

THERESA HAS TO write a report for school on a career. She asks her mom, who is a materials engineer, “Mom, what exactly do you do at work?”

“Well,” her mom says, “I help decide what materials should be used to make different products by evaluating their properties—such as how strong they are, if they are flexible, and if they react with chemicals. For example, when I work in my lab I wear gloves made of a polymer, a protective coat made of fabric, and protective goggles made of plastic. Each of those materials was chosen to protect me in different ways.”

“Wow,” Theresa says, “I never thought about how many different materials we use every day. Just in my backpack for school, I have books, a water bottle, my soccer uniform . . . and they’re all made from different materials!”

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In this unit you will:

- *Explore phenomena* related to different materials being used for different purposes
- *Develop and use models* to explore materials under different conditions
- *Gather and make sense of information* about different materials and their uses
- *Investigate the issue* of how the properties of materials determine their uses and how they affect the environment

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Exploring Materials

TALKING IT OVER

CONSIDER THE WORLD around you. The book in your hands, the floor underneath your feet—each is made from a type of material. The word **material** can have several meanings. To a scientist or engineer, a material is a type of solid matter used to make things. For example, clothing, homes, and computers are all made from different materials. Materials scientists and materials engineers study existing materials and design new ones. When they design new materials, here are some of the things they think about:

- How will the materials be used?
- What resources are needed to make them?
- What will happen to them when they are no longer useful?

For example, think about the materials used to make drink containers. Plastic was not used to make bottles until 1947. Until then, almost all drink containers in the United States were made of glass. Consumers would return glass milk and soft drink bottles and get their deposits paid back, and the drink bottling companies would clean and refill the bottles to sell again. Today, most drink containers are made mainly of aluminum, plastic, or glass. Each material has particular characteristics, or **properties**, that make it useful for holding drinks. Each material is made from specific resources and affects the environment when it is discarded or recycled.



In this unit, you will learn about some of the properties that materials engineers investigate when deciding which material to use for a specific purpose. For this activity, you will look at materials used in making disposable drink containers.

You are a materials scientist working for a bottling company. The president of the company has asked you which type of material to use to make containers for a new drink brand. You decide to look for a material that will both work well and have the fewest bad effects on the environment. Should it be aluminum, glass, or plastic? How will you decide? What evidence will you use?

GUIDING QUESTION

What information would help you decide which material is best for making a single-use drink container?

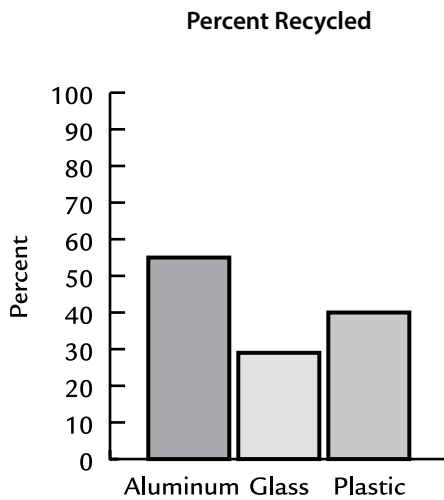
PROCEDURE

Part A: Comparing Properties of Materials

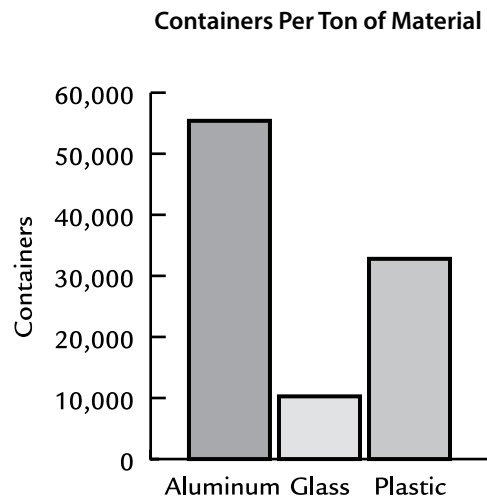
1. Prepare a data table for recording the advantages and disadvantages of each of the three materials—aluminum, glass, and plastic. Your table should fill an entire page in your science notebook. Give the table a title.
2. With your group:
 - a. Discuss and list the properties you already know of for each of the three materials—aluminum, glass, and plastic.
 - b. Decide whether each property is an advantage or disadvantage if you are using the material to make a drink container.
 - c. Record in your data table your decision from Step 2b.
3. With your group, discuss what other questions you would like answered before deciding which of the three materials—aluminum, glass, or plastic—is the best choice for making a single-use drink container. Record your group’s questions in your science notebook.

