A Big Waste Problem

NO MATTER HOW YOU SLICE IT

CONTENT AREAS

- **Math**
  percentages, pie-chart graphs, volume, ratios
- **Social studies**
  business, industry, community
- **Science**
  solid waste, prediction, classification, measurement of weight and volume, verification

OBJECTIVES

Students will…

- recognize that there are many kinds of garbage generated by a variety of sources
- classify trash and predict the percentage of each trash category in the total solid waste stream
- discuss and debate the actual percentages and compare them against their predictions
- observe the difference between weight and volume of trash categories

MATERIALS

For groups of three or four students

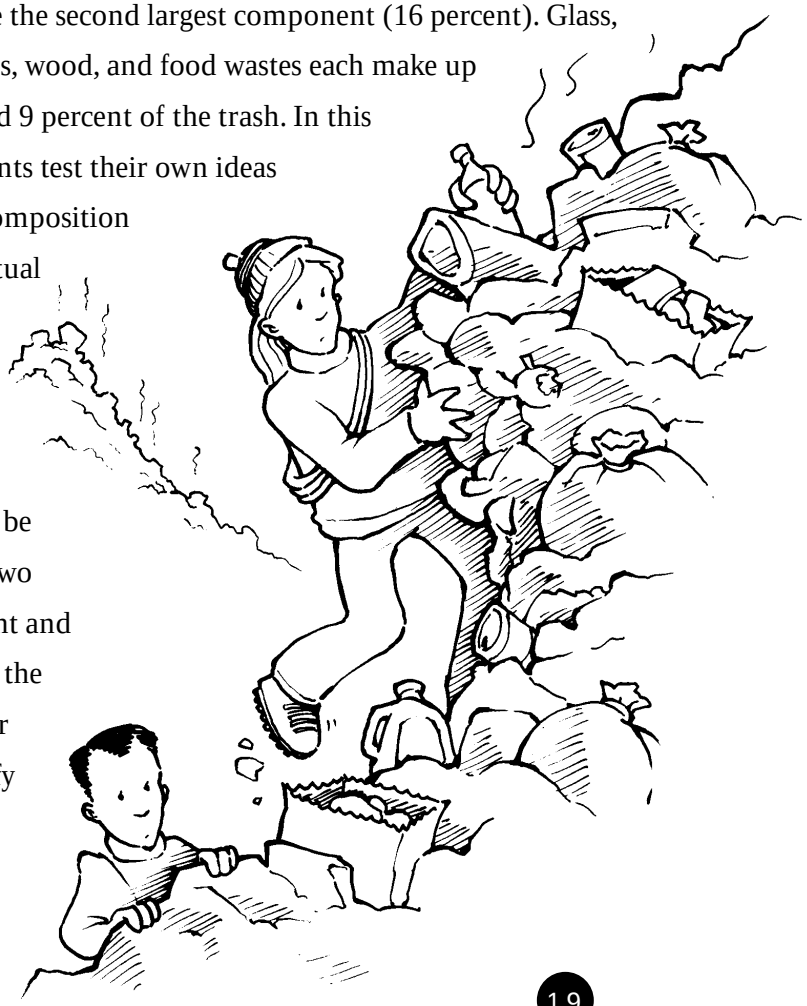
- *What's in Our Trash?* Pie Chart Recording Sheet

TIME

Two periods
45 minutes each

Americans generate more than 200 million tons of garbage each year. No question, that's a lot of trash. But to begin to solve our garbage problem, we need to understand garbage better. What is in our trash? To answer this question without digging through dumpsters or tramping through landfills, this activity uses figures from the most recent (1994) U.S. Environmental Protection Agency (EPA) report that characterizes municipal solid waste.

The figures are surprising: paper and paperboard products are the largest component (38 percent) of the waste stream, and yard trimmings are the second largest component (16 percent). Glass, metals, plastics, wood, and food wastes each make up between 7 and 9 percent of the trash. In this activity, students test their own ideas about trash composition against the actual EPA figures. They also come to understand that trash can be measured in two ways, by weight and by volume. In the end, no matter how we classify the trash problem, it's a big one.



