

## RECYCLING

### PROBLEM PRESENTATION / EXPLORATION

- A. Collecting trash for a day
1. Give each student a 13-gallon plastic trash bag.
  2. Instruct each student to place his/her name on the bag with a label or permanent marker.
  3. Ask students to collect everything in the plastic bag that they would throw away during the school day, beginning with this class and continue with their collecting until the beginning of this class tomorrow.
  4. Tell students that collection should take place during school hours only and that collection bags should remain at school overnight.
  5. No food waste or wet material should be placed in the bag.
  6. The next day, begin the class by having groups of four students combine their trash and categorize what they have collected. List categories on the chalkboard or overhead. Make sure that the entire class agrees on these categories (i.e. paper, plastic, glass, etc.).
  7. Have each group construct a data table containing each of the categories that were agreed upon by the class and record the total numbers of each item in the appropriate category.

Group	Glass	Paper	Aluminum	Plastic	Other
1					
2					
3					
4					
5					
6					
7					
8					

- B. Estimation of volume of trash collected
1. Now, ask each group to devise a method for estimating the volume of trash collected by their group, assuming that the 13-gallon bag will hold about 12 gallons of trash when full. (Check with each group to make sure that they understand that if the bag is only half full, it will contain about 6 gallons of trash, etc.)
  2. Once the method for estimating volume has been established, have each group record their total volume of trash in a separate data table on the chalkboard or overhead.

GROUP #	Volume of Trash	Volume of Compacted Trash	Difference in Volume of Trash
1			
2			
3			
4			
5			
6			
7			
8			
TOTAL			

3. Next, have each group compact their trash as much as possible and again record their estimates of volume in the data table on the chalkboard or overhead. Explain that compacting occurs in garbage trucks and in landfills.
4. Using the average volume of the eight groups of students in the class, compute how much trash an average student in your school discards daily.
5. Assume that there are 70 million students in schools across the United States. How much trash is discarded daily?
6. Carry out these comparisons for both the compacted and uncompactd trash. What difference did compacting make? Was there a difference in weight as well as in volume? [The volume got smaller, but the weight stayed the same.]

### CLASS RESPONSE / CONCEPT INVENTION

- A. Recyclable vs. nonrecyclable
  1. Instruct the groups to look back at their first data table and to separate their items into recyclable and nonrecyclable products.
  2. Which items can be recycled? Which are in the greater amount, those that can be recycled or those that cannot be recycled?
- B. The landfill problem - volume and mass
  1. In this experiment, the needed materials are 2 large cardboard boxes of equal size and 1 set of bathroom scales.
  2. Label one cardboard box "A" to receive crushed containers and the other "B" to receive uncrushed containers.
  3. Instruct students to use the bathroom scales to measure the mass of each empty box, devising their own method. (Since boxes may not sit alone on the scales, students should come up with the idea of standing on the scales first with the box and recording the mass, and then standing on the scales without the box and recording the mass, and finally subtracting the two to find the mass of the box.)
  4. Explain that the two boxes represent the last two available landfills in the county (or city).
  5. Instruct students to bring in empty aluminum cans that have been rinsed each day. (Plastic containers may be used instead.) They may decide each day whether or not to crush their cans before placing them in the appropriate box.
  6. All students should monitor the boxes daily and keep a record of the number of cans being placed in each.

DAY #	Number of Cans (Box A)	Number of Cans (Box B)

7. When a box is completely filled, announce that the "Landfill is full," and close the lid to the box.
  8. When both boxes have been filled, ask, "Which landfill was better and why?"
  9. "Which box contained more cans and why?"
  10. "Which box contained the greatest mass of cans?"
  11. "Which box contained the greatest volume of cans?" (Note: The volume for both boxes is the same.)
- C. Identifying plastics
    1. More and more people are beginning to recycle plastics in addition to such items as aluminum cans and paper.
    2. The Society of the Plastics Industry, Inc., has developed a voluntary uniform

coding system for plastic containers which identifies containers by material type for the convenience of sorting the containers. The code is a three-sided triangular arrow with a number in the center and letters underneath. The number inside and the letters indicate the resin from which the container is made.