Part B: Choosing a Material

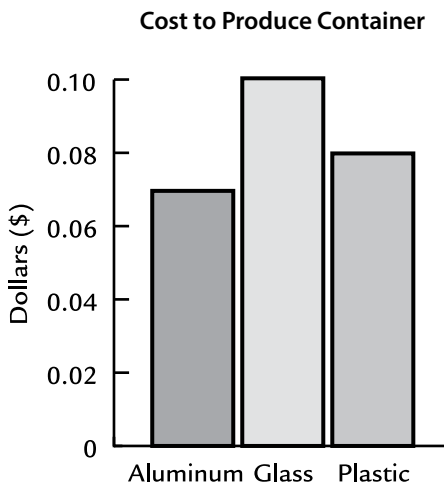
4. Review the information provided in the following graphs and descriptions. Do the following with your group for each graph and description:
 - a. Discuss what you think the data in the graph mean about each of the three materials—aluminum, glass, and plastic. Is it an advantage or disadvantage if you are using that material to make a single-use drink container?
 - b. Record in your data table your decision from Step 4a.



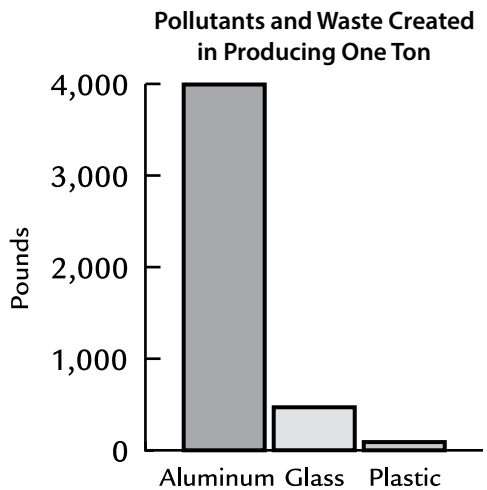
This graph compares what percentage of the material is recycled.



This graph compares how many containers can be made out of 1 ton of each material.



This graph compares the cost (in U.S. dollars) of making one container out of each material.



This graph compares how many pounds of pollutants and waste are created during the process of manufacturing 1 ton of each material.

5. With your group, discuss which material you think is the best choice for making a single-use drink container based on the evidence you have. Record your group's choice and your reasoning for that choice in your science notebook.

ANALYSIS

1. Did the graphs of the data help you make a decision about the advantages and disadvantages of each material? Explain.
2. **Revisit the issue:** Imagine that you are an environmentalist who is concerned with pollution, litter, and problems with a bottle's impact on the environment. Based on the information from this activity, which material would you claim is the best for making a single-use drink container?

Write a letter from an environmentalist's viewpoint to the president of the drink company describing your recommendation at this time. Support your reasoning with evidence, and identify the trade-offs of your decision.

Hint: To write a complete answer, first state your opinion. Provide two or more pieces of evidence that support your opinion. **Evidence** is factual information or data that support or refute a claim. Consider all sides of the issue, and identify the trade-offs of your decision. A **trade-off** is a desirable outcome given up to gain another desirable outcome.

3. In this unit, you will investigate phenomena related to the properties of different materials. What questions do you have about the properties of the three materials you considered in this activity: glass, aluminum, and plastic?