PART 1

Pie Chart Activity

PROCEDURE

1. Introduce the activity by asking the class to respond to this question in writing or as part of a discussion: "Where does garbage come from?" Have the students list as many places as possible. (See Teacher Notes for a list of sources to use as prompts.)

2. Share the answers and compile a class list of trash sources on the chalkboard or on an overhead.

3. Divide the class into groups of three or four students. Ask each group to look at the class list and write down as many different items of trash as possible that each source would generate. If the list of sources is lengthy, assign each group a different set of sources to brainstorm. You might also want to set a time limit on this part of the activity.

   As an example, a restaurant is a source of garbage. Trash items would include food scraps, food packaging, napkins, old menus, receipts, paper hats worn by kitchen workers, and so on.

4. Ask the groups to classify their list items into major categories of trash with one category reserved for "other." (Examples of categories include paper, wood, clothes and glass.)

5. As a class, share the groups' lists of categories and establish a master list of categories that all groups will use to complete the activity. Although groups may initially come up with different categories, guide them to using these EPA classifications: paper and

paperboard products, plastics, yard trimmings, metals, rubber/leather, textiles, wood, food, aluminum, glass, and "other." List these categories on the chalkboard or overhead.

6. Give each group a copy of the Pie Chart Recording Sheet, *What's in Our Trash?* Ask students to decide which category of trash is represented by weight in each section of the pie graph.

7. Ask each group to report to the class which category of trash they think each section represents. Which categories of trash do they think account for the largest percentage of solid waste? Which categories are the smallest contributors? Encourage debate and have each group support its choices.

8. Reveal the correct Environmental Protection Agency (EPA) answers to the pie chart. (See Teacher Notes and Charts 1 and 4 for the answers.)

QUESTIONS

Have the students compare the EPA answers to theirs and analyze reasons for any differences that they find. This can be accomplished by their answering these questions in writing or as part of a discussion:

a. In general, were you correct in identifying the largest components of the solid waste stream?

b. Were you surprised to find out the actual figures?

c. How does reality compare to your predictions?

d. How does this information affect your perception of the nation's trash problem?

e. What are some factors that could cause your answers to be different from those provided by the EPA? How would season of the year or region of the country affect these percentages?

EXTENSIONS

1. Have each group formulate a plan to scientifically verify the EPA figures. Share the plans. Discuss the variables/problems in each of the procedures.

2. Have students enlarge their graphs and depict the information as a collage. Provide magazines and newspapers for picture cutting, labels from trash items, or have students illustrate the various categories.

PART 2

Weight/Volume Demonstration

INTRODUCTION

The pie chart in Part 1 represents the percentage of each category of trash by weight. How would the chart change if it represented each category of trash by volume? Volume measures the amount of space an object takes up. Some trash has a higher volume than weight– that's why it's compacted before hauling. A teacher-led demonstration to illustrate this can be done using discarded sheets of paper from the recycling bin.

MATERIALS

for class demonstration

- empty gift box
- stack of flat 8.5 x 11-inch paper from the recycling bin

PROCEDURE

To involve students in the demonstration, ask for volunteers to help you with the following steps. Alternate volunteers from the various groups to include as many students as possible.

1. Find an empty gift box large enough to hold flat sheets of 8.5 x 11 inch paper.

2. Weigh the box and record the figure on the chalkboard or overhead. Measure the box's length, width and height. Record the figures. Have students copy the figures on paper and calculate the box's approximate volume:

Volume(V) = length(l) x width(w) x h(height)
Record the figure.

3. Fill the box with flat sheets of paper from the recycling bin. Neatly stack the sheets and count how many it takes to fill the box. Weigh the box and the paper. Ask all students to subtract the weight of the empty box from the weight of the box full of paper. This number is the weight of the paper alone. How much is it? How many sheets did the box hold?

