tell.
   - What are the facts that are presented? Are any of the facts documented? What is the source of these facts? Are there any opinions? Is there any fantasy?

     A **fact** is something true and accurate which has real, demonstrative existence.

     An **opinion** is a personal belief with or without positive knowledge or proof.

     A **fantasy** is a product of the imagination with no basis in fact or reality.
   - Who is quoted?
   - Are any weasel words used? **(Weasel words** are words that are ambiguous, obscure, or evade the issue and are not specific. For example, "Many officials complained." How "many?" Who are these "officials?" Some good examples of weasel words are several, many, frequently, substantial, etc.)

7. Give each student the same copy of an editorial about the environment and a piece of paper with one blank side. Ask the students to divide the blank paper into two columns. Label one column "fact" and the other column "opinion." Ask students to list statements in the editorial under the appropriate column.

8. An editorial generally consists of four different parts, the question, proof, conclusion, and suggestions for reader action. Review several editorials and identify the four components.

9. Look at an editorial cartoon and analyze the various components which relay its intended meaning: stereotyping, caricature, exaggerations, symbolism, fact, opinion and fantasy. Ask students to explain how each component works together with the others to achieve the cartoonist's message.

10. Discuss with students the fact that people often believe what they read in print or hear on the radio or television. Explain that people need to always use a critical eye and analyze what they are seeing, hearing or reading.

11. Here are some helpful steps to keep informed and to help in the decision-making process regarding environmental issues:

Steps for Making Informed Decisions about Environmental Issues

A) **Understand the situation.** Gather as much information as possible from as many sources as possible. Know the bias of your sources. Everyone filters information through their own experiences.

B) **Check your feelings and know your own value system.** What gut-level reaction do you have? Check your reaction against the information you have collected. If they don't match, perhaps you should re-evaluate your position.

C) **Work cooperatively with others.** Solutions to problems are often found on middle or common ground, where many people will work together. Value others' experiences.

D) **Consider all the alternatives,** even those that don't initially seem practical. Take each alternative to its logical conclusion(s).

E) **Decide upon an action or response,** after looking at all the alternatives and their consequences.

Assessment

Ask students to explain how newspapers and magazines can be useful or harmful in changing people's attitudes about environmental issues.

Enrichment

Have students invent an environmental problem, using a real situation from articles as springboards to their invented situation. Then ask them to write a news article about the invented problem, keeping in mind that they are citizens of the local community.

Have students write editorials about local solid waste management solutions. Remember to use the four different parts: question, proof, conclusion and suggestion for reader action.

Have the students draw an editorial cartoon.

Create your own "Daily Environmental Times."

Various Components of a Newspaper Page

EDUCATION
Special Series: "Kids and the Environment," a new twist for savvy students.
Details, see page 16.

Index box tells the reader where to find different selections and standing features.

WEATHER
High: Lower 90s
Low: Near 60
Partly cloudy, 30% chance of rain
Details, back page

BUSINESS
Motorola chip production to begin next week.

Promo boxes, sky boxes or overmast teases: refer to other big stories in the paper (normally found at the top of the page.)

National American Guardian

Flag or nameplate is the name of the newspaper in a distinctive type style.

FIFTY CENTS | ESTABLISHED 1871 | MONDAY, JULY 24, 1992

Inside

Special section on indoor air pollution.
Your Home, D1

90-mile Alaska road at heart of fight over acess to national park lands

By Hugh Dellios
Tribune Staff Writer

Lead is the first paragraph that contains the most important facts of the story with more detail than a headline.

KANTISHNA, Alaska—Like landowner, Valerie Mund dreams for her property. Y recent plan was a recreationa hicle park for tourists who might enjoy panning for gold, much like the fortune hunters who once inhabited this historic mining camp.

But Mundt faces a special problem. Her land is at the dead end of a 90-mile gravel road that is the only access into perhaps the nation's most treasured wilderness, Denali National Park and Preserve.

...administra-...cess rules ...etworks of ...a Alaska's ...nyonland ...pposed de- ... and even ... are allowed.

That predicament puts Mundt and the Denali road at the heart

Refer is a brief description of a related story that appears elsewhere in the paper.

COLORADO

Local residents fuming over feared "Gold Rush" on national park lands A7

of a long-running dispute over ecotourism and industry that now has grown into a national battle ...e ...t ...of ...m ...d ...tt ...d ...m ...it granted rights-of-way over federal lands to encourage the pioneering of the West.

U.S. military reservations.

The move is part of a "back-to-nature" campaign in which Interior Secretary Bruce Babbitt has vowed to reduce the number of hotels and roads in the nation's ...

"These claims could completely change the character of highly valued pristine areas across the West," said Terri Martin, a regional director for the National Parks and Conservation Association. "We're talking about virtually any dirt track or trail, even if it was the passage of one pair of wheels to a mine abandoned long ago."

Many Westerners see the move as another assault on their way of life, like the administration's earlier attempts to impose stricter environmental regulations on ranchers, miners and loggers who use public resources, and to charge them more for the privilege.

The wider-access issue arose in recent years when Alaska officials

See Alaska, Page 14

Jump line tells where the story is continued inside the paper.

Ecotourist's dream

Tiny Belizean town shares its natural wonders with a warm welcome

Deck head is a smaller headline that gives more detailed information.

By Douglas McArthur
Toronto Globe and Mail

CROOKED TREE VILLAGE, Belize—We set off at dawn in search of the legendary jabiru, the original Big Bird. With a mind-boggling wingspan and standing up to 5 feet tall in its bare feet, the jabiru stork is the sort of bird other birds call "Sir."

It is one of the largest flying creatures in the Western Hemisphere.

Technically, our expedition wasn't quite a search. Rudy Crawford, my host and guide, knew exactly where we would find a jabiru on this blue-sky

Follow the sun

Crooked Tree is also convenient for touring Chau Hix, an outstanding, but largely unexplored, Mayan archeological site. It is also home to some friendly and enterprising Belizeans who are developing a sustainable tourism economy on their own terms.

Crawford and his family run Paradise Inn, one of three small, rustic lodges at Crooked Tree Village. The inn's six thatch-roofed buildings—five sleeping cabanas and a dining hall—sit beside a lapping lagoon that turns into a mud pit in the dry months.

Photos courtesy International Expeditions, Inc.

The Paradise Inn at Crooked Tree Village in Belize. The inn's six thatch-roofed buildings sit beside Crooked Tree Lagoon.

Cutline tells the story of what's happening in the photo.

Surplus U.S. Army tanks ... the plunge as artif...al reefs

Byline is the name of the person who wrote the story.

By Stephen d'Oliveira
Ft. Lauderdale Sun-Sentinel

Credit line tells what newspaper or wire service provided the story.

MIAMI BEACH—In the war to attract diving tourists to South Florida, Dade County has won a battle of sorts by sinking two surplus U.S. Army tanks off Miami Beach.

The M60s are the first of 100 tanks that several Florida counties hope to sink as artificial reefs next year.

Instead of transporting battle-ready Marines, the 45-ton tanks, painted in black and green camouflage, will provide a habitat for a variety of marine life.

Divers can partially enter the rear sections of the tanks, where the engines and transmissions were before they were removed. But that's it. All the hatches.

"They're pretty neat," said Ben ...
Department of Environmental Re... Management.

Like ... to become artificial reefs, ... spray-painted with the ... workers and other volunteers associated with Project Reef-Ex.

A bumper sticker attached to the 105-mm gun barrel on one of the tanks states, "Proud to be a Teamster."

The tanks were deployed in 48 feet of water 1¾ miles off Miami Beach recently. Nearby are some radio towers and the Shamrock, a 110-foot ship once used as a troop landing craft.

"There is tons of stuff in this area," said Capt. Don Scholen, a veteran dive boat operator who watched as the first tank was sunk.

The tanks are 100 feet apart near a jumbled pile of limestone boulders. The huge rocks, dropped there recently, are already home to small numbers of snapper and hogfish.

Dateline tells where the writer was when writing the story—usually, but not always, where the story took place.

LET'S BE VOCAL

Objectives

Students will improvise definitions of vocabulary words associated with solid waste.

Method

Taking turns within a small group, students will develop vocabulary definitions, one word at a time.

Materials

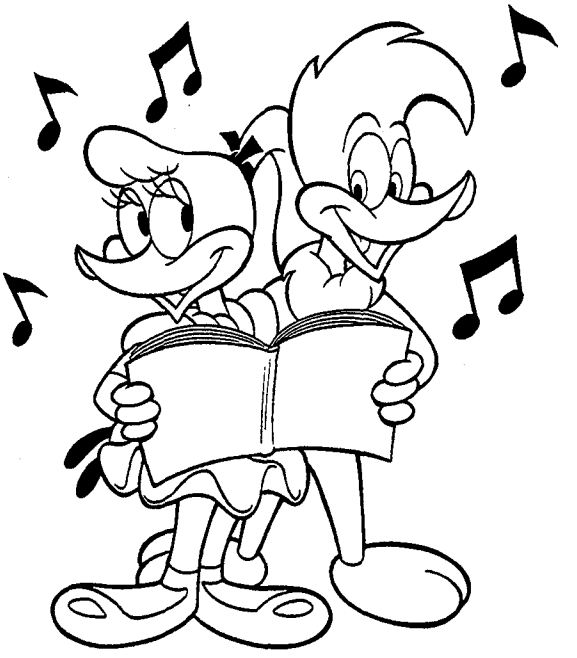
Waste-In-Place glossary or selected list of solid waste terms and definitions

Vocabulary

selected entries or entire Waste-In-Place glossary

Procedure

1. Background: Improvisation (improv) is the action of inventing or composing without preparation from materials at hand. In the hands of the educator, improvisation becomes a bridge to self-confidence, responsibility, acceptance of others, and most frequently, creativity. Improv deprograms the standard student response and allows the innate creative sense to flourish. Its essence is that of divergence. Viola Spolin, the master of the improvisational game, speaks of talented behavior as a "greater capacity for experiencing." Like few other activities, improv creates these new experiences while allowing talents to unfold naturally. The student learns from the process by <u>being</u> the process, creating a natural balance between the "frame of the game" and the "wild of the child."



2. Let's Be Vocal is a game in which 3 to 6 students act as one person to define solid waste vocabulary words given by the teacher. Answers are created as each member in order gives one word of the definition without prior collaboration. Each single word response follows the previous player's response until a final definition is obtained.

3. The teacher explains the rules of the game.

   a. The group must improvise a definition of the word given them without discussing it with each other.

   b. The definition is composed by each student giving one word following the previous student's word until the group has made a complete sentence.

4. The teacher calls 3 to 6 students to the front of the room.

5. Using selected solid waste terms and definitions or the Waste-In-Place glossary, the teacher gives a word from the list to the students.

6. The first person in the group begins the response by speaking one word of a definition.

7. The person to his/her left will give the next word, and so on until the group is satisfied with their response.

8. After the group has finished, the teacher will compare their definition to the one given with the vocabulary word.

9. Continue the game with different groups of students until all the students have taken at least one turn.

Assessment

The game itself can be used to pretest, to review, or to check for understanding of any or all waste related terms.

Enrichment

Have students make their own lists of words related to solid waste issues to be used for the game.

Play the game as suggested in the procedure, but do not let the "audience" (students not defining the term) know what the term is that is being defined. Have the "audience" write down the term they think is being defined, or have them call it out as it soon as they know what it is.

LITTER VALUE BAG

Objectives

Students will be able to: 1) state why litter is harmful; and 2) state that littering is a behavior that can be changed.

Method

Students will rank a variety of litter items from "most harmful" to "least harmful" and discuss their reasoning.

Materials

1 set per group of the following: paper sack, disposable cup, small glass bottle, string, snack bag, plastic six-pack yoke, cigarette butt, balloon, orange peel, beverage can, straw; writing materials

Vocabulary

litter, biodegrade

Procedure

1. Put together "value" bags with the following items in them: paper sack (use it to hold the rest of the items), disposable cup, small glass bottle, string, snack bag, plastic six-pack yoke, cigarette butt, balloon, orange peel, beverage can and straw.

2. Divide the class into small groups of 4-6 each. Give a "value" bag to each group. Explain that the bag and the items in the bag are common LITTER items. Assure students that their bags are filled with "clean trash," and not items that were actually littered, so it is alright to touch them. Each group should also have a piece of paper and a pen or pencil.

3. Instruct the groups to empty their bags and arrange the items so that everyone in the group can see and touch them. Write a list of the eleven items on the blackboard (the paper bag is included).

4. Tell students that they are to rank the litter items from "most harmful" to "least harmful." They should consider **people, animals,** and the **environment** when deciding on an item's harmfulness. Remind students that the ranking should be a group decision. Do not give the groups any further guidelines or suggestions on criteria to use to rank the items. Let them discover their own criteria for labelling items.

5. When groups have ranked all 11 items, they should write their order down on a sheet of paper from "most harmful" to "least harmful." Below their list, they should also write the reason why they chose one item to be "most harmful" and one item to be "least harmful."

6. After all the groups have finished, have them report their decisions to the class. On the blackboard, keep track of the reasons groups are giving for choosing items as harmful. Look over and discuss the list of reasons on the blackboard. Stress the fact that there is no one right answer; their answers were based on the values by which they were ranking, and values are neither right nor wrong. Reinforce the concept that littering is an inappropriate behavior. We must all value our environment by keeping it clean.

7. Ask the class if they had discussed any other ways litter could be harmful. Add these to the list on the board. Thoroughly discuss all the reasons that litter is harmful to people, animals, and the environment. Make sure all of the following points have been raised:

   - Litter can physically harm people. Broken glass or metal pop tabs that have been littered at beaches, at playgrounds, or on neighborhood sidewalks can often cause cuts if children are playing barefoot. Animals always go barefoot, so broken glass or other sharp objects are very dangerous to them.
   - Litter can be a threat to public health; illegally dumped tires are breeding grounds for mosquitos that carry encephalitis, and disease-carrying rats flourish in waste piles.
   - Many animals eat litter. Litter cannot be digested for energy and often blocks an animal's stomach so it dies of starvation even though its stomach is full.
   - Animals become caught or entangled in litter, often with deadly results.
   - Smokey the Bear® knows that carelessly littered cigarette butts can totally destroy an animal's habitat by starting a fire.
   - Toxic substances that are littered, such as motor oil, pollute water sources such as ponds, rivers, and groundwater. This pollution is a health hazard to both people and animals.
   - Litter is land pollution; it is an eyesore that destroys the aesthetics of a place.

Assessment

Ask students to name 3 examples of harmful litter.

Enrichment

Many schools participate in balloon launches, yet the released balloons are a form of littering and pose a threat to wildlife. Develop a list of activities that could be conducted as alternatives to a balloon launch. Mail this list with a letter to the head of the PTA and the school superintendent. If possible, have the class plan and implement one of the activities as an awareness project.

We place value on an item by its worth to us. Group the items in the bag by the criteria of recycling, reusability, compostability, etc. You could have one group rank the items from most harmful to least harmful. Others rank from most recyclable to least recyclable. Others rank from most reusable to least reusable. Still others rank from most compostable to least compostable. Groups can select their own criteria for ranking. After all groups have ranked their items, compare results and discuss the movement of an item from the "bad" end to the "good" end, depending on the criteria used to measure it.

LITTER LITERATURE

Objectives

Students will be able to: 1) describe the effects of littering; 2) realize that cleaning up provides many benefits; and 3) simulate the roles of characters from a story. Students will discuss and describe the characters in the story *The Wartville Wizard*.

Method

Students listen to a story, discuss, and then portray the roles of the citizens in the story.

Materials

book: *The Wartville Wizard* by Don Madden (Aladdin Books, Macmillan Publishing Company, 1993); writing materials. Available by order at most book stores, or from :

Aladdin Books
Macmillan Publishing Company
866 Third Avenue
New York, NY 10022
ISBN 0-689-71667-2

Copies are $4.95 each, plus shipping and handling.

Vocabulary

environment, litter, non-point source pollution, trash, waste

Procedure

1. Introduce the term ENVIRONMENT. The environment is everything around us. Our environment at school is different than our environment at home.

Ask students to name objects from their home and school environments.

2. Discuss the importance of keeping the environment clean. Ask students what happens when the environment is not clean. Introduce the terms LITTER and WASTE. Explain that litter is waste put in the wrong place (e.g., on the ground, on the road, etc.) Ask the students, "What happens to some litter when it rains?" Explain that when litter ends-up going down a storm drain, it is one type of non-point source pollution.

3. Read aloud the book *The Wartville Wizard*. This story takes place in the town of Wartville. Wartville citizens are illegally dumping their trash and litter: soda bottles under flowers, juice cans by mailboxes, and candy wrappers and papers on the road side. Every day the trash pile continues to grow. One man continues to clean the town litter, and one day, he realizes he has the power to get rid of all the litter forever. He magically sends each piece of litter back to the

person who dropped it. The town has a meeting to decide how to handle the problem.

4. Discuss the book as a class:
   - Describe the man's home. How was the inside of his home different from the outside?
   - Where was all of the litter that the old man found coming from?
   - How did he feel about all the litter? How would you feel if the town was your home?
   - What did the old man do with the litter?
   - What happens after the old man got power over the litter?
   - How would you feel if you had power over the litter?
   - How would you feel if the litter stuck to you?
   - What did the people of Wartville finally do?
   - What would you have done if you had been a citizen of Wartville?
   - How did the people of Wartville discover that the old man had power over the litter?
   - How did the townspeople solve their litter problem?
   - What is litter?
   - What can you do to help prevent other people from littering?
   - What does litter do to our environment?
   - Where have you seen litter in your community?
5. Ask the class to identify the main characters in the book *The Wartville Wizard* (an old man, Barbette Swartley, the driver, Harvey Bender, Mr. Fullerton K. Hardboard, Mrs. Mabel Botts, Dr. Melvin Splint, Wartville citizens, Jimmy VanSlammer, the sheriff).
6. Ask for student volunteers to pantomime the various people in the book. Read the story again as the students pantomime.

Assessment

Have students describe the effects of littering and suggest ways it can be prevented.

Enrichment

Have the students create costumes and write the script for a play of the book *The Wartville Wizard*.

Plan a litter art fair. To enter the fair, students must design a litter character using trash or litter. Display the litter characters at school, a public library, or a local shopping mall.

GOOD HABITS

Objectives

Students will be able to: 1) recognize that many of their actions are habits; and 2) realize that littering is a habit that has a negative impact on the environment.

Method

Students will discuss littering as a bad habit. Students will portray various litterbugs and suggest ways to change littering habits. Students will discuss how certain actions are better for the environment and will work on making a few of these actions habits.

Materials

writing materials

Vocabulary

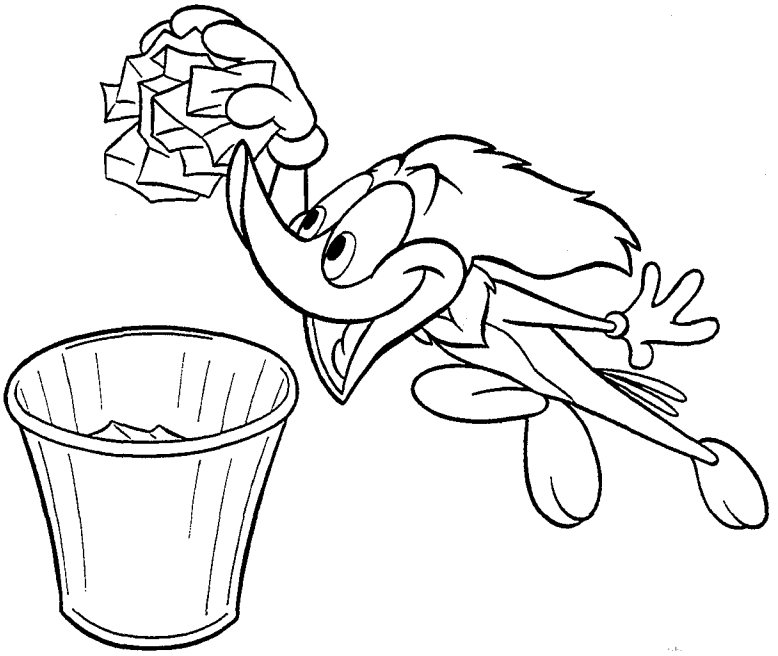
disposable, environment, habit, littering, litterbug, reduce, solid waste

Procedure

1. Introduce the topic of HABITS by asking students the following questions:

   Do you do any of the following things without thinking about them?