**PETE      HDPE      V      LDPE      PP      PS      OTHER**

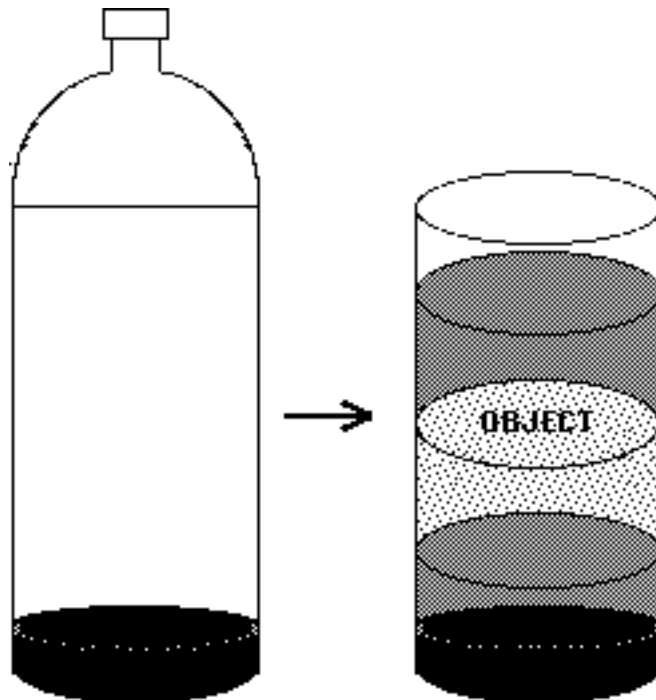
3. Not all plastics will contain a code because it is up to manufacturers to decide whether to place the code on their product.
  - (1) **PET** soft drink bottles
  - (2) **HDPE** milk bottles, detergent bottles, orange juice bottles
  - (3) **V** shampoo bottles, salad dressing bottles, vinyl seats
  - (4) **LDPE** shopping bags
  - (5) **PP** catsup bottles, yogurt cups
  - (6) **PS** foam cups, prescription bottles, plastic knives, forks, and spoons
  - (7) **Other**
4. Have students bring to class as many different containers or substances as they can that contain this symbol. Determine, based on your study, which type of plastic seems to be used most often in making things that your students contact in their daily lives.
- D. Instructions for separating the different classes of plastics by their differences in density are given in the experiment entitled **Mixtures** starting on page 36 of this manual.

### CONCEPT EXTENSION

- A. To decompose or not to decompose
  1. The materials needed for this experiment for the class include:
    - a. samples of various materials that might be found in landfills (aluminum cans, disposable diapers, pieces of catalogs, newspapers, plastic containers, coffee grounds, polystyrene pellets, cardboard, etc.)
    - b. enough 2 or 3 L bottles or milk containers so that there are 2 for each of the above materials
    - c. plastic trash bags or Ziploc<sup>®</sup> bags
    - d. hammers and nails
    - e. soil
    - f. sand
    - g. metric rulers
    - h. larger tray or broiling pan to hold all containers
    - i. a small block of wood (should fit inside containers)
    - j. graduated cylinders
  2. Divide the class into equal groups, so that each group is responsible for one container.
  3. Have students predict how long it would take each of their samples to decompose and record in the data table.
  4. Ask, "How could you design an experiment to check out your predictions?" If students have trouble designing their own experiment, have them complete the procedure below.

	Appearance of Item #1 After	Appearance of Item #2 After	Appearance of Item #3 After	Appearance of Item #4 After
Prediction				
1 Week				
4 Weeks				
8 Weeks				
12 Weeks				
16 Weeks				
20 Weeks				
24 Weeks				

5. Cut the tops off the 2 or 3-L bottles so that all bottles are the same size.
6. Using a hammer and nail, punch four equally spaced holes in the bottom and four equally spaced holes along the sides of the container.
7. Fill the container with a 5 cm layer of dirt and cover with a piece of plastic..
8. Cover the plastic with 3 cm of sand and then cover the sand with another piece of plastic.
9. Place 2 cm of moist soil around the sides of the container.
10. Add a small piece of one of the samples.
11. Compress all of the above as much as possible using a small block of wood.
12. Add 3 cm of dirt on top of all of the above.



13. Add 200 mL of water.
14. Place all containers on a large tray to catch water.

15. Add 100 mL of water every third day.
  16. At the end of 1, 4, 8, 12, 16, 20, and 24 weeks dig up the samples and record their appearance.
  17. Have students evaluate the accuracy of their predictions at the end of the experiment.
- B. The packaging problem
1. Ask students to bring in various packaged food products from home.
  2. Give each group of four students a balance and ask them to devise a method to determine what percent of the product is waste (packaging).  
(% packaging = mass of the package/mass of the product X 100)
  3. Compare various brands of food products as well as different sizes of products. For example, does a larger size laundry detergent contain more or less waste, percentage wise than a smaller size?
  4. Another alternative is to calculate the amount of waste produced from eating a meal at a fast food restaurant.