4. Now crumple enough sheets of paper and place them into the box to the top. Do not compact the paper. Count the number of sheets required to fill the box. Weigh the box and the paper. Subtract the weight of the empty box from the weight of the box and the paper. This is the weight of the crumpled paper alone.

QUESTIONS

Ask students the following questions as part of a class discussion:

a. How does the weight of the stacked paper compare to the weight of the crumpled paper? How do the number of sheets compare?

b. How does the volume of the stack in the box compare with the volume of the crumpled paper in the box?

c. How could you get more sheets of crumpled paper into the box? Students will most likely be able to tell you to compact or "crunch" the paper. Ask them why this would work. (You are reducing the space between the pieces of paper.) Have a student try the process without breaking the box. Compare the weight and number of compacted sheets with the loosely crumpled paper and with the stacked, flat paper.

d. Which is more a problem in a landfill–volume or mass? (The volume of trash is more of a problem. It causes the available space to be used quickly by very lightweight or loose fitting items. Landfill capacity is measured by volume, not by the weight of the material placed in it.)

e. How would you reduce the volume of loose, lightweight waste in a landfill? (Compact them.)

PART 3

Volume/Weight Activity

PROCEDURE

1. Provide the EPA figures that categorize the solid waste stream by volume of trash.

2. Have the students or student groups construct a pie chart of this data. You might have to teach the students how to use a protractor and compass and how to show (the percentages have already been "determined" by the EPA) the percentages using a circle. Use a computer if possible.

3. Have students analyze/compare their pie charts of trash by volume with their pie charts of trash by weight and answer questions such as these:

a. Which items have different percentages for volume and weight?

b. Which items have a larger percentage for volume than for weight?

c. Which items have a larger percentage for weight than for volume? How can you explain this? (Items such as yard grass clippings, wood chips and dead leaves are very compact and weigh more but take up a relatively smaller percent age of total volume. Items such as plastic don't weigh much, but the types that are hard to compact take up a relatively larger percentage of total volume.)

d. Why is compacting trash important?

EXTENSIONS

1. Investigate to see if your town or city pays to haul and dump its trash by weight or by volume. If you were paying by weight, which would be the least expensive per container or load–crumpled, compacted, or stacked paper? Which form of paper would be best if you were paying by volume?

2. Determine the different densities of the same box with a) stacked paper, b) loosely crumpled paper and c) compacted paper. Use the formula $D=M/V$.

Teacher Notes

SOURCES OF TRASH

- schools and universities
- libraries
- industries, factories, mills, refineries, chemical producers
- printers, publishers, copy centers
- dry cleaners, laundromats
- cafeterias, restaurants
- homes, farms, yards
- business, government offices
- stores, malls
- movie theaters
- slaughter houses, food preparation factories
- auto repair shops, body shops
- construction, demolition firms
- automobile service centers/body shops
- hospitals, clinics, doctors' offices, laboratories

ANSWERS TO THE PIE CHART RECORDING SHEET

What's in Our Trash?

See page 26 for answers to the Student Handout, which deals with waste in tons. Chart 4 in the Materials Section of the Curriculum Guide shows the volume of materials in our landfills. The chart below summarizes landfill waste in terms of both weight and volume.

Landfill Materials in Solid Waste, 1993

% of Solid Waste

	By Weight*	By Volume**
Paper & paperboard	38	30
Yard trimmings	16	8
Plastics	9	24
Metals	8	10
Glass	7	2
Wood	7	7
Food	7	3
Other	9	16