   - Do you bite your nails when you are nervous?
   - Do you chew on your pencil when you are thinking hard?
   - Do you look both ways before crossing the street?
   - Do you buckle your seat belt when you get into a car?



   These behaviors are habits. A habit is something a person does over and over again without thinking about it. Some of our habits are considered good, such as buckling our seat belts, and some of our habits are considered bad, such as biting our nails.

2. Some of our habits have an impact on the environment. Habits that hurt or harm the environment are considered bad. Explain that some students have a habit of throwing unwanted items on the ground. What is this called? (LITTERING) Littering is an example of a bad habit that hurts the environment. Littering may happen by accident, but the result is land and water pollution that must be cleaned up. Look around the classroom and schoolyard for evidence of littering. Discuss how adults can have the same bad habit of littering.

3. People who litter are called LITTERBUGS. Litterbugs thoughtlessly litter everywhere they go, because littering has become a habit. Explain to students that they are going to portray different types of litterbugs.

4. Divide the class into six small groups. Assign each group a type of litterbug to portray from the following list (or develop a list of your own):

   - **The Sport Bug**—This litterbug loves to attend all types of sporting events and cheer his team on. In between his cheers, he samples every type of food from the concession stand, and leaves a pile of food wrappings under his seat.
   - **The Movie Bug**—Every Saturday night, you will find this bug at the local theater, enjoying the latest movie release, and littering beverage cups, popcorn, and candy wrappers.
   - **The Smoking Bug**—A trail of cigarette butts is evidence of this bug. (Notice traffic intersections.) Some smoking bugs are especially thoughtless (and dangerous) and throw down cigarettes that are still burning. This can cause grass fires.
   - **The Traveling Bug**—This bug is constantly on the go. When traveling in his car (one of his favorite pastimes) he can be seen continually throwing items out of his window (another favorite pastime).
   - **The Picnic Bug**—A true nature lover, this bug loves to enjoy a meal in the beautiful outdoors. When he leaves the site (littered with the remains of his meal), he is surprised to find the site is not as pretty as he originally thought, and he vows to find a better spot for his next picnic.
   - **The Bad Aim Bug**—This bug makes a game out of throwing trash in the trash can. He gets one point if the toss is good. If he misses, he figures there's always next time.

   Instruct groups to develop short skits that portray the typical actions of their litterbugs. Each group member must be in the skit.

5. Play "Name That Litterbug." The class will try to name the litterbug portrayed in each skit. No guessing is allowed for the first thirty seconds of the presentation.

6. After each skit is presented, review the actions of that particular litterbug. Ask students if they have ever seen that type of litterbug. Have they ever been that type of litterbug?

7. Brainstorm and list reasons a litterbug might give for littering. Make sure all of the following reasons have been mentioned:

   - "There was already litter there."
   - "Who cares? I don't live there."
   - "It was only one little piece."
   - "The trash can was too far away."
   - "They pay people to pick up this junk, anyway."
   - "I didn't litter, the wind blew it away."

   Guide students into realizing that these reasons for littering are really just excuses for a bad habit.

8. We can change bad habits. To change a habit, first you have to be aware of what you are doing when you are doing it. For instance, if chewing gum too loudly is a bad habit of yours, you first have to be aware of when you are doing it before you can stop it and change it. To replace the bad habit with a good one, you then have to practice doing the good habit in place of the bad one until it becomes so natural you don't think about it anymore. Then it has become a new habit. (It takes 21-30 days to create a new habit.)

9. Tell the class that they are going to work on correcting bad "solid waste" habits and developing good ones.

10. List on the board the following good "solid waste" habits:

    - Write on both sides of paper.
    - Use paper you were going to throw away as scrap paper.
    - When you buy only one item at a store, don't take a bag for it.

- Reuse paper and plastic bags at home; take cloth bags to the store.

Discuss how these actions REDUCE our solid waste and are good for the environment.

11. Brainstorm and list other good solid waste habits. Have each student select one action from the list and work on making it into a habit. Have students write down their choices at the top of a sheet of paper. Every time they do this action, have students record the time and date on this sheet. Give them two weeks to try to establish their good habits.

12. At the end of the two weeks, have students share their experiences. Did anyone succeed in establishing a good habit? Do they think it takes more time?

13. These are the Keep America Beautiful system program steps:

    1) Get the facts

    2) Involve the people (students)

    3) Make a plan

    4) Focus on results

    5) Provide positive reinforcement

    Using this KAB approach, ask each group to come up with suggestions for how to change people's attitudes about littering. How can they encourage people to develop the good habit of throwing trash in a proper container (not littering)? Have the groups share their ideas with the rest of the class. You will identify a number of excellent ideas for litter prevention.

Assessment

Have students name an action that reduces waste and would be a good habit.

Have students explain how they would convince litterbugs to change their littering habits.

Enrichment

Develop a video presentation of the litterbugs that will convince people not to litter. Show the video to all the classrooms.

For a one week period, instruct each student to keep track of the number of times they see someone throw litter out of a car window. Have students report their results. Is there an epidemic of the traveling bug in your community? How could such a problem be brought to the attention of the community?

Have each group illustrate their bug on a large scale.

As a class, create a list of statements that students can use to score themselves on how well they are reducing waste. Write statements that could be answered with a "yes" or "no" only, such as "I use both sides of writing paper," "I use a lunch box instead of a paper sack," etc. Students can then determine their rank based on the number of questions they replied with a "yes" answer (e.g., based on 15 statements: 13-15 "yes" answers = excellent, 10-12 "yes" answers = good, 7-9 "yes" answers = needs some improvement, etc.).

Play "charades." Have each student act out the good solid waste habit chosen.

KEEP IT BEAUTIFUL

Objectives

Students will be able to: 1) describe how beautifying an area prevents littering; and 2) design and implement a beautification plan.

Method

Students will clean up an area and then beautify it by planting flowers they have started from seeds.

Materials

small cups (paper or foam polystyrene) or peat pots (several per student), trays, flower seeds, soil, scissors, pens, newspaper, trash bags

Vocabulary

beautify, graffiti, litter

Procedure

1. Ask students what it means to LITTER (throw trash in a place other than a trash can or bag). Have students answer the following questions:
   - Would you feel bad about littering in an area where there is already a lot of trash lying around? Why or why not?
   - Would you feel bad about littering a very clean area? Why or why not?
   - Would you feel bad about throwing litter into a flower bed? Why or why not?

   Discuss the fact that people tend to litter less in a well kept and well landscaped area.

2. Introduce the term BEAUTIFY (and beautification). Ask students to think of ways to beautify an area. For example, we could pick up litter, plant flowers or trees, paint a mural on a wall, or paint over graffiti. Point out that people litter less frequently in areas that are well kept and pretty. So, beautification prevents littering.

3. Tell students that they will be beautifying an area by cleaning it up and then planting flowers that they have started from seeds. As a class, choose an area to beautify and design a plan. What flowers will be planted? Consider growing season, annual or perennial, color, height, lighting, and maintenance requirements (native wildflowers are often hardier and require no daily watering or other special care). Draw a simple plan of your beautification project. Display the plan in your classroom.

4. Start your flowers indoors 5-6 weeks before you intend to plant them outside. To prepare to plant the seeds, lay out the following supplies: cups or peat pots, flower seeds, soil, water container, scissors and pens. Each student should have their own cups or peat pots and be assigned a type of flower seed to plant. Have each student follow these steps:

a) Cover work area with newspaper (if working indoors).

b) If using cups, punch two holes in each of the cups with the tip of a pen for drainage. If using peat pots, check to see that drainage holes exist. Place the cups or peat pots on trays to catch any water that drains out after each watering.

c) Fill each cup or pot about two-thirds with soil. Place 2 seeds on top of the soil, and cover with more soil. Water the seeds.

d) Place seeds in a sunny window or under grow lights. Keep soil moist.

e) If more than one seed sprouts in a cup, allow the healthiest seedling to grow by cutting away the other one.

f) Suggestion: Take this opportunity to discuss the parts of a plant and what a plant needs to grow.

5. A week or so before you plan to plant your flowers, conduct a litter pick-up in the area. Pass out trash bags to teams of students; they can each hold one side of the bag and pick up litter with their free hand. Caution students not to pick up any sharp objects. Students may want to bring gloves from home to protect their hands.

6. Plant your flowers outside. Don't forget to water them periodically and keep the area litter free.

Assessment

Have students explain how beautification prevents littering. Ask them to name an example of beautification.

Enrichment

Students may write and/or illustrate a booklet about their local beautification project. Display the booklet in the school library or share with other classrooms.

As a special treat, serve "Dirt Dessert" after flower planting. The students can help prepare the dessert.

Dirt Dessert Recipe:

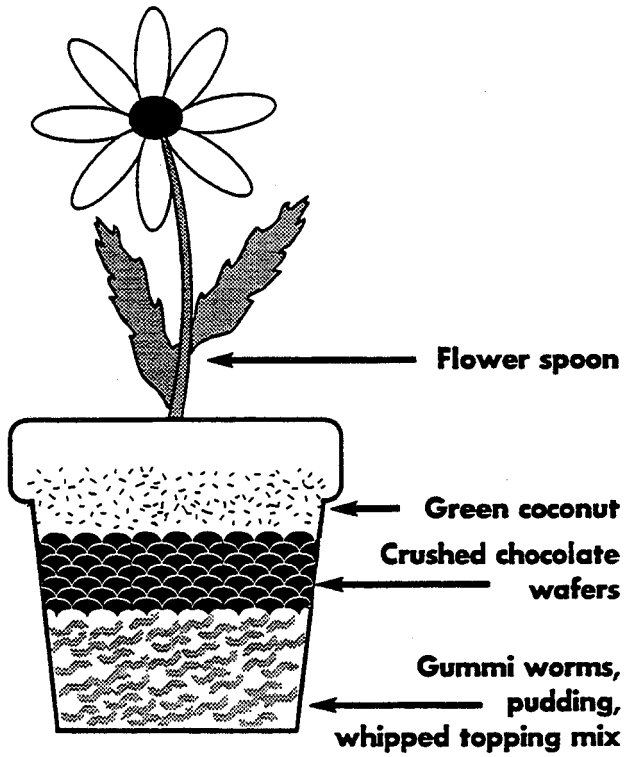
Bottom layer: Mix together 3-1/2 cups milk and 2 small packages chocolate instant pudding. Fold in 10 ounces of a dessert whipped topping. Gently fold in gummy worms.

Middle layer: Finely crush a bag of chocolate layer cookies with a rolling pin or put in a food processor (this is the "dirt").

Top layer: Dried coconut, colored with green food coloring (as "grass").

Layer ingredients in a flowerpot lined with foil or make individual servings in 6 oz. clear plastic cups. Refrigerate. Attach (with a hot glue gun) an artificial flower to each spoon for decoration. To serve, spoon into individual cups. Make sure everyone gets some worms! (Note: This recipe serves approximately 10. To double or triple the recipe, prepare in a 9x13" pan.)

Take the class on a walk in the neighborhood and look for examples of beautified areas. Have each student draw a picture of their favorite spot.



MARKET OUR MERITS

Objectives

Students will be able to: 1) plan and implement a litter prevention campaign; and 2) create a program to reward desirable behavior.

Method

Students will devise and implement a marketing plan to promote litter prevention in the neighborhood. Students will reward citizens for their litter prevention efforts.

Materials

poster board, crayons and/or markers, writing materials

Vocabulary

litter, litter prevention, littering

Procedure

1. Ask students to define LITTER and give examples of litter they have seen in the neighborhood surrounding the school. Introduce the term LITTER PREVENTION and ask students to explain what it means. Although communities must periodically pick up litter, the real solution to the litter problem is to prevent LITTERING in the first place. Tell the class that they will be developing and implementing a litter prevention campaign in the school and surrounding neighborhood.

2. Before an effective litter prevention campaign can be developed, the litter problem must be assessed. As their first task, students must determine **where** litter is found, **what** is being littered, and **who** is doing the littering. Students will have to thoroughly scout the area to come up with the answers. They may have to do some educated guesswork in answering the question of who is littering, because littering does not always occur in front of onlookers (litterbugs can be sneaky!). Who is littering can sometimes be deduced by what is littered.

3. After assessing the problem, the next step is to devise a marketing plan. Introduce the concept of a marketing plan. In the business world, marketing plans are used to market or sell a product, such as a certain brand of soft drink. In the case of a litter prevention campaign, a marketing plan is used to "sell" a message or idea. Don't litter! Many non-business organizations market their ideas every day. Ask students to name some of these organizations and their messages (e.g., The American Cancer Society—Don't smoke).

   There are three main components to a marketing plan: 1) the message; 2) the target audience; and 3) the promotion mix. The whole class could work to develop a marketing plan, or the class could be broken up into several small groups which

would each develop a plan that supports the others. Provide students with the following information about the marketing plan components:

The Message

Messages must catch the audience's attention, otherwise they will be ignored and therefore be ineffective. Students should create a catchy slogan that will convey the litter prevention message and attract attention (e.g., No butts about it—cigarettes are litter!). Encourage the students to be creative.

The Target Audience

A successful promotional campaign must identify the target audience, the people at whom the message is targeted or aimed. Each campaign usually identifies several very specific target audiences. For example, adults who litter cigarette butts and students who litter candy wrappers could be two target audiences. Defining target audiences as specifically as possible is important because it determines the content and style of the message. The message and the target audience go hand in hand.

The Promotion Mix

The promotion mix defines the medium to be used to convey the message to the target audience. The choices are advertising, publicity, personal selling, and sales promotion. Any combination of these can be used.

Advertising is a paid message conveyed through a mass medium, such as TV, radio, newspaper, handbills (a printed notice passed out by hand), direct mail or outdoor signs. Students will not have the funds to actually pay for this type of advertising, but they can produce their own "home-grown" version of such things as handbills and outdoor signs.

Publicity is a message that is conveyed through a mass medium in the form of a news story. Publicity is free. Students could approach local newspaper and radio stations about their project and ask them to do a story.

Personal selling is conveying the message through face-to-face communication, which can be very effective. Students may want to prepare a short presentation (make it interesting) to give to the other classes.

Sales promotions are things such as contests, special giveaways, coupons, etc. Students could work with a local fast-food restaurant to give away free drink coupons to homes that have kept their yards litter free during the special promotion period.

4. Provide ample time for students to consider all of the possibilities and arrive at a workable plan. Try to stress the "fun" factor throughout the planning stage. Help students set up a timetable for implementing the plan(s). Developing and implementing a marketing plan is a long-term project, but it is a very valuable exercise in creativity as well as a wonderful civic project.

5. Rewarding appropriate behavior can be a very effective component of a litter prevention plan. Have students design a system to recognize individuals who have done their share to keep the community clean.

Assessment

Have students define litter, and describe a litter prevention and reward plan.

Enrichment

Work with a local TV station to develop a short public service announcement (psa) on litter prevention. Most stations have a public service director who will work with nonprofit groups.

Run a litter prevention slogan and poster contest in school or in the local newspaper. Display entries in businesses and public offices throughout the community.

TRASHY TUNES

Objectives

Students will be able to: 1) describe how litter negatively affects the aesthetics of their community; and 2) create songs to express an environmental message.

Method

Students will write their own songs to encourage people to keep their communities clean.

Materials

pictures of litter-free scenes (including some of your town), writing materials

Vocabulary

litter

Procedure

1. Introduce the term litter. Lead a discussion with the students asking the following questions:

   What is litter?

   What types of materials can be litter?

   How do you think litter got where it is?

   How do you feel about litter?

   Ask students to discuss how litter spoils the beauty of places.

   Ask students to describe littered places they have seen and how they felt about these dirty places.

2. Show pictures of litter-free areas throughout America, including areas in your city (check with the local Chamber of Commerce or your local KAB office). Have students discuss how they feel when they look at these clean areas.

3. There are many ways that people can express their feelings; one way is through music. Songs can express the feelings of the songwriter. Many songs go beyond that to deliver a message to listeners. Songwriters have used their music to try to influence people's environmental attitudes.

4. Tell the students they are going to practice the art of song writing and write a song to convince people not to litter. They will be writing new lyrics to an old, familiar song (e.g., "Row, Row, Row Your Boat"), or to a current favorite.

5. Develop two lists of words that could be used in the students' songs. One list should describe littered scenes, the other should describe litter-free scenes. Separate the lists into nouns, adjectives, and adverbs. Write the lists on the chalkboard, chart tablet or overhead so that students can

refer to them. Explain to the students that their "word bank" will become the lyrics of the songs.

6. Using a time limit of 15 minutes, have students brainstorm as many advertising jingles and theme songs from television and radio as possible. Record this list on the chalkboard, chart tablet or overhead so that students can refer to them. Tell the students that this list will be their "tune bank" for song writing.

7. As a class group activity, write one or two examples before assigning individual or group work. Then have students write their own songs, using the "word bank" and "tune bank" as a guide.

8. When the class has finished, have students present their songs to the rest of the class. For each song, discuss the meaning of the lyrics and the message the students are trying to express through their songs.

Assessment

Ask students to explain how songs can be useful in changing people's attitudes about littering.

Enrichment

Have students bring examples of music with environmental messages to class. Listen to the lyrics and talk about their messages.

Sponsor a cleanup at a nearby natural area, such as a beach or forest. Using students' songs as a marketing tool, encourage other classes and parents to participate.

Trashy Tunes

Examples:

Reduce, Reuse, Recycle Trash
(To the tune of "Row, Row, Row Your Boat")

Reduce, reuse, recycle trash.
It's the way to go.
Let's all think how good it feels
To handle waste just so.

It's My Garbage
(To the tune of "It's My Party")

It's my garbage,
I'll reduce 'cause I want to ,
Reuse 'cause I want to,
Recycle, I want to.
Please do it, too.
We'll be proud of you!

ATTITUDE ADJUSTMENT

Objectives

Students will be able to: 1) understand the attitudes that predominate people's thinking about handling litter; and 2) identify the seven sources of litter.

Method

Students will look for and document places in their community where littering has occurred and attempt to determine its source.

Materials

maps of the community for each pair of students (graph paper may be used instead of maps), seven different colored markers or crayons per student or group, litter bags

Vocabulary

biodegrade, litter

Procedure

1. Background: The Keep America Beautiful, Inc. System, developed as a result of three years of research, is a behavioral-based, systematic approach to changing attitudes and practices related to proper solid waste handling. This research identified three attitudes that predominate our thinking about litter.

2. Students should brainstorm and list reasons why they think people litter. Have a student recorder list them on a blackboard, chart tablet or overhead. This can be done in small cooperative groups.

3. Ask the students to look at their lists and see if they can group any of their reasons into major categories.

4. The three main reasons why people feel it is acceptable to litter are:
   - where they feel no sense of ownership of the property
   - where someone else will clean up after them
   - where trash has already accumulated

5. The seven sources of litter that the KAB research also identified:
   - household refuse
   - commercial refuse
   - construction/demolition sites
   - uncovered vehicles
   - loading docks
   - motorists
   - pedestrians

6. Provide maps for each student or group of students. The students may also use graph paper to draw their own maps. Tell them that the class is going to take a "litter walk" around the school. Have the class assign each of the seven sources of litter (see above) a different color code (ie: refuse = green). Before going outside, ask the students to make a color key on the back of their maps. The students are to color code on their map or graph paper where they found the litter. The colors will help them identify the possible sources. IMPORTANT: Remember to clean up the litter along the way. (Consider giving a prize to the team that collected the most litter!)

7. For two additional days at varying times, have the students take their litter walk. Varying the time of the litter walk will also help them identify litter (ie: take the students on the litter walk after a class has been outside for lunch or recess).

8. After the three day period, have the students plot their findings on a master classroom map.

9. Lead a discussion with the class using the following questions as a springboard:
   - Can you notice any trends or patterns? How do you know?
   - What places did the class identify as major locations for littering?
   - Why do you think it happens there so much?
   - Where are some of the places that are not littered? Why or why not?
   - Will cleaning up litter after it's been thrown on the ground really solve the littering problem? Why or why not?
   - How could you use KAB's reasons why people litter to educate others about litter prevention?
   - What are some things we could do as a class to prevent littering from occurring in our community?

Assessment

Ask students to rewrite the three attitudes that predominate litter into "slang" or "children's language."

Enrichment

Have students document their litter walks on the same paths for one month. After that month, the students could prepare their data for a research paper to the principal and other classrooms.

Tips For Preventing Litter In Your Town

Why Do People Litter?

Litter is misplaced, improperly handled waste. In a three year research project, Keep America Beautiful, Inc. found that people litter for one of three reasons. They feel it's OK to litter:

- where they feel no sense of ownership for the property
- where someone else will clean up after them
- where litter has already accumulated

Where Does It Come From?

Although motorists and pedestrians are most often blamed for litter, Keep America Beautiful, Inc. identified seven sources that contribute to the problem. They are:

- commercial refuse sources, including dumpsters
- household trash handling
- construction/demolition sites
- uncovered vehicles
- loading docks
- motorists
- pedestrians

From these sources, litter is carried in every direction by wind, water, and traffic. It moves until trapped by a curb, wall, fence, a row of trees, a building, or other stationary object. Once trapped, litter becomes not only an eyesore, but an invitation for people to add more.

The Cost Of Litter

Litter is a costly problem. City, county, and state highway departments spend millions of dollars and many hours each year cleaning up litter—money and time that could be used for more needed services. Cleaner communities also have a better chance of attracting new businesses than those where litter is common.

12 Ways That You Can Prevent Litter

There are many ways that you can help make your community cleaner. Here are 12 suggestions:

- Set an example by not littering.
- Pick up one piece of litter every day.
- Teach others the proper way to dispose of their trash. Show them the difference between a clean area and an area spoiled by litter, and stress why it's important to put trash in proper containers.
- Make sure that your trash cans have lids that can be securely attached. If you have curbside trash service, don't put out open containers or boxes filled with trash.
- Carry a litter bag in your car. Ask local businesses to buy car litter bags and distribute them to customers. Encourage them to print their names and an environmental message on the bag.
- Ask your neighbors to join you in cleaning up one public area where litter has accumulated. Ask your local Department of Public Works to become involved by collecting the bags of litter, or by waiving the disposal fee at the landfill or solid waste facility.
- Tie papers in a bundle before placing them in a curbside recycling bin. Loose papers can be blown out by the wind.
- If you or a member of your family is involved in a civic group, scouting, or recreational sports program, encourage the group to become involved in a cleanup. In some communities, groups can earn cash by separating recyclable products from litter and redeeming them. Or have the group "adopt" a spot and maintain it on a regular basis.
- Find out how you can plant and maintain flowers along a curb or sidewalk. People litter less where areas have been beautified.
- Ask business owners to check their dumpsters every day to make sure tops and side doors are closed. If the business has a loading dock, ask them to keep it clean, and to put out a receptacle for employees to use.
- If you own a construction or hauling business, make sure your trucks are covered when transporting material to and from sites. Use snow fencing around construction or demolition sites to prevent debris from being blown into other areas. Put trash containers on every floor for construction workers.
- Ask a local Chamber of Commerce or civic group to start an awards program that recognizes individuals, groups, and businesses for their litter prevention or beautification efforts.

The most successful way to prevent littering in your community is to have an ongoing, organized program that involves local government, businesses, civic groups, the media, schools, and private citizens.

(Reprinted from Keep America Beautiful, Inc.'s *Tips For Preventing Litter In Your Town.)*

PACK IT IN

Objectives

Students will be able to: 1) list examples of "natural" packaging, modern manufactured packaging; and 2) list the primary functions of a package.

Method

Students will identify items (provided by the teacher or brought from home) that have natural and manufactured packaging. Through discussion and examination, students will identify several types of packaging for the same product.

Materials

apples, bananas, coffee beans, coconuts, eggs, peanuts, peas (in the pod), potatoes

Vocabulary

packaging, reduce, waste prevention

Procedure

1. Background: A package is the container that encloses products, items or other packages. Packages come in a variety of shapes , sizes and materials including bags, boxes, cups, trays, cans, tubes, bottles, jars, wraps and pouches. Manufactured packages serve four primary functions:

   a) to contain a specific product,

   b) to protect and preserve the product,

   c) to provide information about the product to the consumer, and

   d) to provide convenience and ease for the consumer (for handling, dispensing, etc.).

In addition to performing the essential functions described above, packages must provide compatibility with the contained product. Today, packaging scientists must consider several factors in determining product to package compatibility. These factors are:

a) chemical compatibility—the physical and chemical properties of a particular product and its compatibility with the packaging (and vice versa) must be evaluated to ensure integrity and that the materials will remain compatible during transportation and distribution to the final consumer;

b) physical endurance—selection of a packaging material must also consider the physical stress exerted on the package by the product;

c) product appearance—selection of a packaging material must be able to preserve and display the product effectively.

2. Have students bring to class (or teacher have ready) several items that have packaging, including natural and manufactured packaging.

3. Discuss with the students that some of the most original packages ever created are found in the natural environment. Have the students separate the package samples brought to class into natural packages and manufactured packages.

4. On the board, begin a list of products and packages. See the example below:

PRODUCT	PACKAGE
apple	apple peel
egg	egg shell
coconut	coconut shell (meat and milk)
peas	pea pod
corn	husk (on the cob)
milk	paperboard carton or plastic bottle
soda pop	aluminum can or plastic bottle
ink	pen
giftbox	wrapping paper or bag

5. Discuss with the students that many fruits, vegetables, and nuts are naturally contained in their own packages. Do these natural packages have any functions? What are some of the benefits of natural packaging? What are some of the limitations of natural packaging? What are some of the benefits of manufactured packaging? What are some of the limitations of manufactured packaging?

6. At this time begin a discussion with the students on the major functions of a package. Ask the students: Does this product need a package? Why or Why not? Why do we use packages?

7. As the students brainstorm answers, begin to list them in groups of the four functions of packaging. Then discuss the four functions of a package using the background information.

8. Have students analyze which part of the package is used for:

   - protecting the product
   - conveying necessary product information
   - advertising
   - convenience
   - preventing theft
   - other

   Did any of the packaging appear to be more than was needed? Were there examples of over-packaging? What appears to be "over-packaging," in some cases may be necessary for safe distribution. Breakage can create more waste than a little "extra" packaging.

9. Although packaging does serve a purpose, some products are over-packaged. As a class, develop a list of recommendations for reducing packaging waste. Use the recommendations below as a guide:

   - buy unpackaged products whenever possible (e.g., stuffed animal loose, not in a box)
   - buy larger quantity products (e.g., 7 ounce tube of toothpaste vs. 3 ounce tube)
   - buy concentrates when possible
   - buy products in bulk
   - buy REUSABLE packaging (e.g., glass jelly jars that can be reused as drinking glasses)

10. After the discussion of the functions of packaging, discuss with students that packages must provide compatibility with the contained product. Today, packaging scientists must consider several factors in determining product to package compatibility.

Assessment

Ask students to list the four primary functions of packaging, and give examples of both natural and manufactured packaging.

Enrichment

Discuss the cost of the packaging compared to the cost of the product. Discuss when students might want to purchase peanuts in a large container versus a situation when they might want them in a smaller container.

Tour a local manufacturing facility that produces packaging.

Have the students redesign packaging for a given product using the information from this lesson. Have them build a prototype of the packaging and send it with a cover letter explaining its advantages to the company's product development department.

PEAS IN A POD

Objectives

Students will be able to: 1) understand the need for packaging; 2) identify how packaging can reduce the amount of food waste that goes to a landfill or incinerator; and 3) describe purchasing decisions that reduce packaging waste.

Method

Students will compare and contrast the food waste (garbage) resulting from the natural versus the manufactured packaging of peas and orange juice.

Materials

PART ONE: one one-pound bag of frozen peas, 2 1/2 pounds of fresh peas in pods, bowls large enough to hold one pound of peas, scale; **PART TWO:** orange juice in various containers (i.e.: fresh oranges, glass bottle, plastic bottle, a brick pack of paperboard cartons, a six pack of orange juice in aluminum cans, a six pack of orange juice in steel cans, a brick pack of orange juice in aseptic containers), containers for measuring liquids

Vocabulary

compost, garbage, recycle, reduce, waste

Procedure

PART ONE

1. Have the students shell the fresh peas, separating the peas from the pods. Place the peas in a bowl.

2. Weigh out one pound of shelled peas.

3. Ask the students how they would handle the pea pod waste in their homes (compost, garbage disposal, trash can)? Discuss how much food waste was created compared to edible food.

4. Hold up the one pound bag of peas and discuss what is "waste." An empty one pound bag of peas weighs about 1 oz. Open the bag of peas and pour them into a bowl. Weigh the bag (for verification). Again, ask the students how they handle this waste in their homes (trash can, recycle)?

5. Weigh the pea pods on the scale. Compare the amount of waste, by weight, created by shelling the peas at home versus the amount of waste created by purchasing the preshelled peas. For every pound of peas, 1.6 pounds of pea pod was created.

6. Ask the students, if we purchase the peas already shelled, where are the shells? Food processors generally do not throw out the pea pods (or other food "wastes"). These are usually

converted to by-products such as animal feed, fertilizer or compost.

PART TWO

7. Set out the packages containing orange juice. Tell the students the amount of orange juice in each item and the price. Have the students write down which item they would buy for orange juice and why. Then lead a discussion on what each student chose.

8. Pour the orange juice into measuring containers and discuss with the students which item has the most orange juice for the price. At this time mix up the concentrate and measure it as well.

9. Look at the amount of packaging waste left for discarding and discuss with students which container had the most waste. Use the following questions: How do the choices we make when buying a product affect the solid waste stream? Why do we choose certain products and their packages? Woud you choose the same orange juice now? Why or why not?

10. Industry is coming up with some new ideas to reduce packaging, such as:

    - making packaging materials thinner and lighter (e.g., aluminum cans have been getting thinner)
    - producing packaging that is used as the product is used (so-called consumable packaging)
    - combining products in one package (e.g., detergent and bleach)
    - selling a starter bottle of a product which is subsequently refilled with tap water mixed with a small packet of the product in concentrated form.

    Can students think of other innovative ideas?

Assessment

Have students compare and contrast the amount of waste from one pound of fresh, home-shelled peas to one pound of packaged, preshelled peas. Have students compare and contrast various orange juice containers. Have students describe 3 purchasing decisions they could make to reduce packaging waste.

Enrichment

Calculate how much material was used to make one million glass, aluminum, steel, and plastic containers in 1972. Compare to 1992. Use the table below, which lists weights in pounds per 100 containers.

Container	1972	1992
Glass bottle	75.7	48.04
Steel can (12 fl. oz.)	10.5	7.19
Aluminum can (12 fl. oz.)	4.5	3.51
PET bottle (2 liter)	14.6	11.95

Over the past decade, the amount of paperboard required to make 12-can soft drink carriers was also reduced 23%. Using less materials saves resources and money. Manufacturers call this process lightweighting.

SCAMPER

Objectives

Students will be able to: 1) recognize that reuse is a viable option for extending the life of a product; and 2) name seven new uses for a discarded item.

Method

Students will discover new uses for used containers by stretching their thinking skills to a higher level.

Materials

empty, clean, used containers (examples: glass jar, milk carton, liter bottle, detergent bottle, etc.)

Vocabulary

recycle, reuse, waste

Procedure

1. Background: SCAMPER is an improvisational thinking skill. SCAMPER stands for substitute, create, adapt, modify, produce, evaluate and recycle. Use SCAMPER as a group activity in which each group gets one object. The object is passed from one student to another, and as each student holds the object he/she must state one characteristic or attribute concerning the object using one of the following:

   Substitute: a jar can be substituted for a vase;

   Create: a jar can be created into a gift by painting it:

   Adapt: a jar can be adapted into an insect cage by attaching a screen cover;

   Modify: a jar can be modified into a measuring cup by marking it;

   Produce: a jar can be produced into a stained glass window by breaking it and gluing it into a new shape.

   Evaluate: a jar can be evaluated by comparing it with other containers;

   Recycle: a jar can be broken down, reprocessed into recycled glass

   These words are general guidelines for brainstorming ideas. Don't get hung up by literal meanings, because it stops the flow of ideas.

   Our society tends to use an item only once and then discard it. This planned obsolescence perpetuates a "throw-away" mentality.

2. Divide the class into groups of 5 to 7 students.

3. Using SCAMPER background information, explain SCAMPER to the students. List the SCAMPER

terms on the board or have the students list them for easy reference.

4. Give each group one container. One student from each group should be the recorder. Have each person in the group pass the container around to the person to the left. As a "warm up," each person states one characteristic of the container before passing it to the next person, while the recorder lists the statements/characteristics. Continue until the group runs out of suggestions.

5. After a "warm up" round, then the students should apply SCAMPER to the concept of reusing the containers in new and different ways. The students may use any of the SCAMPER words, but should identify which word is applicable. Students continue to pass the container to the left, and the recorder continues to list the group's statements.

6. After SCAMPERing for several minutes, and when the flow of ideas seem to slow down, have the groups take turns sharing their reuse SCAMPER lists for each container.

Assessment

Ask students to identify a reuse for several different containers.

Enrichment

Try to SCAMPER on an individual basis or apply SCAMPER to different objects.

Scamper Worksheet

SUBSTITUTE

CREATE

ADAPT

MODIFY

PRODUCE

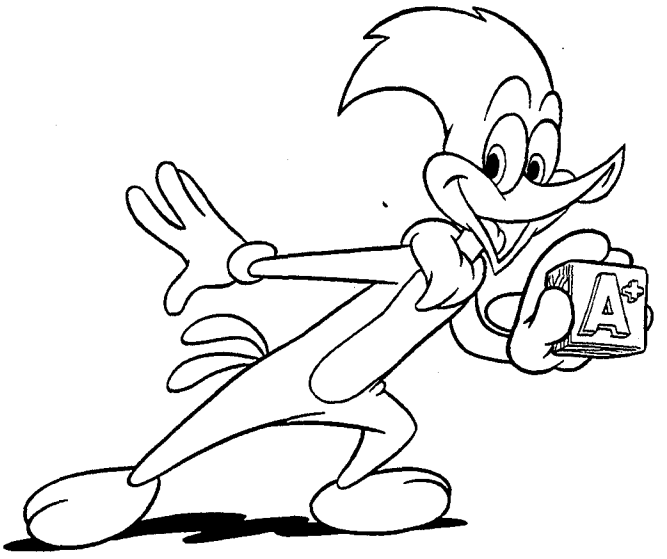
EVALUATE

RECYCLE

STAMP OF APPROVAL

Objectives

Students will be able to extend their knowledge of solid waste reduction by creating useful items from otherwise waste materials.



Method

Students will create stamp forms from rubber and wood discards and print with them on scrap paper.

Materials

tire inner tubes (from side of highway or used tire lot), small wood blocks or small containers with flat lids (one per student), rubber cement, stamp pad or printer's ink and brayer, scrap paper to print on, scissors, small hole punch

Vocabulary

reduce, reuse, waste

Procedure

1. Before class, cut pieces of scrap paper to fit the surfaces of the wood blocks or flat-topped containers onto which students will be mounting their stamps.

2. Give each student wood blocks that they will be using for the rubber stamps, and several scrap papers. Have them make several sketches on the scrap papers of what they would like to put on their stamps. Remind students that everything will be reversed when printed.

3. Transfer their designs to the rubber and cut them out, using one piece of rubber for as many stamps as possible (conservation). Even the tiniest scraps make good designs: flying birds, snakes, etc.

4. Mount the rubber cut-outs to the wood blocks or containers with rubber cement. For best results, apply rubber cement to both the rubber and the wood. Use two coats of rubber cement. When the first coat is dry, apply a second. When the second coat is "tacky," apply rubber to wood. Hold firmly in place or weight down until dry. (Note: pine blocks absorb rubber cement. Try wood glue instead.)

5. Using scrap paper, practice making prints from the new stamp.

6. Use the stamps to create notecards using scrap paper or recycled paper (made in another lesson).

7. Create a scene combining prints and other media, such as crayons, colored pencils, watercolors, etc.

Assessment

Have students describe the steps involved in creating a stamp from "waste" materials.

Enrichment

Research further reuses for discarded tires and/or wood.

Create a logo for the school and make a stamp. Give it to the principal on Earth Day.

Students may create a stamp to designate scrap paper that is being reused, such as the blank back side of a sheet of used looseleaf paper. Print the "reuse" stamp on the corner of the clean side and use the paper. (i.e. spelling dictation, mathematics practice, etc.)

REUSE BOX

Objectives

Students will be able to: 1) name useful objects and waste objects; and 2) apply understanding of reuse by actually reusing potential waste materials from the classroom.

Method

Students will design and use a "reuse box."

Materials

2 large boxes, construction paper, glue, crayons

Vocabulary

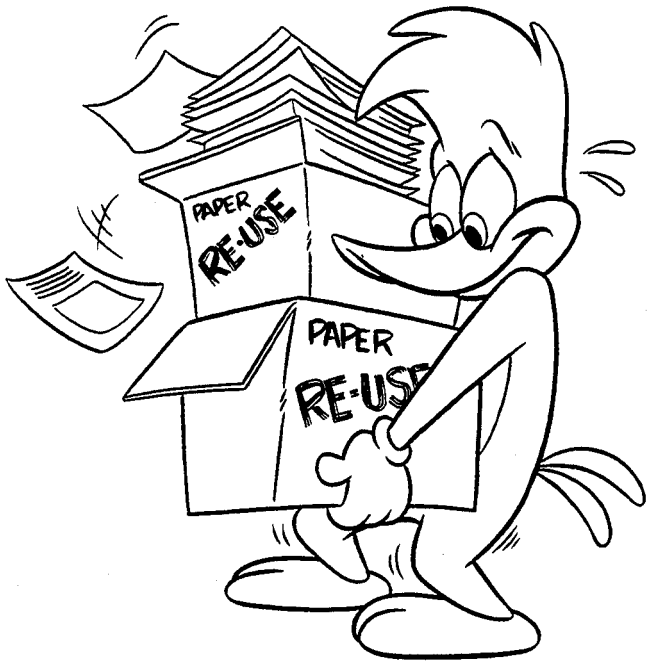
environment, reuse, waste

Procedure

1. Introduce the term USEFUL. If a thing is useful it helps us do something. Useful things often make a job easier to do.

2. Ask students to look around the classroom for useful objects (desk, book, crayons, paper, chalkboard, lights, etc.). Have each student name a useful object and tell why that object is useful; what does the object help us do?

3. Discuss what makes an item WASTE. Waste is something that has no use anymore. Some objects are useful for a long period of time, while other objects are useful for only a very short time. Ask students to name some waste items. Are they long-lasting or short-lived? When something is no longer useful, we throw it into a trash can or trash bag.



4. Describe how some things that are thrown away as waste could actually be used again, even if it is for a different purpose. We call this REUSE. By reusing something, we do not throw it away, and that is good for the ENVIRONMENT.

5. Have students determine what classroom waste items could be reused. Paper that has writing on one side is one of the most reusable items. When students mention paper, ask them how they could reuse it (use the blank side for scrap paper).

6. Tell students that you would like them to create a "paper reuse box" so that paper is only thrown out once it has been used on both sides. Ask them to decide where the paper reuse box should be placed in the room—it must be convenient for everyone to use.

7. As a class, decorate the outside of the box so that it is attractive and will be fun to use. Be sure to write "Paper Reuse Box" on the outside so that nobody mistakes it for trash.

8. When you begin your paper reuse project, appoint a trash monitor each day who will make sure that paper that can be reused is being put into the reuse box and not the trash.

Assessment

Have students define reuse and give an example (other than scrap paper).

Enrichment

Over a period of time, calculate how much paper has been reused by periodically weighing the paper in the box. Develop a bar chart to graphically portray the amount (weight) of paper saved. Can students think of other common items which would weigh about that much (a bag of sugar, 3 textbooks, etc.)?

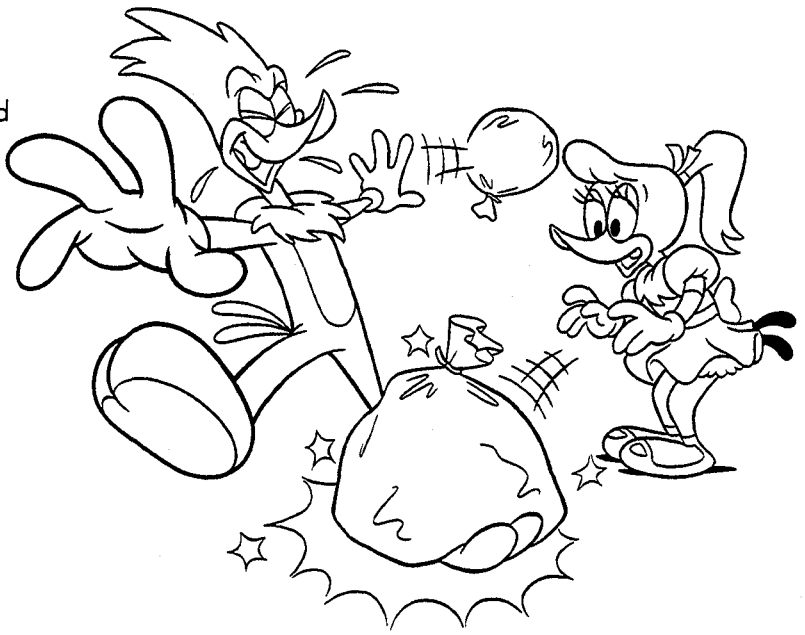
Make a reuse suggestion box and put it in the school's office. Encourage all students to think of reuse ideas throughout the year and submit them for consideration.