**See Chart 1 in Curriculum Guide*

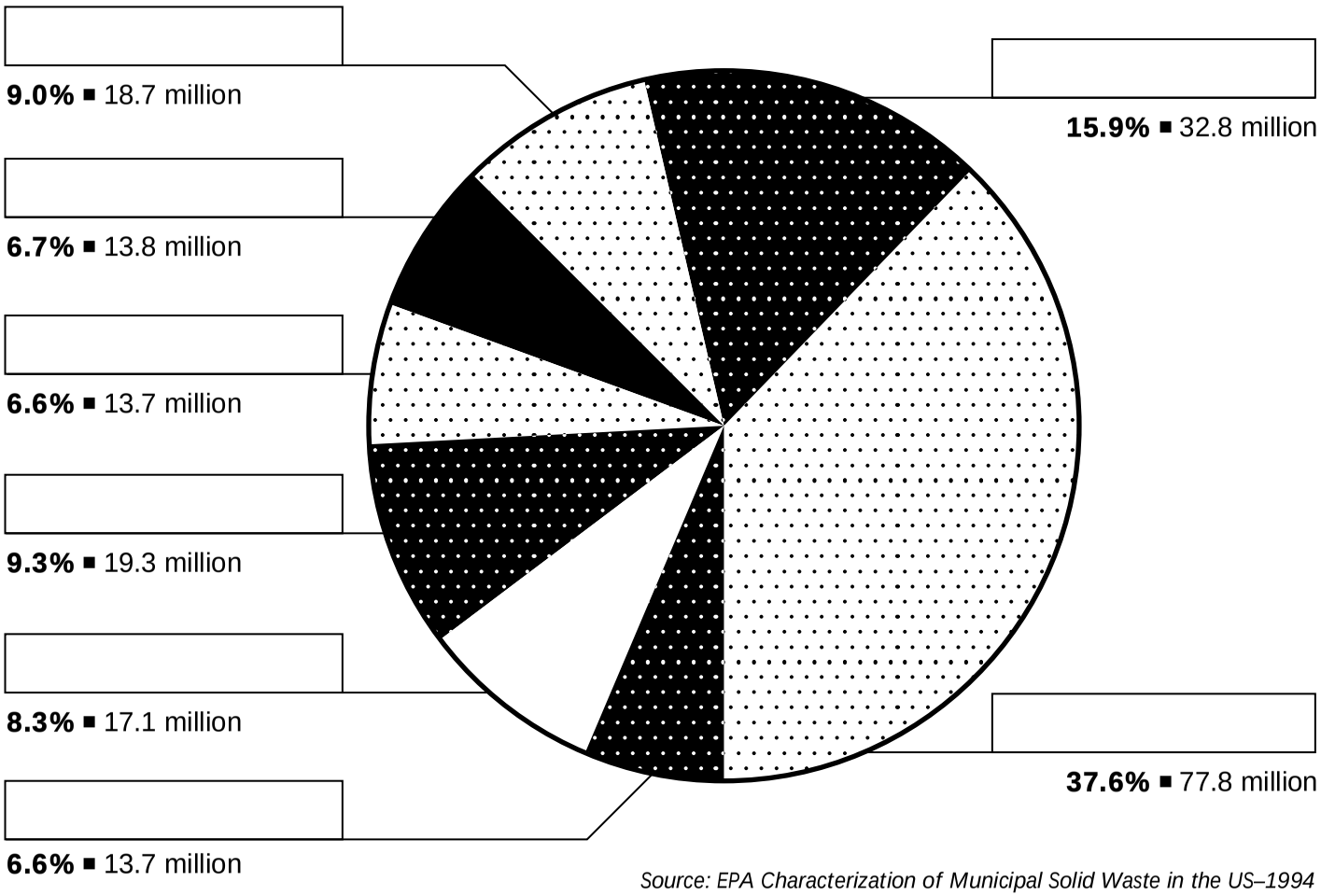
***See Chart 4 in Curriculum Guide*

Source: EPA Characterization of Municipal Solid Waste in the US–1994

What's In Our Trash?