Since other things besides paper can be reused, start odds-and-ends reuse boxes. Items such as stray pieces of string, packaging peanuts, plastic or paper bags, cans, and other throwaway items can be put in them to be used again. Sort the items. Write "Please Use Me" on the boxes to encourage students to participate. Don't let students put in obvious junk items which cannot be used again.

SWAP DAY

Objectives

Students will be able to recognize that some waste items have value to other people and can be reused instead of thrown away.



Method

Students will bring items from home they no longer want and swap them for items other students do not want.

Materials

reusable waste items (provided by students), poster-board, markers or crayons

Vocabulary

reuse, waste

Procedure

1. Define WASTE as something we are finished using and want to throw away. Ask students what they think the following saying means: "Your trash may be someone else's treasure." Discuss how some waste items may still be functional; we may not want the item anymore, but someone else might. Some waste items could be REUSED by someone else instead of being thrown away. Ask students to name examples of things that could possibly be reused by someone else (they could think of things that are often given away to charitable organizations).

2. Introduce the concept of bartering, which is to trade goods or services for other goods or services. No money is used in the bartering system; the goods or services traded are seen as having value, just like money. In the past, bartering was the most common way to acquire necessary goods and services. Bartering may be useful in today's world because it could help reduce the amount of waste we throw away.

3. Tell students that you are going to hold a classroom swap day, where students will bring in unwanted items and trade them for an item that another student has. To prepare for the day, instruct each student to go through their belongings at home and make a list of unwanted items that may be useful to someone else (e.g., a toy that has become boring but is still usable). Students should show the list of items to parents to make sure it is O.K. to trade those items. (Parent letter provided in the appendix to this manual.) Also have students check with other family members to ensure that they do not want any of the items. Students should hand in a paper indicating what items they will be trading on swap day. Every student should bring in at least

one item (you might want to set an upper limit, too). All items must be clean and usable.

4. In order for bartering to be successful, others must think that what you have to trade is valuable in some way. Have students create posters to advertise the good points of their items. It might help students to think about why they originally wanted the item. A personal sales pitch is also an important sales tactic (especially in a bartering system), so have students also prepare a short sales pitch on their items. It might be useful to brainstorm on possible benefits and uses of items before having students complete these assignments. Encourage students to be creative; some items may be reused for a purpose different than what was originally intended.

5. Hold the swap day. Have students set their items out on tables and allow everyone time to view all of the items before swapping begins. After swapping is over, evaluate the pros and cons of bartering.

Assessment

Ask students to define reuse and give two examples of items reused by someone other than the original owner.

Enrichment

Plan and conduct a school-wide auction of reusables. Use the money raised to buy carts or bins for temporarily storing recyclables saved by all of the classes.

Plan a one-day neighborhood or school yard sale. Ask all the families living near the school to set up a table of old reusables for sale. Encourage bartering between tables. Advertise the yard sale in the newspaper.

LOGOS AND SLOGANS

Objectives

Students will be able to: 1) define logo (symbol) and slogan; 2) recognize logos used in recycling; 3) identify products made from materials that can be recycled; and 4) create a logo and slogan to use in promoting a school recycling program.

Method

Students will create a recycling logo and slogan.

Materials

recycling symbols, paper, writing/drawing/painting materials

Vocabulary

recyclable, recycled

Procedure

1. Background: The familiar recycling symbol seen today had its origin in 1970 when the Container Corporation, a Chicago design firm, sponsored a national contest for the first Earth Day. The company was looking for a symbol to represent paper recycling. The winning entry, created by University of California at Berkeley graphic arts student, Gary Anderson, was later modified by William Lloyd, Container Corporation's manager of design. The design represents the three phases of recycling: the collection, processing, and manufacturing of recovered materials into new products. Seen in the center of the logo is a stylized outline of an evergreen tree.

Two designs represent: 1) products that can be recycled (arrows not in a solid circle), and 2) products made from recycled materials (arrows arranged inside a solid circle). Because the original symbol was not copyrighted, the original appearance and meaning of the symbol may be used and interpreted by companies in different ways. The original version in all its many variations has lost its intended meaning and is now a generic recycling symbol. This has created consumer confusion. For instance, the symbol does not imply any specific type or amount of recycled content. Recycled content may vary by state and/or company. Consumers must rely on the ethics of a company until that time when environmental claims are regulated.

2. Ask students to brainstorm examples of familiar logos and slogans.

3. Discuss how these logos and slogans represent the values of the product or organization being promoted. Have students evaluate the logo and the message it represents.

4. Show examples of well-known recycling logos.

5. List products that display recycling symbols. (paper, milk cartons, soft drink cans, corrugated boxes, etc.)

6. Show samples of the symbols used on plastic materials. Point out that these symbols are derived from the original recycling logo and are used to indicate material made from different types of plastic. Ask students why it is important to indicate types of plastic on containers. (To assist recyclers in sorting plastic containers by resin composition.)

7. Have students summarize the values of logos and slogans. For example:
   - They attract attention.
   - They promote a program with simple symbolism.
   - They stimulate instant recall.
   - They are attractive.
   - They enhance feelings of identification with the program.

8. Tell students they will each be designing a logo and a slogan for a school recycling program. Discuss what values their logos and slogans will represent.

9. Have students design a poster using their logos and slogans.

Assessment

In addition to successful completion of the project, students will be able to answer the following questions:

How may logos and slogans help advertise recycling?

List three logos and three slogans and the companies or products they represent.

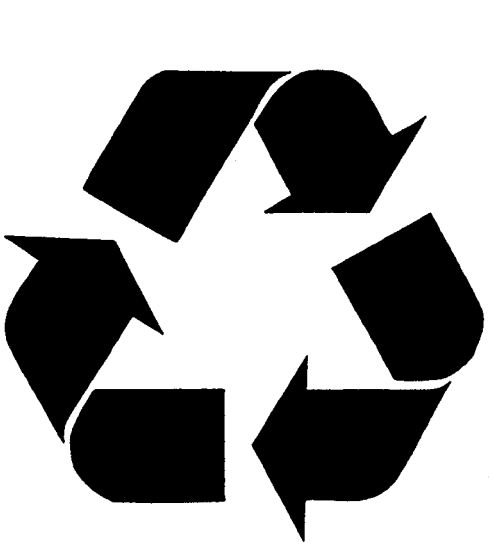
Enrichment

Choose the favorite logo and slogan. Reproduce the winning design and display throughout the school and/or community. (Optional: provide awards for the best designs.)

Have art students reproduce design(s) on T-shirts and sell them throughout the school and community.

Contact a local organization, business, hospital, civic group, etc., and ask them to sponsor a contest for the best logo/slogan which represents their interest.

Know the Difference Between RECYCLED and RECYCLABLE



NOTE: Not standardized nationally.

The OUTLINED arrows denote a material which CAN BE RECYCLED.

The arrows in a DARK BACKGROUND denote a material which has been MADE OF RECYCLED MATERIALS.

Know the Difference between Pre- and Post-Consumer Waste:

One of the primary goals of being environmentally responsible is preventing materials from being landfilled. This kind of waste is primarily POST-CONSUMER, or that which the end-user throws away. PRE-CONSUMER waste is generated during the manufacturing process and includes industrial scraps, trimmings and overruns.

PLASTICS RECYCLING BY THE NUMBERS

Objectives

Students will be able to: 1) recognize the place of plastic in our society; 2) describe the plastic code system; 3) demonstrate the separation of plastic for recycling; and 4) explain the need for a plastic code system.

Method

Students will discover and identify several physical properties of plastics and record this information in a chart to better understand plastic use.

Materials

handouts "Plastic Container Code System," and "Plastic Code Chart," collection of items displaying the recycling symbol (several examples of all seven types)

Vocabulary

recycle, source reduction, waste

Procedure

1. Background: The simple word *plastic* actually is a collective reference to a wide range of materials. This can cause confusion. It's no wonder; there are 45 basic families of plastics and each can be made with hundreds of variations. Plastics are made from materials found in nature - petroleum, natural gas, and coal. Basic compounds of carbon, hydrogen, oxygen, and nitrogen are extracted and combined to produce many kinds of plastics.

   The popularity and wide use of plastics can be attributed to their wide range of properties and design possibilities:

At Home: protects, resists breakage, makes handling easier, allows tamper protection, adds convenience, allows use of lightweight windows, pipes, flooring;

At Work: furniture and upholstery, classroom erasable boards, assembly line parts that don't corrode, lightweight automotive parts, fax machines, computers, copiers;

At Play: toys, movies, safety helmets, mouthguards, boats, dome stadiums, campers, playground equipment;

In Health Care: artificial heart, artificial limbs, contact lenses, x-ray film, filtering devices, tubing, guards against infection and contamination.

2. Introduce the topic of plastics to the students. Brainstorm types and uses of plastics.

3. Give the students copies of the handout "Plastic Container Code System." Discuss the components of the handout. Practice pronouncing the full name of each type of plastic.

4. Give the students copies of the handout "Plastic Code Chart," if it has not been copied on the back side of the handout "Plastic Container Code System."

5. Ask students to sit in a circle around the pile of plastic containers they have brought in (or the instructor has provided). Each student chooses a container and begins to record the required information on the "Plastic Code Chart."

6. On the teacher's signal, students will start the "Plastics Stream" flowing, by passing items that they have finished recording, to the right. Keep the stream flowing until all blanks are filled or until seven types are entered. Students may "draw" from the pile if necessary to keep the activity moving.

7. Have the students share their conclusions based on the data recorded on their charts.

8. In the center of the circle or on a table, group the containers by their plastic code numbers. Discuss the properties of each.

9. Find out the types of plastics that are collected in your community. Set apart those numbers and/or container types.

Assessment

Ask students: What role does plastic play in our society? Describe the plastic code system, including numbers and descriptions of each. Why do we need a plastic code system?

Enrichment

Using the handout, "Enrichment: Plastic Package Survey," provided, have students survey their homes and/or grocery store. In class, analyze the data collected on the survey sheet.

Based upon the information collected, from other research and reports, have students describe the role of home, school, and community in plastics recycling efforts. How can home, school, and community participate in collection and recycling programs?

PLASTIC CONTAINER CODE SYSTEM

(found on the bottom of coded containers)

CODE				
ABBREVIATION	PETE	HDPE	V or PVC	LDPE
FULL NAME	Polyethylene Terephthalate	High Density Polyethylene	Vinyl	Low Density Polyethylene
PERCENTAGE OF TOTAL BOTTLES	20-30%	50-60%	5-10%	5-10%
CAN BE TRANSPARENT	Yes	Yes	Yes	No
TYPICAL CONTAINERS	soft drink, instant coffee	milk, laundry detergent	liquid dish soap, peanut butter	grocery bags, coffee can lids

CODE			
ABBREVIATION	PP	PS	OTHER
FULL NAME	Polypropylene	Polystyrene	Other resins or a mixture of resin types
PERCENTAGE OF TOTAL BOTTLES	5-10%	5-10%	5-10%
CAN BE TRANSPARENT	Yes	Yes	Yes
TYPICAL CONTAINERS	deli tubs, bottle caps, straws	foam cups, trays, egg cartons	catsup and syrup bottles

PLASTIC CODE CHART

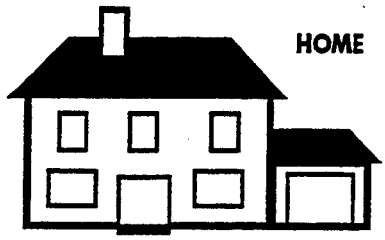
NUMBER SYMBOL	LETTER CODE	TYPE OF PRODUCT	OBSERVABLE PACKAGE PROPERTIES
Examples: 1, 2, 3, 4, 5, 6, 7	Examples: PETE, HDPE, V or PVC, LDPE, PP, PS, other	In this column, write the name of the product, or sketch the product container shape.	Examples: Flexible, rigid, transparent, opaque, translucent, color, white, creases when crushed, other...
			
			
			
			
			
			
			

Enrichment: Package Survey

DIRECTIONS:

1. **Conduct a plastic package survey** in a grocery store or at home.

Which store or aisles?



Which rooms at home?

2. **Look at the bottom** of each plastic package. Find the arrows. Record the number symbol and the letter code, e.g.:

DATA ANALYSIS AND CONCLUSION:

Analyze your data. Count how many times you found each code. Which was the most frequent? Which was the least? Calculate the percent for each code. If you filled in all 50 boxes, count the number of boxes for each code, then multiply the number by 2 to get the percent; or use this formula:

$$\frac{\text{counts for a code}}{\text{counts for all codes}} \times 100 = \%\text{ of the code in total}$$

What surprised you about your results?

PHOTO SESSION

Objectives

Students will understand the processes of photodegradability and closed-loop recycling.

Method

Students will perform an experiment over several weeks to learn how six-pack rings are broken down by sunlight (photodegradability).

Materials

plastic six-pack yokes (brought from home by students), a warm, sunny spot in direct sunlight (a windowsill, a protected spot outside, or under a grow-light), and a cool, dark spot away from light (in a closed closet or cabinet)

Vocabulary

closed-loop recycling, photodegradable, polymer

Procedure

1. Background: Plastics are a whole class of petroleum-derived materials. There are over a hundred different types of plastic resins though only a handful are commonly used for products we see on store shelves. Plastics are used to make products ranging from food packaging to toys to automobile parts. For additional information, see lesson "Plastics Recycling by the Numbers."

   Plastic six-pack rings are made from plastic type #4, LDPE (low-density polyethylene). This type of plastic is commonly made into coffee can lids, plastic grocery bags, and plastic six-pack rings. Various plastic food containers, after use, must be recycled into new plastic products (such as flower pots, laundry detergent bottles, and video cassettes) to prevent food contamination. Six-pack rings are one of the few plastic products that can be collected after use to be made back into new six-pack rings.

2. Ask students to collect plastic six-pack rings from home and bring them to class. You will need two rings for each student. Set up an area in the classroom in which to collect these rings, such as a box with a recycling logo.

3. Introduce the word "photodegradable." If a product is photodegradable, it becomes brittle and breaks into pieces when exposed to sunlight. The time needed to degrade can be as short as three to six weeks in the summer, when the sun's rays are stronger. In the winter, it can take seven to fifteen weeks, depending on the location and the weather.

4. To demonstrate the photodegradation process, perform the following experiment to see how long it takes six-pack rings to degrade in your classroom. Each student should put his/her name on two six-pack rings. Have the students stretch their six-pack rings to test flexibility. Place one six-pack ring for each student in direct, warm sunlight (on a windowsill, in a protected area outside, or under a grow light) and make sure the rings will receive direct sunlight for a majority of the day (southern exposure is best). Place one six-pack ring per student in a cool, dark place (under the sink, or in a closed closet or cabinet).

5. Every week, check the progress of the photodegradation by having the students stretch their six-pack rings to retest flexibility. Perform the stretch test on both six-pack rings, the one in the sun and the one in the dark. Rate stretchability/flexibility on a scale of 1 to 10. (1=very rigid, hard to stretch; 10=stretches easily, breaks into pieces.) Keep a record of class photodegradation progress by posting a chart with each child's name and two columns, one for six-pack rings exposed to sunlight and one for six-pack rings kept in the dark. Weekly, have each student record his/her stretch rating in both columns on the chart. Continue to test the rings weekly until photodegradation takes place and stretching is no longer possible.

6. Discuss with students the results of their experiment. Ask them why sunlight breaks the plastic apart, while leaving the plastic in a dark place does NOT allow it to break apart. "Polymer" is another word for plastic. A polymer is like a chain with many tiny links. Each link is held together by a strong bond when the polymer is made. Sunlight tears the links apart, making the plastic rings turn into plastic "dust," leaving the unconnected links in the chain behind.

Assessment

Ask students to define the vocabulary words.

Have students explain the effects of sunlight on the plastic (#4 low-density polyethylene) found in six-pack rings.

Enrichment

Students can compare the rate of photodegradation by placing plastic six-pack rings in light at increasing temperatures (i.e., one ring at 70 degrees Fahrenheit, one at 90 degrees, one at 110 degrees, etc.), checking flexibility weekly. Compare the data to determine the extent to which temperature effects photodegradation.

Students can compare the effects of water/humidity on photodegradation by placing one six-pack ring in the sunlight and one in a pan of water in the sunlight. Collect data weekly. Compare the data to determine the effect of water on photodegradation.

TIN CAN PAPERMAKING™

Objectives

Students will be able to: 1) name the benefits of paper recycling; 2) summarize the paper recycling process; and 3) make a sheet of recycled paper.

Method

Students will recycle used paper to make new paper.

Materials

used paper (white and colored), blender, two or more twenty-six ounce tin cans, support screen, papermaking screen, sponges, paper towels, board for pressing, two or more 12 oz plastic cups, measuring cup, water, newspaper, and (optional) aprons, cloth towels, plastic dish pan. To purchase a complete "Tin Can Papermaking Kit™," contact:

Greg Markim, Inc.
Suppliers for Hand Papermaking
Post Office Box 13245
Milwaukee, WI 53213
414/453-1480

Vocabulary

recycle

Procedure

1. Discuss the meaning of the word RECYCLE. Recycle means to use waste materials again by saving them from the trash and reprocessing them. Reprocessing waste materials involves breaking them down and then reforming them into a new product.

2. Gather the materials listed and prepare as follows:

   Tin Cans: Get two per station. Twenty-six ounce coffee cans work well. Other tin cans will work. The diameter of the cans will determine the size of the paper. Cut one end out of one can. Cut both ends out of the other.

   Support Screen: Since this screen supports the papermaking screen, it needs to be quite rigid. Hardware cloth is excellent. It is sufficiently rigid. Like window screen, it has strands going both directions, but the strands and the openings between them are both bigger. Hardware cloth often comes in three different sizes of openings. Any size works. You will need at least one 6 x 6-inch piece per station. Get a little extra.

   Paper Screen: Get non-metal (for safety) window screen. A minimum of two 6 x 6-inch pieces are needed per station. Get a little extra. Window screen is right on the edge of being too coarse for papermaking, but most of the time it will work alright. Later you may want to experiment with other "sieves" such as cloth, etc.

Sponges: Sponges are natural for water removal. Get a good cellulose sponge not too big or too little for your hand, one that is good for soaking up water.

Paper Towels: Get large size paper towels, singles or in a roll. (Kit uses reusable couch sheets). As said elsewhere, after paper towels (couch sheets) get wet from being used, they are dried and reused. Don't throw them away, handle with care.

Board for Pressing: This will be used to press down on a wet sheet of recycled paper between layers of towels. Use a size that fits your hand. (A 1" x 4" board cut into six-inch lengths works well).

Blender: Any kitchen blender will do.

3. Set up a paper recycling station equipped with the above materials. Be sure to cover the work area with newspaper or a sheet of plastic.

4. Take a tin can with one end cut out. Set it on a level surface, in a dish pan, open-end up.

5. Over the tin can's open end, place a 6 x 6-inch piece of hardware cloth.

6. Place a 6 x 6-inch piece of non-metal window screen on top of the hardware cloth.

7. Place a tin can with both ends cut out over the window screen. If the cans are of the same size, match their rims. (The top can may be smaller, but not larger than the bottom can.) This is the "pour" hand mold with which you can make handmade paper.

8. Tear into small pieces a sheet of scrap paper at least 7 x 7-inches. Put the pieces into the blender. Add about two cups of water. Put on the lid. Run the blender for approximately 30 seconds. This is the pulp for your recycled paper.

9. Pour half of the blender's contents into each of the two plastic cups. Add about a half of a cup of water to each container.

10. Take one container in each hand. Pour rapidly (not slowly, but dump) contents of both containers at the same time into the top can. Pour from opposite sides so that the streams from the two containers hit each other. Let all water drain into the bottom can.

11. When all the water has drained into the bottom can, raise the top can straight up and off. There on the window screen is the new sheet.

12. Lift the new sheet and window screen off the support screen. Place them on a flat, dry surface (table top, several layers of cloth, piece of plastic, etc.).

13. Place another 6 x 6-inch piece of window screen over the new sheet, for protection.

14. Take a sponge and press it down on top of the window screen and new sheet. Squeeze water from the sponge. Continue pressing and squeezing until the entire sheet has been covered and the sponge has little, or no more, water.

15. Carefully start at one corner and peel off the top window screen.

16. Lay three paper towels on top of each other. (They must be wider than the new sheet.)

17. Pick up the screen with the new sheet on it. Turn them over onto the towels, new sheet up against the towel.

18. Apply sponge as before (step 14). This time push down with as much force as possible. Apply pressure over the entire new sheet.

19. Starting slowly at one corner, peel off the window screen, leaving the new sheet on the towels. If the sheet rises with the screen, apply the sponge again with all the force you can. If the sheet still rises with the screen, carefully peel an edge of the new sheet from the screen and separate the two with care. At the end of this step, the new sheet should be on top of the paper towels.

20. Place three or more paper towels on top of the new sheet. Take a flat piece of wood (or other protected, flat item) and press down hard on top of the dry towels.

21. Remove the top wet towels. Replace with dry ones. Repeat pressing. Repeat replacement of wet towels with dry ones, and pressing, until little water is removed with dry towels. Do not throw wet towels away. Lay them out to dry. Re-use them in future papermaking.

22. Students should write their name on a sheet of paper beside their recycled paper. Let the paper dry overnight.

Assessment

Have students describe the process of recycling paper.

Enrichment

For additional sheets of recycled paper:

Place one or two dried leaves of trees or flowers into the blender with the paper to be recycled.

Combine threads, ribbon lengths, leaves, grass, in a single new sheet. Put leaves and grass into the blender with the paper to be recycled. Add the threads to the pulp when it is in containers just before pouring.

Try glitter; add it either in the blender and/or in the containers just before pouring.

Collect examples of recycled paper products. Some possibilities are: food boxes such as cereal boxes (look inside the box; if it is brown or grayish in color, it is made from recycled paper), egg cartons, berry cartons, greeting cards, stationery and carry-out trays from fast-food restaurants. Make a display.

Make a paper tree out of newspaper (see instruction sheet).

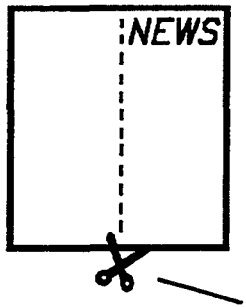
Adapted from *Tin Can Papermaking: Recycle for Earth And Art*, by Arnold Grummer ©1992. Used with permission.

A Newspaper Tree

You will need: • newspaper • tape • scissors

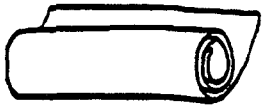
STEP 1: Cut two full double pages of newspaper in half lengthwise. This will give you four sheets of newspaper.

(2 sheets)

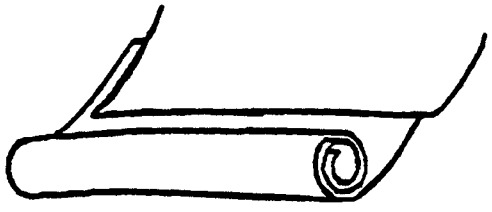


Cut or tear

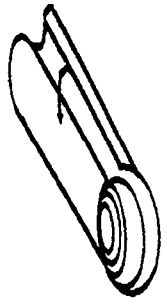
STEP 2: Roll one of the sheets loosely to form a tube. Leave an inch or so unrolled.



STEP 3: Lay another sheet on the first so their ends overlap. Roll again. Roll the third and fourth sheets in the same way.



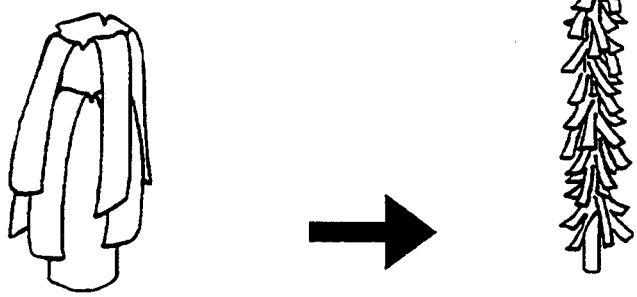
STEP 4: About 5 inches from the bottom, tape the end of the last sheet to the roll to keep the tube from unrolling.



STEP 5: Starting at the end not taped, make a cut through the roll to about halfway. Turn the roll a quarter turn and make another cut. Make 2 similar cuts (4 cuts total).

STEP 6: Bend back the cut parts and fold them down against the sides of the roll.

STEP 7: Put two fingers inside the center at the top. On the count of three say the magic words "Paper trees" and pull upward to extend the tree to its full height.



A LITTLE R & R

Objectives

Students will be able to: 1) demonstrate understanding of which materials are collected and which are not collected for recycling in their community; 2) demonstrate an understanding of the proper procedures for collection, storage, and preparation for recyclables in their community; and 3) understand the difference between the words and symbols for "recycled" and "recyclable."

Method

Students will bring examples of clean discards from their homes. These discards will be used in a relay race.

Materials

clean waste items including recyclables collected in local community and some items which have recycled content, 4 recycling collection bins (2 labelled "Collected Locally" and 2 labelled "Not Collected Locally" (Teacher may need to bring in a variety of waste items to fit each category.)

Vocabulary

recyclable, recycle, recycled, waste

Procedure

1. Students are to research and discuss their local community's recycling collection. By using the telephone book, radio, television, newspaper, calling their local KAB affiliate and/or their city solid waste department, etc., students should answer the following questions:

- What materials does my community collect?
- What collection system is used in my community? (Curbside, drop-off, buy-back center, reverse vending machines)
- Where does this collection take place?
- Does my community have more than one type of collection? Why or why not?
- How should recyclables be prepared for collection? (washed out, labels removed, crushed or not crushed, etc.)
- Is this method of collection used in our neighboring communities? Why or why not?

After the students have finished their research, lead a discussion with the class answering the previous questions.

2. Stress to students that a general rule for recycling collection is to follow the rules for their community and that those rules may not apply to other communities. Discuss with the students how the rules change from community to community and why.

3. Discuss with the students the difference between **collecting** and **recycling**. In order to have recycling collection, the recyclables must also be reprocessed, remanufactured, and then bought back in a product made from recycled content material.

4. Show students the recyclable sign and the recycled sign (full page diagram p. 91). Discuss the difference between these two. Ask the students to look at the waste items they have brought to school to see if any of them have the recyclable or recycled sign.

5. Explain to the students that they are now going to play a Recycling Relay Race. Divide the class into two groups and place two bins approximately 30-50 yards in front of each team. Each team should have one bin that says "Collected Locally" and one bin that says "Not Collected Locally." This game can be played outside on a playground, or in a gym.

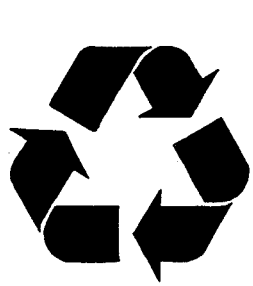
6. Divide the discards that the class brought in into two even groups. Each team will get a group of discards. The object of the game is to pick up a waste item, run to the bins, and place the item into the correct bin. The team that finishes first AND has the most items in the correct bins wins.

Assessment

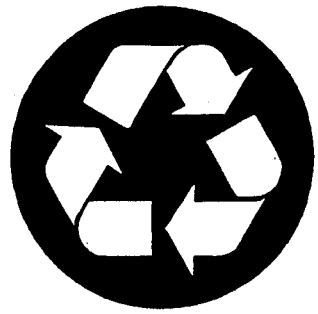
Ask students to write a paragraph on how their community collects recyclables including what the local citizens should do to prepare those recyclables for collection.

Enrichment

Have the students play the game again, but this time label the bins "Recyclable" and "Recycled Content" or use the different symbols.



Recyclable
(can be recycled)



Recycled
(contains recycled content)

Compost Pile Troubleshooting

SYMPTOM	PROBLEM	HOW TO FIX IT
pile is wet and smells like a mixture of rancid butter, vinegar, and rotten eggs	• not enough air • or too much nitrogen • or too wet	• turn pile • add straw, sawdust or wood chips • turn pile and add straw, sawdust or wood chips; provide drainage
pile doesn't heat up	• pile is too small • or pile is too dry	• make pile larger • add water
pile is damp and sweet smelling but will not heat up	not enough nitrogen	add grass clippings or other sources of nitrogen
center is dry and contains tough materials	not enough water	add water and turn
pile is attracting animals	meat and other animal products have been added	keep meat and other animal products out of the pile; enclose pile in a 1/4-inch hardware cloth

12. Have students brainstorm a list of suggested uses for the finished compost. Be sure to include the following:

    - spread compost on a garden in the spring before turning the soil for planting
    - place or bury compost in a garden between plant rows. The plant roots will grow into the compost and take up nutrients
    - use compost as mulch for shrubs, trees, and plants
    - when transplanting house plants, add compost to the soil
    - do not use compost to sprout tender seeds. The seeds may be killed by a fungus in the compost that causes damping off disease

Assessment

Ask students to list the essential materials for making compost and to identify various soil animals (from observation in the classroom).

Have students use the chart of possible compost problems to solve any problems that may occur with the classroom compost pile.

Have students list possible uses for compost.

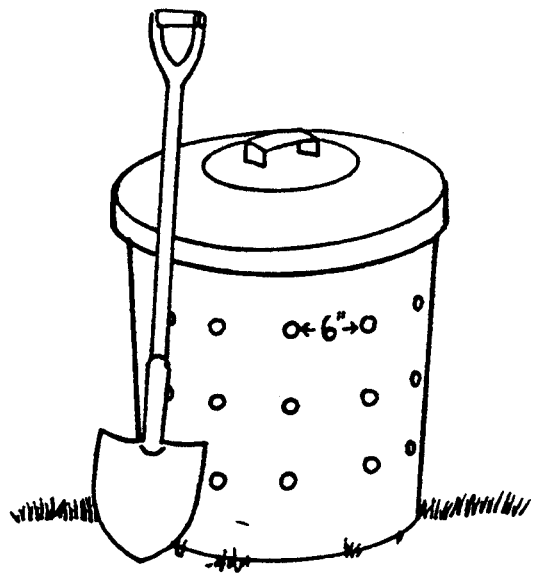
Enrichment

Observe a compost sample under a magnifying glass or under a microscope. Have students draw what they see. If possible, identify the organisms.

Count the number of soil animals (earthworms or pill bugs) prior to adding them to the pile, and again after the compost is "done." Note any population number changes.

Garbage Can Composter:

A garbage can composter is inexpensive and easy to build. It can be used for food or garden wastes. You do, however, need to turn the wastes.



Adapted from *Composting: Waste to Recources*, Cornell Cooperative Extension. Used with permission.

TURN OVER A NEW LEAF

Objectives

Students will be able to understand proper backyard composting for replication at home.

Method

Students will create a miniature backyard compost pile in a classroom setting.

Materials

a cardboard box or empty fish tank, organic matter such as grass clippings, leaves, twigs, bark, etc., samples of various types of soil (sand, silt loam, clay), soil from outdoors, container of water, thermometer, spray bottle (optional)

Vocabulary

aeration, compost, microbes, organic

Procedure

1. Background: What is composting? Composting is a biological process during which organic materials, such as grass and leaves, are broken down by microbes into a soil-like product. It is a form of recycling, a natural way of improving the texture and porosity of soil.

2. Show students samples of different soil types (sand, silt, loam, clay). Discuss good soil and poor soil. Introduce the term COMPOSTING. Explain that composting is a way to improve the physical properties of soil (texture and aeration). Composting is a natural (biological) process during which organic material, such as leaves, grass and

selected kitchen wastes, are turned into a soil-like product. Yard and kitchen waste is often thrown away and buried in a landfill. Composting can transform yard and kitchen waste into a rich, organic soil additive, and save valuable landfill space.

3. In this activity, consider a cardboard box or empty fish tank as the composting site. Tell the students that they will be building a small compost pile in the classroom to learn about the composting process first-hand. The classroom model will contain only yard wastes and no food wastes.

4. Getting the recipe right:

   One part green and two parts brown,
   Makes the compost turn to ground.
   Add some water and some soil,
   Turning is the only toil.©

   (Ray Ayer,
   Solid Waste Department,
   Ann Arbor, MI)

Green grass adds nitrogen. Leaves and brown things add carbon. It is important to have both for proper composting.

5. Prepare the compost materials. Have students bring in chopped up yard wastes including leaves, grass hedge clippings, and weeds. The smaller waste is chopped up, the faster it will break down into compost.

6. Build the compost pile by following these steps:

   Put a layer of coarse materials (sticks, small brush, larger pieces of bark) on the bottom of the container to create a way for water to drain and air to circulate.

   Mix the chopped yard wastes together; the more variety of materials, the better. Lay a one to two inch layer on top of the bottom layer.

   Cover organic wastes with a one inch layer of soil.

7. Maintain the compost pile until the compost is "done." After the first week, turn the pile weekly. Keep the compost moist by misting. Heat is produced within the compost pile due to chemical reactions. In compost piles larger than one cubic yard, temperatures reach 140 to 160 degrees Fahrenheit in the center. These high temperatures sterilize the compost. Have students monitor the temperature of the classroom compost pile as a way of tracking progress. How high did temperatures get? Odors can occur if the compost is not ventilated enough or if there is too much moisture. Crushed limestone can be used to help eliminate odors.

8. The compost is "done" when it is crumbly not sticky, dark in color but not black, and smells earthy but not rotten.

9. Discuss the qualities of a good compost pile:

   A good compost pile is kept moist but not soggy.

   A good compost pile has enough oxygen. Good compost piles are aerated by stirring regularly.

   A good compost pile has a good mix of organic ingredients.

   A good compost pile contains nitrogenous material. Nitrogen is required by the decomposing organisms. Most compost piles use manure as the nitrogen source, fertilizer may be substituted.

Assessment

Have students describe materials that are used in composting and why.

Have students illustrate the layers in a compost pile and label them.

Enrichment

Encourage students to set up compost piles at home.

At home, students should choose a level spot about three feet square that is preferably out of direct sunlight or receives equal amounts of sunlight and shade during the day. Following are different methods that can be used to prepare a compost pile at home:

Use no enclosure at all. Simply pile the materials up, keeping them in a fairly dense heap.

Assemble wooden stakes and chicken wire into a simple round enclosure for the pile.

Construct a wooden compost bin (use old lumber, if you have any).

Fashion a three-sided enclosure by placing cinder blocks on top of each other. Leave the front open.

Select the proper materials. Some things belong in a compost pile, and some do not. In general, do not compost materials containing animal fat. (Many heavily-populated or urban areas have regulations against piling and storing food wastes; these rules may also apply to adding food wastes to a compost pile. Less populated areas may not be under such constraints.)

Do Compost:

leaves and grass
small garden clippings
wood ashes
bark
peanut and nut shells
weeds

Do Not Compost:

meat and fish
bones
dairy products
vegetable oils/fats
poultry
plastics or synthetic fibers

Adapted from *Demonstrating Home Composting,* University of Michigan. Used with permission.

NATURE'S RECYCLING

Objectives

Students will be able to: 1) identify materials needed in the composting process, including microorganisms and soil animals; 2) identify problems that may arise in composting; and 3) list ways to use compost.

Method

Students will work cooperatively to create a composting system, solve composting problems, and use resulting compost in and around the school and home.

Materials

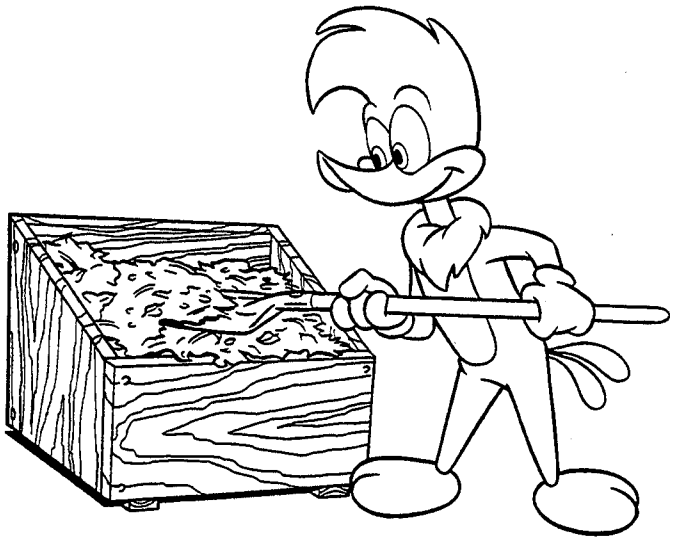
a 55-gallon plastic garbage can with cover, coarse sawdust, straw or wood chips, drill, shovel, work gloves, soil from outdoors containing soil animals (some or all of the following):

- earthworms
- ants
- beetles
- centipedes
- land snails & slugs
- pill bugs

Kitchen or yard wastes (some or all of the following):

high in nitrogen
- vegetable & fruit peels and seeds
- coffee grounds
- egg & nut shells
- grass clippings
- manure (or fertilizer)

high in carbon
- hay or straw
- leaves
- ashes
- sawdust & wood chips
- shredded paper
- weeds & other garden wastes



Vocabulary

aeration, composting, microbes, organic

Procedure

1. Background: Composting occurs naturally nearly everywhere. Leaves drop from trees. Grass clippings are left after mowing the lawn. Plants and animals die. Over time, these organic materials break down or decompose. The rich, dark soil-like material that results is called compost.

   Tiny living things do much of the work of breaking down organic materials to form compost. These tiny workers, called microbes or microorganisms, include such things as bacteria and fungi. Animals living in the soil help microorganisms break down organic materials. Worms and pill bugs are examples of soil animals that help change organic wastes into compost.

As microorganisms and soil animals turn organic materials into compost, they use the organic materials as food. The organic materials provide nutrients for growth and activity. Eventually, these nutrients are returned to the soil, to be used again by trees, grass, and other plants. This is nature's way of recycling.

By composting at school or home you can return organic wastes to the environment as valuable resources for other living things.

2. For composting with soil animals, such as earthworms, you will need a large enough composter to maintain a healthy soil animal environment.

   To build a garbage can composter, you will need a 55-gallon plastic garbage can. Drill three rows of holes 4 to 6 inches apart all around the sides of the garbage can. Then drill several holes in the base of the can. The holes allow air movement and the drainage of excess moisture. (If you plan to keep your compost can in the classroom, you will need to place a larger tray beneath the can to keep any possible drainage from reaching the floor.)

3. Place 2 to 3 inches of dry sawdust, straw, and/or wood chips in the bottom of the can to absorb excess moisture and let the compost drain.

4. Have students collect kitchen and/or yard wastes for composting. Place these wastes into the composting bin. Chop or shred organic materials if you want them to compost quickly. **(Do not** add meat scraps, bones, dairy products, oils or fats. They may attract pesty animals.) Make sure not to add too much of any one waste at a time.

5. Have the students collect soil from outdoors that contains some or all of the following soil animals:

   earthworms
   ants
   beetles
   centipedes
   land snails & slugs
   pill bugs

   Do not use potting soil purchased from a garden center, as this has been sterilized and contains no living microorganisms.

6. Spread soil containing microorganisms and soil animals over the compost pile in the can. These microorganisms and soil animals will do the work of making the compost. This also helps keep the surface from drying out.

7. Adjust the moisture in your compost pile. Add dry straw or sawdust to soggy materials, or add water to a pile that is too dry. The materials should be damp to the touch, but not so wet that drops come out when you squeeze it.

8. Allow the pile to "bake." It should heat up quickly and reach the desired temperature (90 to 140 degrees Fahrenheit, or 32 to 60 degrees Celsius) in four to five days.

9. The compost pile will settle down from its original height. This is a good sign that the compost is "baking" properly

10. Regularly mix or turn the compost with a shovel, and keep it covered. This adds air and mixes up the different wastes, preventing the compost from getting smelly. If you turn your compost pile every week, it will be "done" or ready to use in one to two months.

11. Discuss with the students the various problems that may occur when making compost. Stress the importance of air, moisture, the size of the pile, the need to balance the wastes added, and the need to protect the pile against nuisance animals. Use the following chart:

HOT TOPIC

Objectives

Students will understand that some waste material can be burned to generate electricity.

Method

Students will observe a demonstration of how a turbine is turned by steam. They will then calculate how much energy could be produced by burning municipal waste.