PIE CHART RECORDING SHEET *(Figures in tons)*

Write your choices in the boxes



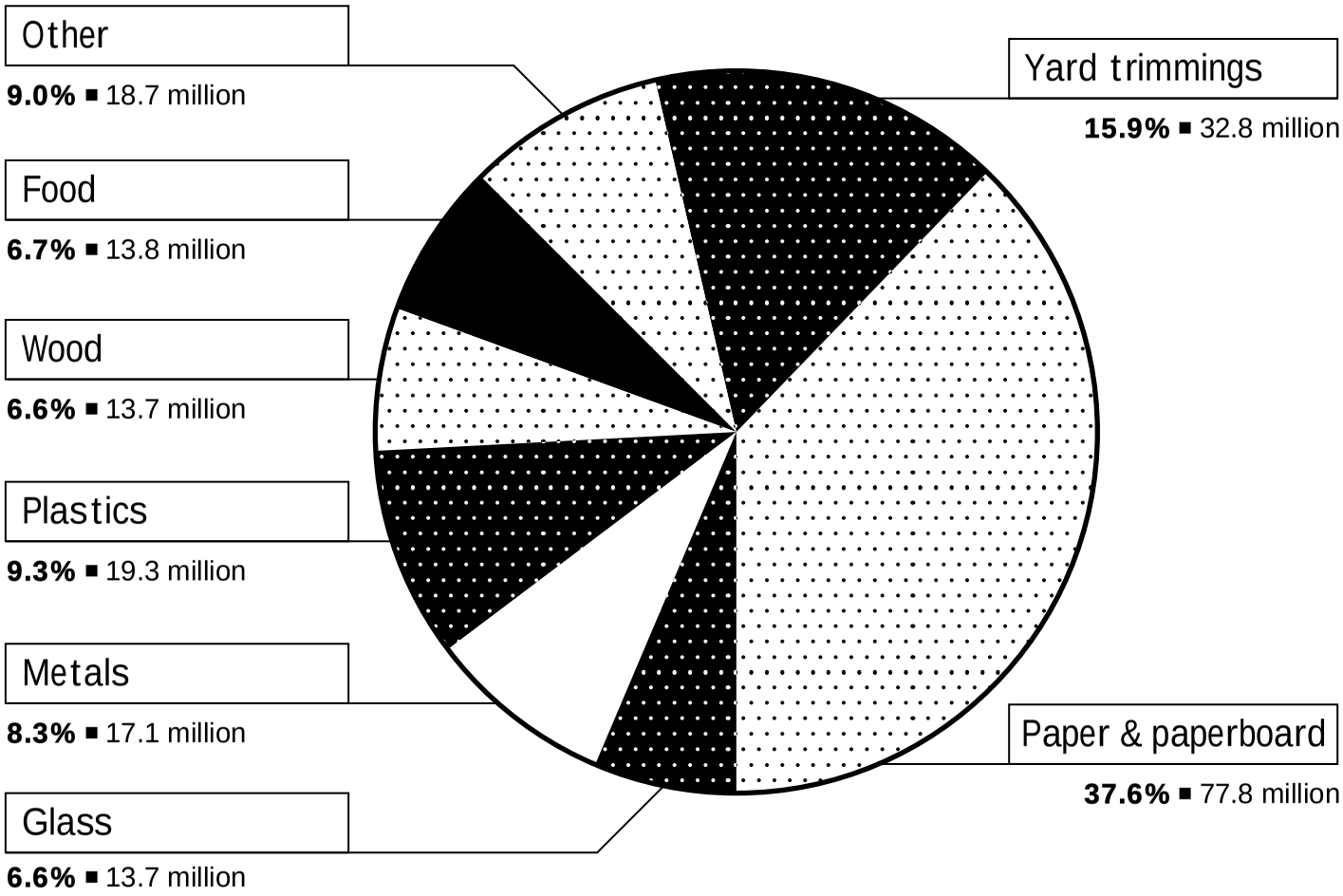
Choices

- Food
- Glass
- Metals
- Other
- Paper and paperboard
- Plastics
- Wood
- Yard Trimmings

Source: EPA Characterization of Municipal Solid Waste in the US–1994

Materials Generated in MSW by Weight, 1993

Total weight = 206.9 million tons. All figures in tons



Source: EPA Characterization of Municipal Solid Waste in the US–1994