Materials

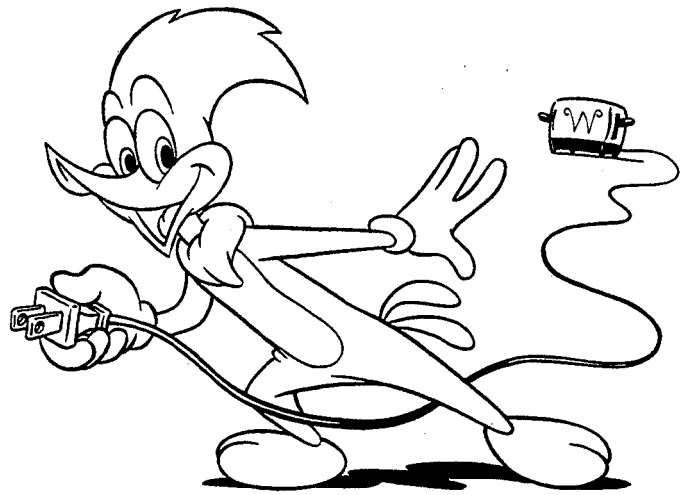
a coffee can, water, hot plate, windmill toy, copies of the work sheet "Waste-To-Energy Challenge," safety goggles, pot holder

Vocabulary

combustible, compost, energy recovery, incinerate, noncombustible, recycle, refuse derived fuel, resource recovery, sanitary landfill, Solid Waste Management, waste-to-energy

Procedure

1. Background: Explain to students what Solid Waste Management is. Simply put, solid waste management addresses the question, "What do we do with all our trash?" The most common answer is to bury the trash in a sanitary landfill, but there are several other Management options available for portions of the solid waste stream. Depending on the particular waste item, it can be recycled, composted, or burned. By burning certain trash, you reduce its volume and conserve space in the landfills.



Energy shows up in many forms, such as heat, light, and movement. Energy can be stored, and it can change from one form to another. In this demonstration, heat energy will be converted into energy which creates motion.

Most of the electricity which we use is produced by the burning of fossil fuels or by heat produced in nuclear reactions. The heat produced in electric power plants is used to boil water and create steam. The steam then causes a turbine to turn, which generates electricity. In waste-to-energy facilities waste material is burned instead of fossil fuels to produce electricity. During this incineration process, various organic chemicals and heavy metals may be emitted or concentrated in the ash.

Devices are available to monitor emissions and curtail incineration if air quality criteria and standards are not met. The Overview found in the appendices of this guide contains more detailed information about the waste-to-energy process.

2. Have students brainstorm a list of all the ways they have used electricity for the day so far. Ask the students if they know from where electricity comes. Explain the process as described in the Background information provided.

3. Explain that you are going to demonstrate how heat energy can be used to produce steam which can then turn a turbine to generate electricity. Make sure you are wearing safety goggles and follow all safety procedures required.

4. Put approximately one cup of water in the coffee can.

5. Punch a small hole in the lid.

6. Tape a windmill toy to the side of the can so that it will catch the escaping steam and spin.

7. Place the coffee can on the hot plate. Turn on the hot plate.

8. Watch the windmill spin.

   Be sure that the students understand that in a waste-to-energy facility waste material would be burned to generate the heat and that the turbine would be connected to an electrical generator.

9. After the students have watched the demonstration, have them use the worksheet to calculate how much energy could be produced by the garbage generated in one year. (Answers: Part one, $35.00; Part two, 208.33 days.)

Assessment

Students should be able to explain what waste-to-energy is. They should arrive at correct answers on the student sheet.

Enrichment

Visit a waste-to-energy facility if available.

Invite a resource person to discuss waste-to-energy facilities. Possible sources might include county solid waste managers or engineers, or representatives from your local KAB affiliate.

Diagram or build a model of a waste-to-energy facility.

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A Waste-to-Energy Challenge

Every year, each of us is responsible for about 1 ton of garbage. One person's yearly garbage fills about 27 large garbage cans.

When 1 ton of garbage is incinerated in a waste-to-energy facility, we recover 500 kilowatt hours of energy. Electricity costs 7 cents per kilowatt hour. The energy contained in 1 ton of garbage is worth how much?

_____.

This is enough energy to light a lamp for 5,000 hours. How many days can you light your lamp with the energy that can be recovered from the ton of garbage you will generate this year?

_____.

THE LAYERED LOOK

Objectives

Students will: 1) accurately construct a model of a sanitary landfill; and 2) identify the parts of the landfill and explain their function.

Method

After classroom instruction on the components of a sanitary landfill, students will diagram and construct a non-working model of a landfill.

Materials

For each group of 3 or 4 students: clear plastic shoe boxes or deli salad containers, large sheet of clear plastic, enough modeling clay to cover the bottom and top of the container, enough potting soil to make three or four layers in each container, paper scraps and other refuse scraps (do not include food or organic waste), plastic straws of various sizes, grass seed (optional)

Vocabulary

groundwater, impermeable, leachate, methane gas, solid waste management, sanitary landfill

Procedure

1. Begin by giving students background information on the difference between a garbage dump and a sanitary landfill. A dump is a place where garbage is left in an open pit or pile. In a sanitary landfill refuse is buried under carefully monitored conditions. A sanitary landfill begins with an opening in the ground. Each opening is

called a cell. The bottom and sides of the cell are first lined with compacted clay and plastic liners to prevent ground water contamination. Daily, a layer of waste material is placed in the cell and capped with soil. When a cell is filled, it is capped with another layer of clay and soil. Grass and shrubs are planted on the top layer to keep the soil in place. Many landfills have been landscaped and developed into recreational facilities such as golf courses or ski slopes.

All sanitary landfills should have systems for collecting and monitoring groundwater to ensure against contamination. They also have systems for collecting leachate, liquid that filters down through the landfill with rainwater and could contain harmful chemicals. Methane gas is produced inside the landfill and must be removed. In some cases this gas is simply burned off, in other cases it is collected and used as fuel. These systems for collecting ground water, leachate, and methane gas do not breach the lining systems of the landfill. It should be understood that degradation

processes which rely on the presence of light or air do not take place inside a landfill. The *Overview* found in the appendices of this guide contains an excellent explanation of sanitary landfills.

2. After students have taken notes on the proper construction of a sanitary landfill, have them work in cooperative groups to diagram a landfill. Make sure they have included all parts of the landfill and labelled them correctly.

3. Distribute to each group the materials to build the model landfills. Do not give students step by step instructions on how to construct the landfill. If their diagrams are correct, they should be able to accurately simulate the construction on their own.

   The clay should line the bottom of the container.

   Then the plastic will line the bottom and sides.

   Next, students should layer the waste material and potting soil.

   The straws represent the leachate, groundwater, and methane collection equipment and should be placed so that they extend above the surface of the completed landfill.

   The final layer of the landfill is covered with clay followed by top soil.

   Students may wish to plant grass seed on this layer and decorate it to represent a golf course, etc.

Assessment

Student models should contain all the elements of a sanitary landfill and they should be properly placed. Students should be able to explain the function of each part of the landfill.

Enrichment

Invite your local landfill operator to speak to the class.

Take a field trip to a nearby landfill.

Have students locate on a map where the closest landfills are.

Dear Parents,

Our class is about to begin a unit of study concerning solid waste management issues. Using the curriculum guide *Waste In Place* published by Keep America Beautiful (KAB) we will be studying issues such as litter and waste prevention, composting and recycling. KAB is a national, nonprofit, public education organization dedicated to improving waste handling practices in American communities.

At various times as we work through this unit, I may ask your child to bring in various items from home. Don't be surprised if empty cans and plastic bottles make their way into your child's book bag. Your recycling bin may be lighter for a while! I may also send home requests asking you to grant permission for your child's participation in special activities or projects.

We are very much looking forward to this new unit. If you have any questions please feel free to contact me here at school. Be sure to ask your child(ren) about the exciting things they're learning in order to make this a more beautiful world. Thank you in advance for your interest in your child's educational activities.

Sincerely,

Dear Parents,

As you know our class is currently studying various issues involved in the management of municipal solid waste. Some of the lessons which your children are taking part in include activities on litter prevention, waste prevention, recycling, composting, waste-to-energy, and sanitary landfills. We are now preparing to carry out an activity called

_____.

For this activity we are asking that the students bring in the following items:

_____

_____

_____.

We also would like permission for your child to

_____

_____

_____.

Please sign the attached permission slip and return it to school promptly.

Thank you for assisting us in this most important area of study.

Sincerely,

My child _____ has permission to

_____

_____

_____

_____

Parent signature Date

OVERVIEW OF MUNICIPAL SOLID WASTE

I. OVERVIEW OF MUNICIPAL SOLID WASTE DISPOSAL

Municipal solid waste (MSW) is constituted from household, commercial, institutional, light industrial (including a slight amount of hazardous waste), and small quantities of special wastes, such as from hospitals and laboratories. This document will focus on waste from household, commercial and institutional sources and does not attempt to deal with the medical waste issue.

In a 1992 update of a study conducted for the U.S. Environmental Protection Agency by Franklin Associates, Ltd., it was estimated that we produced 195.7 million tons of municipal solid waste in 1990. This figure breaks down to the equivalent of 4.3 pounds of trash produced daily by every man, woman, and child in the U.S. The study predicts that the total amount of MSW generated annually will grow to 222 million tons by the year 2000 as the population increases.

As the quantity of garbage increases, landfill capacity is diminishing. Major cities including New York and Los Angeles will exhaust their landfill space in just a few years, Philadelphia and others are already out of space.

Today, the U.S. is recycling and composting approximately 17% of its trash. Another 16% is incinerated for energy recovery, and the remainder is being disposed of in landfills. Yet the U.S. EPA predicts that one-third of our nation's landfill capacity will be exhausted by the year 2000.

Historically, managing MSW has been the responsibility of local governments to protect public health and community livability standards. The federal government has attempted to provide guidance through the 1965 Solid Waste Disposal Act, the 1970 Resource Recovery Act and the 1976 Resource Conservation and Recovery Act (RCRA).

RCRA amends the preceding bills to provide a program to regulate hazardous waste, to eliminate open dumping, to promote solid waste management programs and to further solid waste management options in rural communities through grants. It is the states' responsibility to carry out these laws.

Many federal regulations and the reauthorization of RCRA, which have a vital role in future waste management decisions, are currently in a state of transition. These laws will affect standards for landfilling, waste-to-energy ash management and air emissions. In order to deal with the waste this nation produces we can not look to a single solution.

Effective management requires an integrated approach—the consideration of a number of technologies working compatibly—including reducing the amount of waste produced, recycling, composting, waste-to-energy incineration and sanitary landfilling.

II. SOURCE REDUCTION

Reducing the amount of waste that is produced and thus discarded must be a priority for government, industry and individuals alike. The U.S. EPA defines source reduction as minimizing toxic substances in products, reducing the volume of material that must be discarded and manufacturing products with longer, more useful lives. The EPA has called for a 25% reduction in waste through source reduction activities and recycling.

Reducing toxic substances involves finding substitutes for heavy metal compounds, including the lead and cadmium found in batteries and other products. To prevent toxic substances' presence in disposal by-products such as compost, incinerator ash and landfill leachate, it is necessary to reduce them in the waste stream.

The volume of material that must be discarded can be reduced through product reuse and product redesign to lessen material usage per unit of product. Reusing

products is as simple as donating or selling old household appliances rather than discarding them, or repairing torn clothing rather than discarding it.

Reducing material usage per product unit results in less waste generated when the product is discarded. For example, steel can manufacturers in recent years have reduced the weight of cans so that more units per pound of steel are being produced. A study conducted by G. Kellman, P.E., indicates that consumers purchasing packaged products in larger container sizes will reduce the amount of packaging entering the waste stream as long as purchasing the larger size does not result in increased food waste due to spoilage. For example, a single 16-ounce can uses 68 grams of metal, or 40% less than the 95.4 grams used in two 8-ounce cans.

Additionally, The Procter & Gamble Company, a major producer of consumer products, is reducing material usage through the redesign of their products and packaging. For example, consumers can now purchase small packets of concentrated products and dilute them at home using larger existing containers. Other methods include refill packaging—products which are sold in space efficient forms, but are then transferred to permanent, durable containers for storage and use; package efficiency—redesign of bulky display packaging for space and materials efficiency; and single packaging— removal of outer cartons and wraps.

Source reduction can also be accomplished by manufacturing products with longer useful lives. Here again, household appliances can be produced that last longer and are repairable. In the case of automobile tires, product durability has been increased. Since 1973 tire durability has almost doubled—today's radials have an average life of 40,000 miles as compared to 15-20,000 miles for bias and bias-belted tires.

III. RECYCLING

In an integrated plan to dispose of MSW, recycling plays a major role. Communities should attempt to recycle as much as possible, but they must also realize that recycling alone can not solve the solid waste disposal problem.

There are varying reports on the potential recyclability of MSW, ranging from 25-80%. Most agree, however, that recycling can realistically reduce the amount of MSW by approximately 25% over time, although this may differ considerably from municipality to municipality. Today the U.S. is recycling and composting approximately 17% of its MSW.

In addition to reducing the waste stream, recycling can conserve natural resources and energy. Recycling also has the ability to generate revenue. However, it may cost more depending on the strength of the markets. Generally, it is best to look at recycling in terms of cost avoidance. Although recycling may cost money, the removal of recyclable materials from the solid waste stream can reduce the expense of incineration and/or landfilling, thereby making recycling cost-effective if it doesn't exceed the traditional cost of disposal. Recycling is a technology which involves collection, separation, preparing to buyer's specifications (e.g., baling), sale to markets, processing and eventual reuse of materials.

It is important to understand that the separation and collection of recyclable material is only the first step in the process. If material is not processed and returned to commerce, then it is not being recycled. In many parts of the country, markets for recycled materials are not yet sufficiently developed to handle the growing supply of collected material. When developing a collection program, it is imperative that attention be paid to developing markets.

MARKETS

Intermediate markets include scrap dealers or brokers. They allow the materials to accumulate, process them to market specifications and then ship them to final markets. When markets are low, scrap dealers will inventory the recycled product until the price goes up.

Final markets are facilities where recycled materials are converted into new materials. They are the last phase in the recycling circle.

MATERIALS RECYCLED TODAY

ALUMINUM

Aluminum, particularly cans, is a very valuable commodity. In 1972, 1.2 billion cans were recycled. In 1992, a total of 54.9 billion cans were recycled—63% of all cans.

Recycling aluminum saves a tremendous amount of energy. It takes 95% less energy to produce an aluminum can from an existing one than from ore. In 1987, for example, the Aluminum Association says aluminum can recycling saved 10 billion kilowatt-hours of electricity—enough to supply the residential electric needs of New York City for over six months.

Various forms of aluminum are recyclable, with cans being the most common. Siding, gutters, downspouts, storm door and window frames, lawn furniture frames, etc. are also recyclable. A magnet, which will attract iron and steel but not aluminum, should be used to make sure aluminum is not contaminated by other metals. To command the highest price, cans must be kept separate.

Aluminum can be separated from MSW through source separation (separating recyclables from the waste stream at the point of generation, e.g. at home) or by technology such as separating and sizing devices like trommel screens, air classifiers and magnetic separators.

PAPER

Nearly forty percent of all the paper and paperboard used in this country is now being collected and utilized as either raw material to make recycled paper and paperboard or as an export to countries overseas.

The paper market fluctuates with the world economy, which primarily drives the demand for recycled paper. The U.S. housing industry, which is sensitive to economic trends, uses a significant portion of the recycled paper in roofing shingles, tar paper and insulation. Another major portion of recycled paper, particularly newsprint, is sold to foreign markets, whose fluctuations are subject to worldwide economic trends. Newsprint is most frequently recycled into new newsprint or recycled paperboard.

Collection increased from 12.5 million tons in 1970 to 28.9 million tons in 1990. Currently, 200 paper mills in the U.S. process waste paper, and there are approximately 2,000 waste paper dealers in the U.S. which buy paper from collectors. Paper mills will also buy recyclable paper at their facilities.

Four broad grades of waste paper are recycled: old newspapers, old corrugated containers, mixed office waste, and high grade waste paper.

Old newspapers represent the major grade of post-consumer waste paper that is source separated for recycling. Approximately 42.5% of consumed newsprint was recovered for recycling.

Old corrugated containers (OCC) are generated in bulk from retail stores and factories. Large supermarkets usually bale their OCC and sell it directly to recycling mills. Small retail stores and factories may depend upon individuals who collect the material in their own vehicles. Usually these individuals do not pay the generator for the waste, but save them the cost of contracting with a private hauler to remove the used containers. Forty-eight percent of old corrugated containers were recovered in 1990.

Generally separated in large office buildings at employees' desks, mixed office waste represents a relatively new grade of waste paper. Separate racks are placed on desk tops for white paper collection that are then emptied into a central collection bin and periodically removed and taken to the loading dock for a hauler to pick up.

Waste paper dealers may also buy mixed office waste and hand sort it into many grades, depending on their customers' specifications.

Finally, high grade waste paper is generated in paper converting plants. The envelope, business form, book and catalogue machine trimmings and clippings are usually of such high quality and value that the commercial printer who generates this high grade waste sells it directly to a recycling mill or to a waste paper broker.

Contaminants of Waste Paper

Waste paper that is recycled must be free from other wastes, particularly food wastes, which contaminate the paper with bacteria and cause odor.

Other materials which must be removed to make the paper a higher quality are: metal, glass, rubber, plastics, textiles, wood and other extraneous materials. These contaminants are not easily removed in the recycling process and must therefore be hand sorted from the paper.

While recycling is greatly encouraged and a necessary means to reduce the waste stream, it is not "clean disposal." There are significant effluents from recycling processes, particularly the paper de-inking process which may contain lead, thus requiring very careful management and disposal.

Oversupply

Dealers may discourage collection during a period of oversupply. When the world economy is in a period of recession, the consumption of waste paper declines and additional collection is unwarranted. The growing popularity of mandatory recycling in the U.S. (which actually mandates collection, not recycling) may also result in the oversupply of waste paper and weaken markets.

GLASS

The primary components of glass—sand, soda ash and limestone—are in abundant domestic supply. However, the use of cullet (crushed glass) in the manufacturing process has economic advantages over virgin materials. Cullet melts at a lower temperature than the raw materials, allowing manufacturers to reduce energy usage and particulate emissions into the atmosphere.

Over the past several years, the market for cullet has been characterized by high demand and increasing prices. The most common use of collected glass containers is as a direct substitute for raw materials used in the production of new glass containers. Recycled glass is also used in the manufacture of fiberglass.

Approximately 1,250,000 tons of glass (5 billion containers) are recycled annually in the U.S. Used glass bottles and jars are collected and remelted with raw materials to make new glass containers. In the last ten years there has been a 453% increase in post-consumer glass collection. Eighty-six glass container manufacturing plants produce new containers in part from recycled glass. And, according to the Glass Packaging Institute, 30% of any given glass container is made from recycled glass.

Contamination

Processing equipment is designed to remove contaminants such as magnetic metals, aluminum caps and labels. Some of the contaminants (like food residue), remain with the cullet and are burned in the melting process. Ceramic materials are not easily removed during processing. Therefore, caution must be taken in collection to avoid contamination with ceramic materials such as baking glass and headlight lenses.

To ensure quality cullet, consumers generally separate glass from other household wastes. Glass is also frequently separated at intermediate processing facilities.

PLASTICS

Plastics recycling is a growing field. Plastics make up approximately 8.3% of the municipal solid waste stream (4% being plastic packaging) and are expected to comprise about 10% by the year 2000. Currently three types of plastic are being successfully recycled while research is being pursued for other varieties.

PET

The most common plastic container being recycled is the PET (polyethylene terephthalate) soft drink container, and approximately 31.5% are being recycled today. Because of contamination concerns, recycled PET is not used for food packaging; it is, however,

commonly being used to manufacture carpet backing and fiberfill for items such as sleeping bags and ski jackets.

Some reclaimed PET bottles are being converted to polyol, a chemical ingredient used in manufacturing rigid urethane foam to produce such products as refrigerator insulation, automobile bumpers and furniture.

Unsaturated polyester made from recycled PET bottles is used in making fiberglass bathtubs, shower stalls, corrugated awnings and swimming pools.

Manufacturers are also using recycled PET to produce engineered plastics such as appliance handles, power tool housings and automotive parts as well as floor tiles, paint, paint brushes and kitchen scouring pads. The Procter & Gamble Company is marketing nonfood products in recycled PET containers.

HDPE

Another type of plastic container that is being recycled is HDPE (high density polyethylene) commonly used for milk jugs and the base cups of PET soft drink bottles. These plastic bottles are easily identifiable and recyclable because they are all made from the same plastic material. Recycled HDPE, like PET, is not used for food packaging. However, a variety of secondary uses are being created such as new base cups for PET soft drink containers, trash cans, flowerpots, piping and traffic cones.

Additionally, recycled HDPE is being used commercially on a small scale to make "plastic lumber." The lumber is being used for railroad ties, decking for boat piers and docks, and fencing. It has benefits over wood in that it does not rot, splinter or chip. The lumber also does not have to be painted, because the desired color can be pigmented into the material.

Polystyrene Foam

Polystyrene foam items such as cups, plates and fast-food carryout containers are beginning to be recycled. Several programs are in place or in the developmental stages.

The material is collected in special trash receptacles at schools, fast-food restaurants, and other institutions, and is then cleaned and converted into pellets. The pellets can be recycled along with other plastic materials to create plastic lumber for walkways, benches, etc., or they can be used to make building insulation and packing material.

According to Dr. William Rathje, an anthropologist at the University of Arizona who has excavated several major landfills, polystyrene foam foodservice products used in this country represent approximately one quarter of one percent (0.25%) of municipal solid waste.

Commingled

Plastics recycling is more complicated than other materials recycling because of the variety of resins used in the manufacture of different plastics resulting in the difficulty of sorting the plastic by resin. For example, two brands of mouthwash may be packaged in bottles composed of different plastics that appear similar to the eye.

In response, the plastics industry has developed a voluntary coding system to identify what plastic material the bottles are made of and to encourage increased separation and recycling of more plastics. Several manufacturers are now coding their plastic packaging.

For those plastics that can not be sorted, because the recycler does not have the accommodations for such a system, or because it is not economical, commingled plastics recycling is now a feasible alternative.

Commingled collection of plastic and subsequent recycling is being investigated by the Plastic Recycling Institute at Rutgers University. Unseparated and uncleaned plastics are mixed together and processed to a very dense material that can be used as fence posts, car stops for parking lots, and park benches.

Other Plastics Recycling

Other examples of plastics recycling involve plastic bags and garment bags made of low density polyethylene, and the recycling of polypropylene automotive battery cases.

In each case, the success of these recycling efforts is related to a continuous supply of material and an application for the recovered material which provides satisfactory performance and economic incentives.

IRON AND STEEL

Steel is recyclable, in whatever form it reaches the public—pipes, automobiles or food cans. It can be remelted and shaped into new steel products. In fact, iron and steel are the most recycled materials used today. According to The Steel Can Recycling Institute, 66% of all steel is recycled into new products. All new steel produced in the U.S. is either 25% or 100% recycled steel.

The use of post-consumer ferrous (containing iron) products as a scrap metal is not new. Metal from consumer waste products such as discarded automobiles and large appliances have traditionally been remelted. Until recently, however, only very small percentages of steel ("tin" cans and bi-metal cans) were used for remelt.

Steel scrap must be segregated into categories so that mills can melt it into quality products. Unwanted contaminants such as paper and wood can be burned off, but other metals can contaminate the end product.

The amount of purchased scrap consumed by the steel industry has increased in recent years, and technological developments in the steel industry promise an even larger market for industrial scrap (generated in manufacturers' plants) and obsolete scrap (material from the waste stream, old rails, food and beverage containers) as steel mills become more efficient and generate less of their own scrap.

A record number of U.S. steel mills, 20 in all, now purchase and melt can scrap to make new steel. They provide markets for the increasing amount of steel collected in municipal recycling collection programs and for the scrap generated in resource recovery plants which magnetically separate scrap and other ferrous materials from municipal solid waste.

Approximately 3 percent of U.S. annual steel production is in the form of containers for food and beverages. The industry itself has embarked on an aggressive campaign to attract more steel can scrap into the recycling stream and to help state and local governments eliminate ferrous scrap from the municipal waste stream. The recovery rate for steel food and beverage cans in 1990 was 48.1%.

Scrap metal dealers and brokers also represent a large potential market for all types of recovered metals. They can provide a regular market, process the material as required and resell to the ultimate buyer. Additionally they can provide a service in transporting the recovered ferrous metals to the final market.

Other Forms of Ferrous Recycling

Other markets for ferrous metals recycling include tin, iron foundries, the production of ferro-alloys and the copper precipitation iron market.

SCRAP TIRES

Well over two billion discarded tires are stockpiled around the country and approximately 280 million scrap tires are generated annually. Tires are usually discarded at retail outlets that sell and mount new tires. They are sorted, and those found satisfactory are retreaded. The remainder, in some cases, are shipped to recyclers, frequently the seller of new tires. Where there are no markets, or acceptable disposal sites, the tires pile up.

Landfilling of whole tires is banned in many states because they cannot be compacted and often rise to the surface due to the resiliency of the rubber. Some landfills require that tires be shredded or split, while others discourage tire disposal by charging disposal fees of $1 or more per tire. Abandoned tires serve as a breeding ground for mosquitos and, when ignited, can take months to extinguish and produce oil-like liquids which can contaminate surrounding surface water and ground water.

The difficulty of disposal is directly related to the lack of market for the scrap tires. Increased recycling promises a diminishing stockpile of discarded scrap

tires, a savings of landfill space, and the assurance that a valuable material and potential energy source will not be wasted.

Following is a brief synopsis of how tires are being reused in the United States:

- **Reclaimed Rubber**

Approximately 10 million tires are disposed of annually through a reclamation process involving grinding, shredding and pulverizing the tires. The material is formed into sheet rubber and sold in bales to producers of molded materials and semi-pneumatic tires.

- **Retreading**

Retreading requires about 30% of the energy necessary to produce new tires and it provides nearly 80% of the mileage of a new tire. Almost 20 million truck tires and 17 million passenger tires are retreaded annually. The market for good quality used tires will always exist in the retreading industry.

- **Marine Use**

Scrap tires are being used as artificial reefs, created by stringing tires together with non-corrosive cable and drilling holes in them so they will sink in the water.

- **Incineration**

Tires added to mass burn units or shredded tires in a refuse-derived fuel system burn completely and are a good source of fuel. Additionally there are waste-to-energy plants that solely burn chipped tires, known as tire-derived fuel. Other plants burn whole tires to produce electricity.

- **Crumb Rubber**

Crumb rubber or ground and shredded rubber can be added to other materials in the manufacture of new products. Following are methods of waste tire recycling utilizing some form of crumb rubber:

Asphalt-Rubber: ground rubber mixed in a bituminous concrete used as an interlayer that reduces stress and prevents cracks. The production of asphalt-rubber is presently more costly than standard bituminous pavements, but it lasts longer and is cost-effective. Recent legislation requires the use of scrap tire rubber in all federally-funded road projects.

Tirecycle: a trademarked process which produces a rubber compound primarily from ground scrap tires. The compounds can be used in the manufacture of virtually any rubber or plastic product.

USED OIL

Used oil is a valuable, renewable resource that must be handled wisely to prevent careless disposal down sewers or in landfill sites which may contaminate surface and ground water. This handling should include reuse practices such as re-refining into lubricating oil and carefully controlled burning for energy recovery.

Fifty-seven percent is reprocessed with water and particulates removed. It is then used for fuel. Twenty-six percent is re-refined and turned into base stock. With additives, it is used as lubricating oil and put to other uses. Seventeen percent is used for road oil, dust control, wood preservative or "fire log" ingredients.

According to the U.S. Department of Energy, used oil is generated at a rate of approximately 1.2 billion gallons annually. This is equivalent to approximately 78,000 barrels a day. Approximately 60%, or 700 million gallons, are used motor oils. The remaining 500 million gallons are industrial used oils such as hydraulic, metal working and cooling oils. Of the total oil generated, two-thirds is recycled, primarily as a fuel. The remaining 400 million gallons, however, are disposed of or dumped.

COLLECTION TECHNIQUES

A variety of methods are used to collect materials for recycling including single and multi-material curbside collection, drop-off and buy-back centers. In every case, a key to success is convenience for the disposer and for the handler.

CURBSIDE COLLECTION

This method requires consumers to sort waste into separate containers that hold the same type of recyclable material. Source separated materials can include newspapers, glass, aluminum and bi-metal

containers, corrugated cartons, selected plastic containers such as PET and HDPE, and used oil. In some cases, all recyclables are placed in one container for separation at an intermediate processing facility.

Many municipalities provide residents with colorful collection bins or clear and colored plastic bags to separate materials accordingly. They are set out on specified collection days, collected by crews and transported to a processing center, storage facility or straight to market. Studies have shown that separating trash is easy, taking approximately fifteen minutes per week.

A good way to evaluate a program's effectiveness is to measure the amount of recyclables collected–the percentage of the waste stream that is diverted from landfills –as well as by the number of households participating.

Expense

While curbside enjoys a high participation rate, it is an expensive way to collect materials. This method involves major capital expenditures including collection vehicles and operating costs such as labor, maintenance, administrative and transportation expenses–all of which can become prohibitive. Labor alone can account for 35-85% of operating costs, depending on the amount of processing needed.

Controlling Costs

There are several ways of cutting costs. The purchase of used equipment can be cost-effective because it is seldom used for more than several hours a day. In-kind services can also reduce the burden of starting a curbside program. For example, empty building space can be donated and vehicle maintenance can be performed by existing staff.

The high participation rate also allows for curbside material sales to typically represent 45% of the average program's revenue. Other sources of income include payments for contracted services, grants, surcharges and tax revenues, and disposal credits. More information on curbside collection expenses is contained in *Comprehensive Curbside Recycling, Collection Costs and How to Control Them,* published by the Glass Packaging Institute.

Methods of Curbside Collection

The most effective approach tends to be once-a-week collection on the same day as garbage pick-up. Again, convenience to the consumer is key. Recyclable materials collected on the regular trash collection day minimizes labor costs by utilizing the same crew. A vehicle with built-in compartments or bins or one that pulls a trailer is generally employed.

Materials can also be collected on a day other than refuse collection day. An advantage is the purchase of additional hauling trucks may not be needed as existing garbage hauling trucks can be used on their off days if collected materials are commingled or if bundled newsprint is collected. If days are not regularly scheduled, however, residents may forget or choose not to store materials for a long period of time.

MULTI-MATERIAL COLLECTION CENTERS

A multi-material collection center is a stationary site where residents bring their recyclable materials. In some cases, recyclers are paid for the materials they bring in, in other cases they are simply dropped off and the funds are used to further the program and offset the cost of disposal.

According to the U.S. EPA, drop-off centers are the most common form of collection for households. However, the volume of materials collected and the participation rate is considerably lower than curbside, because it requires residents to prepare, store and transport material.

Advantages of this collection method include the ability to collect a wider variety of recyclable materials. They are not limited to two or three as are many curbside programs. There is also limited expense to this form of collection because less equipment and labor are required to obtain the materials.

Location

Recycling centers located at landfills, incinerators, transfer stations or convenience centers especially in municipalities without regular refuse collection experi-

ence the best participation rates. They should be convenient to populated areas and be on well-travelled roads. Most consumers who bring materials to a drop-off center live within a five mile radius of the site.

Recycling theme centers have proven to be extremely successful in increasing citizen participation rates. Centers have been designed to replicate a visit to the zoo, circus, riverboat or old town railroad station. These facilities are designed to make recycling fun for the entire family.

Additionally, successful centers must be able to accommodate small vans and pickup trucks for the volume recycler who collects from other people, bars, restaurants, hotels and hospitals.

The role of advertising and publicity can not be overemphasized. All must be aware of the hours of operation, materials accepted and the prices paid (if it is a buy-back center). A single media campaign will not be effective; the publicity must be year-round, employing a variety of methods to educate citizens. Consider conducting a survey to define operating hours that are the most convenient to the public.

SINGLE MATERIAL BUY-BACK OR COLLECTION CENTERS

Single material recycling centers are also widely used to collect recyclable material. These centers typically collect one of the following: aluminum, glass or newsprint. Reverse vending machines are gaining popularity as a method to recover cans. Reynolds Aluminum Recycling Company is the leading operator of these machines in the U.S. Recyclers simply insert their old aluminum cans into the collection machines and receive cash on the spot. Similarly, there are machines in place that accept steel cans.

IV. COMPOSTING*

Composting can reduce the amount of waste disposed of in waste-to-energy plants or in sanitary landfills. For years, many people have had a back yard compost pile for food and yard wastes. Municipalities are now looking to composting on a larger scale to transform MSW components such as paper, cardboard, food wastes and other miscellaneous organic materials into humus or mulch. Increasingly, communities are organizing programs to compost yard waste—which accounts for 17.9% of MSW. Others are diverting a greater portion of the waste stream for composting.

Many communities ignore solid waste composting when evaluating waste disposal options because of a lack of awareness or apprehension about marketing the resulting compost product. Composting is not an option for a major portion of the waste stream. It is, however, a component of an integrated resource recovery program.

Municipalities must realize that composting solid waste costs money. Although revenues generated through the sale of compost products will help defray the facilities' operating costs, composting of solid waste is not going to make money. Rather, the primary benefit of a composting program is the potential for diverting solid waste from landfills and producing a usable compost product economically.

Composting is the aerobic (in the presence of oxygen) biological decomposition of organic waste materials. The process releases carbon dioxide, water vapor and heat. MSW components are decomposed by micro-organisms under controlled conditions during composting. Materials such as metals, plastics, bulky wastes and glass are not compostable.

Solid waste composting results in a stabilized organic material which physically resembles soil or humus material. Compost is a useful additive for improving the physical properties of soil, but it is not a fertilizer.

*Adapted from a paper presented at the Fourth Annual Conference on Solid Waste Management and Materials Policy in New York City, and written by Eliot Epstein, Ph.D., president, and Todd Williams, environmental engineer, both of E&A Environmental Consultants, Inc.

It enhances soil aggregation, decreases soil crusting, and improves water retention, water infiltration, water permeability, soil porosity and soil aeration. Odor results when an anaerobic condition exists, but proper maintenance can control this condition.

PRODUCT QUALITY

EPA requirements must be met in the composting process. Temperatures of greater than 55° Celsius (131° Fahrenheit) must be maintained in the composting material for several days, effectively eliminating viral, bacterial and parasitic pathogens. Monitoring and periodic analysis of the compost assure that all regulatory requirements for the production and use of the compost product are met. MSW composting must be overseen by an experienced operator and the heavy metal content must also be carefully monitored.

Composting MSW in a centralized plant is different from doing so in a back yard. Back yard composting can be dangerous because of the inability to control the temperature, hence the risk of a contaminated end product.

Recovering certain materials will have a significant effect on the content of metals and other compounds in the resulting compost; nevertheless, the remaining metal content renders mixed waste compost unusable on land that grows food crops. The heavy metal content in compost can be minimized by removing such items as lead acid batteries (used in automobiles).

END USE

Purchasers of compost can be divided into five categories:

- **Growers** tend to demand a higher grade product and include golf courses, landscape contractors, nurseries, etc.;
- **Processors** will refine the compost product to their chemical and physical specifications—this group includes fertilizer contractors, manufacturers/suppliers and topsoil businesses;
- **Re-wholesalers/retailers** generally prefer a bagged product for resale—they include garden centers and greenhouse equipment/supply businesses;
- **Bulk users** represent businesses or operations that use compost on large acreages or in large volume, including land reclamation firms, landfill cover companies, park departments and transportation departments; and
- **Service providers** are those in a position to specify the use of compost on building and landscaping construction and maintenance projects including landscape planning companies and landscape design firms.

Aggressive promotion of any compost product will be required to establish markets and optimize revenues. Development of educational materials such as brochures and recommended guidelines for application are all very good tools to be used in promoting a compost product. Transportation and quality control are also vital to strong sales; the product must be of consistent quality and delivered regularly to develop loyal consumers. These activities must be taken seriously to sell the quantity of compost that is produced.

As with recycling, composting will only be an effective waste management tool if there is a demand for the end product.

V. WASTE-TO-ENERGY

Waste-to-energy (WTE) is taking on a vital role in integrated solid waste management planning. Trash is brought to a waste-to-energy plant where it is either burned as received, or following processing to a more uniform fuel, is burned to generate steam or electricity. Waste-to-energy plants can decrease the volume by 60-90% while recovering energy from discarded products.

There are approximately 169 waste-to-energy plants now operating in the U.S. An additional 40 plants simply burn waste without capturing energy. Approximately 29 million tons of waste (16% of MSW) are incinerated annually, generating enough electricity to supply the needs of more than 1 million homes.

The EPA estimates that, by the year 2000, over 300 waste-to-energy facilities will handle one-fourth of the nation's MSW.

There are three basic types of plants operating in the United States to convert waste into energy. They are:

MASS BURN

About three-fourths of the waste-to-energy facilities in the U.S. are mass burn, where refuse is burned just as it is delivered to the plant, without processing or separation. The fire heats boilers, making industrial steam or electricity. These U.S. plants are sized to incinerate up to 3,000 tons of refuse per day and use two or more burners in a single plant. While facilities are sized according to the expected volume of waste, they are actually limited by the amount of heat produced when the garbage is burned. For example, if garbage burns hotter than it is expected to, less volume of material can be incinerated. Some mass burn plants remove metals from the ash for recycling. Mass burn plants have operated successfully in Europe for more than 100 years.

MODULAR COMBUSTION UNITS

Modular incinerators are, for the most part, simply small mass burn plants with capacity ranging from 25 to 300 tons per day. The boilers are built in a factory and shipped to the plant site, rather than being erected on the site as is the case with larger plants. These facilities are often used in small communities.

REFUSE-DERIVED FUEL (RDF)

In an RDF plant, waste is processed before burning. A typical plant will remove noncombustible items, separating glass and metals for recycling, and shred the combustible waste into a smaller, more uniform particle size for burning. RDF requires significantly more sorting and handling than mass burn but does provide greater opportunity to separate recoverable materials and to remove environmentally harmful materials prior to combustion. The RDF thus produced may be burned in boiler on-site, or it may be shipped to off-site boilers for energy conversion. If it is to be shipped off-site, it may be densified into fuel pellets. Several years ago, RDF was used mainly along with coal in coal-fired burners. Now, however, it usually is burned in dedicated boilers designed and built especially for the RDF.

Cogeneration facilities also have the capability of burning solid waste. Cogeneration produces both electricity and thermal energy in the form of steam or hot water. Most cogeneration facilities use natural gas or coal; others use various form of biomass (wood, cornhusks, MSW). Some waste-to-energy plants are cogenerators, such as the 2,250 ton-per-day plant in Baltimore.

Compatible with Recycling

In an integrated resource recovery system, waste-to-energy is totally compatible with recycling, composting and other components. Savings from reducing the amount of waste to be burned can be significant; reducing the size of the plant can also reduce siting problems, as well as lower the initial cost of the waste-to-energy facility. Recycling may improve the efficiency of waste-to-energy plants by removing noncombustibles such as glass and metal, allowing the garbage to burn at a higher heat level and reducing the amount of ash produced. Removing metals may also reduce many of the pollutants, such as lead and cadmium, associated with incinerator emissions and ash.

If a community plans to develop an integrated resource recovery program, then the amount of recycling expected should be figured into the preliminary plans for building the incinerator. Reducing the volume of garbage after the plant is built lowers its utilization, thereby raising costs. While the volume displaced by recycling may be recovered by importing waste from the surrounding area, this may result in strong citizen opposition. Proper planning can avoid such a situation.

Landfills Still Needed

Landfills will always be necessary to dispose of ash and non-burnable material. We will never eliminate the need for landfills, only lessen the amount of material that need be disposed in them.

Cost

The price of building a waste-to-energy facility is high—as much as $400 million for an extremely large plant. However, the facility promises to keep trash disposal costs reasonably stable for 25 or more years—the life of the plant. The revenue for the sale of electricity and/or steam plays a major role in off-setting the cost of the facility.

Generally, tipping fees account for 25% to 40% of plant revenues. Without a strong market for the produced energy, the plant may not be economically feasible.

PURPA

A 1979 federal law, the Public Utility Regulatory Policy Act (PURPA), helps to ensure that small power generators— including waste-to-energy facilities—will have a market for produced energy. PURPA requires utilities to purchase such energy from qualifying facilities at avoided costs, that is, the cost avoided by not generating the energy themselves. However, in some areas the avoided cost is so low that the utility is not a viable market for the energy.

It may be more advantageous for a waste-to-energy developer to seek a market for the steam produced. Some facilities, for example, supply steam to industrial plants or to district heating systems.

AIR EMISSIONS

Incinerators burning MSW can produce a number of pollutants, generally in very small quantities, including carbon monoxide, sulfur dioxide, and fine particles containing heavy metal compounds (e.g., from lead and dioxins). The generation of pollutants and their release into the atmosphere is now being effectively reduced or prevented by a number of air pollution control devices built into modern waste-to-energy facilities.

Many of these pollutants are formed as a result of incomplete combustion. That is, refuse that is not burned at high enough temperatures, for long enough or when too much or too little air has been added to the fire. The generation of pollutants can thus be controlled by proper operation of the WTE facility.

Following is a summary of the air emission control devices now being used to remove pollutants from incinerator stack emissions.

- **Dry Scrubbers** "wash" particulate matter and gases from the air by passing them through a liquid. The scrubber removes acid gases by injecting a lime slurry (a watery mixture) into a reaction tower through which the gases flow. A dry powder containing salts is produced and collected along with the fly ash in an electrostatic precipitator (see below) or in filters and discharged along with the fly ash into the ash residue. The lime also causes small particles to stick together, forming larger particles that are easier to remove. Ash is stabilized by the addition of lime which enhances its natural alkalinity.
- **Electrostatic Precipitators (ESP)** use high voltage to negatively charge incoming dust particles, then the charged particulates are collected on positively charged plates. ESPs—documented as removing 98% of particulates, including heavy metals—are very commonly used as WTE air pollution control devices. Nearly 43% of all existing facilities use this method to control air pollution.
- **Fabric Filters (Baghouses)** consist of hundreds of long fabric bags made of heat-resistant material

suspended in an enclosed housing which filters particles from the gas stream. Fabric filters are able to trap fine, inhalable particles. According to the National League of Cities, fabric filters capture 99% of the particulates in the gas flow coming out of the scrubber, including condensed toxic organic and heavy metal compounds.

- **Stack Height** is an extra precaution taken to assure that any remaining pollutants will not reach the ground in a concentrated area. When the gasses enter the stack they are quite clean due to the controls discussed above. Stacks being built today are 200-300 feet or more in height, twice as high as the stacks used on older municipal incinerators.

Using the best available control technologies, the National Solid Wastes Management Association states more than 95% of the remaining gases and fly ash are captured and removed. These technologies include scrubbers, electrostatic precipitators and fabric filters.

EPA is developing air emission standards for municipal incinerators. Because currently there are no national standards, states are increasingly formulating their own.

In recent years, one group of chemical compounds, dioxins, has attracted special attention. These compounds are found in many foods–including fish, poultry and eggs–and occur in such common products as wood pulp and paper. About 75 different forms of dioxin have been identified.

Fortunately, such compounds can be destroyed. By maintaining very high temperatures during the combustion process, waste-to-energy plants eliminate virtually all of the dioxins that are produced. If small amounts survive, they are entrapped within pollution control devices. In fact, studies have shown that a combination of scrubbers and fabric filtration systems can remove up to 99 percent of these large molecules.

ASH MANAGEMENT

Ash is the solid material that is produced from the combustion of all fuels. It is composed of the following two general types of components: 1) noncombustible inorganic materials that are present in the fuel such as cans, bottles, rocks and stones; and 2) complex organic materials that are formed primarily from carbon atoms that escape combustion and are present in small quantities as part of the small soot residue.

Municipal solid waste contains many noncombustible materials that are found in its ash. Of primary concern is the presence of the metals lead and cadmium. Sources of these materials have been identified in a recent U.S. EPA report. Lead acid batteries used in autos contribute up to 65% of the lead in MSW. Other sources include consumer electronics such as televisions and radios, glass and ceramics, and plastics. Fifty-two percent of the cadmium in MSW comes from rechargeable household batteries, the rest coming from plastics, consumer electronics, old appliances, pigments, glass and ceramics.

Two types of ash are produced:

- **Bottom Ash**—large and moderate-sized unburned and unburnable matter left after the waste has passed through the combustion chamber. This ash comprises 75 to 90 percent of all ash produced, depending on the technology employed.
- **Fly Ash**—a powdery material suspended in the flue gas stream, collected in the air pollution control equipment. Fly ash tends to have higher concentrations of certain metals and certain organic materials and comprises approximately 10-25% of total ash generated.

Bottom ash and fly ash are usually combined, because it is more easily stored, handled and transported than the fly ash by itself. Importantly, combining the two ashes dilutes the concentration of harmful substances and reduces leaching.

The greatest concern with ash is proper disposal and the potential for harmful substances in the ash to be released into the ground water. Research to date has shown that ash disposed of in a properly designed, constructed and operated landfill does not pose a threat to ground water, because:

- quantity and concentration of substances that leach out of ash is low, thereby resulting in less-than-toxic concentrations in receiving water bodies; and

- a properly designed and operated landfill prevents the migration of leachate (from ash or garbage) into ground water.

A report on waste-to-energy ash by Roy F. Weston, Inc. offers the following thoughts:

The fact that substances, which at high enough concentrations can exhibit toxic properties, are present in ash does not in and of itself mean that ash is a danger to health or the environment; it is the potential for these substances to come in contact with the environment or the public, at concentrations high enough to impact health, that must be evaluated in order to understand the impacts associated with this material.

Federal Regulations

Federal regulations governing WTE ash are currently in a state of transition. The issue in question is whether ash should be regulated as a hazardous waste as specified in the Resource Conservation and Recovery Act of 1976.

EPA Draft Guidelines

EPA has offered draft guidelines for handling ash until new regulations are adopted regarding the handling, transport, storage and disposal of ash.

Their provisions include:

- ash containers and transport vehicles must be leak-tight and provided with appropriate covering;
- ground water monitoring must be performed at ash disposal sites;
- liners must be utilized at all ash disposal facilities. Liner and disposal recommendations are as follows:
  - for fly ash disposed of separately, disposal should be at a monofill with a double liner system;
  - for combined ash or bottom ash disposed in a monofill, either a composite (thick plastic) liner or a clay liner with special environmental or operating features should be utilized; and
  - for combined ash or bottom ash codisposed with garbage, a double liner should be utilized or a composite liner with pre-disposal ash treatment or source separation to reduce metals content prior to combustion.

VI. SANITARY LANDFILLS

Modern sanitary landfills are the result of careful planning, engineering, monitoring and supervision. Federal, state and sometimes local regulations must be met and permits obtained from health and environmental officials. Additionally, the permitting process involves review of construction plans and safety features.

Modern landfill design features include liners, leachate collection and removal systems, methane gas controls, and environmental monitoring systems. In some cases, waste-to-energy treatment plants, recycling facilities and energy production plants are also incorporated.

Sanitary landfills provide a final resting place for most solid and non-hazardous residential, commercial and industrial wastes. There are 5,500 solid waste landfills operating today. According to the U.S. EPA, more than half of these will face closure within 10 years.

Currently, 67% of municipal solid waste is disposed of in landfills. While new technologies are gaining popularity, there will always be a need for the landfill, to dispose of nonrecyclables and ash from combustion.

Prior to the mid-1970's many landfills were basically open dumps and allowed to receive hazardous waste. In 1976 the Resource Conservation and Recovery Act (RCRA) was passed by Congress to protect human health and environment from improper waste management practices. RCRA classified landfills and regulates what types of waste they may receive.

Site suitability is determined by a number of factors including careful analysis of the surface and subsurface geology, hydrogeology, the nature of adjacent environments, access routes and proximity to waste generation sources. It requires particularly careful analysis of ground water sources and flow direction, along with soil composition and site engineering. Only after a potential site passes the stringent legal, environmental and engineering criteria in all these areas can work begin in the elaborate preparation required for a modern sanitary landfill operation.

The bottom and sides of a landfill are lined with layers of compacted clay and/or thick plastic liners to insure that any liquid which enters the excavation is retained. Landfill sites are designed so that all rain or snow which falls on the site is retained, collected and treated before release. A network of drains collect the liquid (leachate) that has percolated through the wastes and directs it to recovery points where it is collected for treatment.

Within a typical landfill site, the area for waste disposal is divided into a series of individual cells. In daily disposal activities, only a small portion of the site (known as the "working face") is used, minimizing exposure to wind and rain. At the conclusion of each day's activities, a layer of earth (known as "daily cover") is spread across the compacted waste to minimize odor and prevent insect and vermin problems. Daily cover may consist of soil, foam material, or sheets of synthetic material. Each cell is filled and capped off with a layer of clay and earth and seeded with native grasses according to an approved closure plan.

Development of a modern landfill can take five or more years from the time of site selection to the completion of engineering designs, permit applications and public hearings.

Methane Gas Recovery

As waste decomposes it produces methane gas, which can be explosive, and carbon dioxide. As cells are capped off, venting systems are used to control methane from diffusing underground. Equipment can be installed to collect the gas, dry and treat it for use as a commercial fuel or to prevent emission to the atmosphere.

When landfills reach capacity they are sealed and covered with a final cap of clay and dirt. Control of water infiltration, thus the generation of leachate, is a major consideration in landfill cover design. Post closure monitoring of ground water continues for many years.

Completed landfills vary in usage from ski slopes to parking lots, golf courses to parks. They have been landscaped and blended in with their surroundings, or have been specially developed to provide a recreational asset to the community. Completed landfills are generally not used as building sites due to the potential settling of the fill over time.

DEGRADABILITY

Many citizens and legislators are looking to degradability to solve the nation's solid waste disposal dilemma, believing that the degradation of materials will increase the capacity of landfills. However, current research is demonstrating that bio/photo-degradation does not have a significant effect on the volume of solid waste.

BIODEGRADATION

Biodegradation occurs when micro-organisms such as fungi or bacteria secrete enzymes that chemically break down material that they then eat or digest. Certain plastic products, generally those in sheet form (bags and packaging), can be produced with additives—such as corn starch or vegetable oil—to enhance the biodegradation process when they come in contact with the bacteria in the soil.

Generally, these bags are less durable and considerably more expensive than the traditional plastic bag. Additionally, there is little current information available on the resulting products and their environmental effect when degradation is enhanced. Another concern is the effect on plastics recycling. If degradable plastic is mixed with other plastics it may have an adverse effect on the recycled product.

Effect on Landfills

Research shows that a 65% moisture level is necessary for a significant rate of biodegradation to occur. However, solid waste entering landfills typically contains 25% to 30% moisture. Landfills are kept dry to prevent the generation of leachate and the possible contamination of ground water.

Food waste and paper products that are over ten years old have been found completely intact in landfills. The U.S. Bureau of Mines has found newspapers that could be read after 60 years of burial.

Photodegradation

Photodegradation of plastic is the process whereby the sun's ultraviolet radiation attacks the link in the polymer chain. The breaking of this link causes the plastic chain to fragment into smaller pieces, losing its strength and ability to flex and stretch. As the photodegradable plastic is subjected to the effects of the natural environment, the material is flexed, stretched and disintegrated into plastic dust.

Like biodegradation, photodegradation is also enhanced by the used of additives. Carbonyl additives absorb ultraviolet radiation, thus breaking down the long molecules in plastics. An example of its use is for six-pack ring carriers. Depending upon the duration and intensity of exposure to sunlight, carriers degrade within several months.

Effect on Landfills

For items buried in landfills, photodegradability is not an issue because there is no light. The effect of photodegradability on litter is also a concern. Since litter is a behavioral problem, the effect of telling people that the sun will dissolve plastic bags left on the roadside may encourage, rather than discourage, a littered landscape. Additionally, if the littered item is blown or thrown in the shade, it will not photodegrade in a short period of time.

Keep America Beautiful, Inc. gratefully acknowledges the assistance, expertise and review of those organizations and agencies serving on the KAB Solid Waste Committee in the development of the OVERVIEW OF MUNICIPAL SOLID WASTE

American Public Works Association
American Society of Civil Engineers
Association of State and Territorial Solid Waste Management Officials
Council of State Governments
General Federation of Women's Clubs
International City Management Association
National Association of Counties
National Association of Regional Councils
National League of Cities
The Procter & Gamble Company
Scott Paper Company
Take Pride In America
Tennessee Valley Authority
U.S. Chamber of Commerce
U.S. Conference of Mayors
U.S. Department of the Interior National Park Service
U.S. Environmental Protection Agency

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GLOSSARY OF SOLID WASTE TERMS

The following terms are defined and described relative to the solid waste field and use in *Waste In Place.*

aeration–to charge with air

beautify–to make an area more beautiful; actions such as picking up litter in the community and planting flowers and trees beautify an area; through research, Keep America Beautiful, Inc. has found that beautifying an area prevents littering

bimetal–made of two metals; used particularly in reference to bimetal beverage cans which are made of both aluminum and steel

biodegradable material–waste material which is capable of being broken down, usually by bacteria, into basic elements; most organic wastes, such as food remains and paper, are biodegradable under the right conditions

biodegrade–to break down into basic components by biological processes *(see biodegradable material)*

cleanup–the act of picking up litter in an area

closed-loop recycling–the complete cycle of collecting, processing, recycling and purchasing products with recycled content

combustible–waste material which is capable of being burned

compost–a mixture of decomposing organic matter (e.g., food waste, leaves, and lawn clippings) used to improve the physical properties of the soil, such as texture and aeration; compost is not a fertilizer

composting–the controlled biological decomposition of organic solid waste under aerobic (in the presence of oxygen) conditions; organic waste materials are transformed into soil amendments such as humus or mulch

containerize–to put waste into a proper receptacle, such as a trash can, trash bag or dumpster; properly containerizing waste prevents it from becoming a problem as litter

decompose–to break down into basic components

disposable–products that are designed to be thrown away after one use

dispose–to get rid of waste; throw away

dump–an open land site where waste is deposited; unsightly and possibly harmful due to leaching of toxic substances into surrounding groundwater; often incorrectly used as a synonym for sanitary landfill

energy recovery–synonym for waste-to-energy *(see waste-to-energy)*

environment–everything that surrounds and influences living organisms, including people, animals, plants, soil, water, weather, buildings, etc.

garbage–refuse consisting of food wastes; animal and vegetable wastes resulting from the handling, storage, sale, preparation, cooking, and serving foods

graffiti–crude inscriptions or drawings on a wall or other public surface

groundwater–water stored in the porous spaces of soil and rock underground; more than half of the people of the United States depend upon groundwater for their drinking water

HDPE–abbreviation for high density polyethylene, a type of plastic resin; this is the abbreviation used in the plastic coding system; milk jugs, bottled water jugs, and detergent bottles are commonly made from HDPE

habit–an action a person does over and over again without thinking; littering is a bad habit

hazardous waste–waste that provides special problems because of one or more of the following characteristics: toxic, corrosive, ignitable and reactive

impermeable–cannot be penetrated

incinerate–to burn solid waste; used in energy recovery processes

integrated solid waste management–a practice of disposing of solid waste that utilizes several complementary components, such as source reduction, recycling, composting, waste-to-energy and landfill

KAB–abbreviation for Keep America Beautiful, Inc., a national, nonprofit, public education organization dedicated to improving waste handling practices in American communities

landfill–more correctly termed "sanitary landfill"; a land site where waste is deposited, compacted, and covered with soil *(see sanitary landfill)*

leachate–a liquid resulting from precipitation percolating through landfills containing water, decomposed waste and bacteria; in sanitary landfills leachate is collected and treated to prevent contamination of water supplies

litter–human generated solid waste that is discarded in an inappropriate place (e.g., streets, playgrounds, streams, etc.), or improperly stored waste which has escaped from its container

litter prevention–activities designed to encourage people to not litter

litterbug–term used for people who litter

littering–the act of discarding solid waste in an inappropriate place (anyplace other than a proper trash receptacle); mishandling waste

MSW–abbreviation for municipal solid waste; includes non-hazardous waste generated in households, commercial establishments, institutions, and light industrial establishments; excludes industrial process wastes, agricultural wastes, mining wastes, and sewage sludge

methane–a colorless, odorless, flammable gas formed by the decomposition of wastes in a landfill

microbes–microorganisms

NIMBY–acronym for "Not In My Back Yard," originally referred to the syndrome where people oppose the siting of a sanitary landfill in their neighborhood; now can also refer to the siting of other waste management facilities, such as a waste-to-energy plant

natural resources–valuable, naturally occurring materials, such as wood or minerals

non-combustible–waste materials which are not capable of being burned, especially metals

non-point source pollution–pollution from many different sources, usually associated with rainfall runoff moving over or through the ground, carrying natural or man-made pollutants into surface water and groundwater

non-renewable–natural resources which, because of their scarcity or the great length of time required for their formation, are considered finite or exhaustible

organic–derived from living organisms; organic wastes include food, leaves, grass clippings, etc.

packaging–a product's covering, wrapping, or container designed to protect a product and to attract purchasers

photodegrade(-able)–a process whereby the sun's ultraviolet radiation attacks the link in the polymer chain of plastic; breaking this link causes the plastic chain to fragment into smaller pieces, losing its strength and ability to flex and stretch; as photodegradable plastic is subjected to the effects of the natural environment (wind, rain, etc.) the material is flexed, stretched and disintegrated into plastic dust

pollution–the contamination of soil, water, or air; improperly disposed waste can cause pollution

post-consumer–in *post-consumer waste*, refers to waste from municipal sources, not industrial waste; *post-consumer content* refers to the amount of recycled material from municipal sources that a product contains, for example,recycled paper may contain 10% post-consumer waste, and 30% industrial waste (waste salvaged before reaching the consumer)

pre-consumer–in *pre-consumer waste*, refers to waste generated during the manufacturing process and includes industrial scraps, trimmings and overruns

precycle–to make purchasing decisions based on whether or not an item is made out of or packaged in materials that are recyclable

RDF–abbreviation for refuse derived fuel; a uniform fuel produced from waste, burned as an energy source in waste-to-energy plants

recyclable–waste that can be used again by being manufactured into a new product, i.e., waste that can be recycled

recycle/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 (e.g., ground glass used in the manufacture of new glass)

recycled–refers to a product that has been made from the reprocessing of waste materials

recycling center–a facility where certain waste materials (e.g., aluminum, glass, paper, etc.) are collected and resold for reprocessing into new products (i.e., recycled)

reduce–to lessen the amount of waste generated and thus waste disposed; same as source reduction

refuse–useless or unwanted materials that are thrown away; another word for solid waste

renewable–refers to natural resources whose supply is capable of being replenished (e.g., trees), either naturally or with human assistance

resource recovery–the extraction and utilization of materials which can be used as raw materials in the manufacture of new products, or as values which can be converted into some form of fuel or energy source; an integrated resource recovery program may include recycling, waste-to-energy, composting, and/or other components

reusable–waste materials capable of being used again, either as is or by creating new uses

reuse–to extend the life of an item by using it again as it is, repairing it or, creating new uses for it

sanitary landfill–a method of disposing of refuse on land without creating nuisances or hazards to public health or safety; careful preparation of the fill area, including the use of clay and/or synthetic liners and control of water drainage are required to assure proper landfilling; to confine the refuse to the smallest practical area and reduce it to the smallest practical volume, heavy equipment is used to spread, compact, and cover the waste daily with at least six inches of compacted dirt; after the area has been completely filled and covered with a final two-or three-foot layer of dirt and seeded with grass, the reclaimed land may be turned into a recreational area such as a park or golf course; sanitary landfills have leachate collection systems, methane gas controls, and environmental monitoring systems

solid waste–all useless, unwanted or discarded materials: refuse, trash, garbage, debris

solid waste management–the systematic administration of activities which provide for the collection, separation, storage, transportation, transfer, processing, treatment, and disposal of our solid waste

solid waste stream–the flow of waste from its source (e.g., households) to its final end use or disposal site

source reduction–to reduce the amount of waste generated that must eventually be discarded, including minimizing toxic substances in products, minimizing volumes of products and extending products' useful lives; requires manufacturers and consumers to take an active role in reducing the amount of waste that is produced

source separation–the segregation of various materials from the waste stream at the point of generation for recycling (e.g., householders separating paper, metal and glass from the rest of their waste)

throwaway–designed to be discarded after use; the current American society has been termed a "throwaway society" because so many of our products are designed for a single use or treated as such

transfer station–an intermediate collection facility which temporarily holds solid waste en route to the landfill; materials are often sorted and diverted for recycling or energy recovery

trash–useless or unwanted materials that are thrown away; synonym for waste

useful–items which still have value and should not be thrown away

waste–useless or unwanted materials that are discarded in appropriate trash receptacles or littered

waste-to-energy–a recovery process where waste is burned, as received or after being processed to a more uniform fuel, to generate steam or electricity

waste-to-energy incineration–disposal method where municipal solid waste is brought to a facility for energy recovery *(see waste-to-energy)*