



# Lesson: Get to Know Glass

**Grade:** 4-5

**Subject:** Science, Math, Writing (extension activity)

**Objectives:**

Students will:

- learn about the process of making and molding glass, and the energy and natural resources used in the process
- complete a math worksheet on the properties of glass
- understand the connection between natural resources used in manufacturing and recycling and the waste associated with each process

**Teaching Time:** 45 minutes

**Materials:** See “Making and Molding Glass Experiment,” worksheet, Get to Know Glass

(Optional:) video: Lifecycle of Glass (see Teacher Resource section for availability)

## **Background:**

In 1971, Oregon was the first state to pass the Bottle Bill law which requires that all beer and carbonated beverage containers have a five cent deposit that is charged to the consumer and refunded when they are returned for recycling. This law helps 90% of these containers return for recycling-- many of which are glass. In fact, only 3% of the materials going to the landfill in Oregon are made of glass.

In the past, a lot of glass containers were “refillable” which meant that they were sterilized, refilled and resold many times before being recycled. Even though a few dairy companies in Oregon still utilize this type of service, most manufacturers have stopped using this practice in the U.S. However, in Europe as much as 70% of glass containers are refilled.

Refilling glass containers is more efficient than recycling for a couple of reasons. First, glass generally has a low resale value to end users compared to all the types of materials currently being recycled. Clear glass is the most valuable and is often collected separately from colored (green or brown) glass. Second, because melting glass requires temperatures of 2,500 degrees Fahrenheit, glass is very energy intensive to recycle. (Virgin glass production uses temperatures of 2,800 degrees Fahrenheit, so there is still some energy savings in recycling.)

Today, more and more uses for crushed glass (called cullet) are being found and utilized, like mixing it with asphalt for paving. Because glass is not hazardous to the environment but is heavy and costly to ship and energy intensive to melt, this makes it a good material to target for use in paving and as a “fill” in landscaping areas to improve drainage or create walkways.

## **Procedures:**

- Follow the instructions for “Making and Molding Glass Experiment”
- Show the video the Lifecycle of Glass
- Have students write or illustrate what happens to glass when it is taken to the factory to be recycled.

## **Reflection/Response:**

- Assign the “Get to Know Glass Worksheet”

## **Extensions:**

- Visit the local recycling center.
- Have students research and write a report about the art of glass making, including places like Italy, Malta, Czech Republic, Poland, Austria, etc., and where the natural resources to make glass such as limestone, feldspar and soda come from.



**Oregon Common Curriculum Goal:**

**Science:** Physical Science: Matter

- Understand structure and properties of matter.

**Mathematics:** Calculations and Estimations

- Demonstrate conceptual meanings for addition, subtraction, multiplication, and division

**Grade 5 Benchmark:**

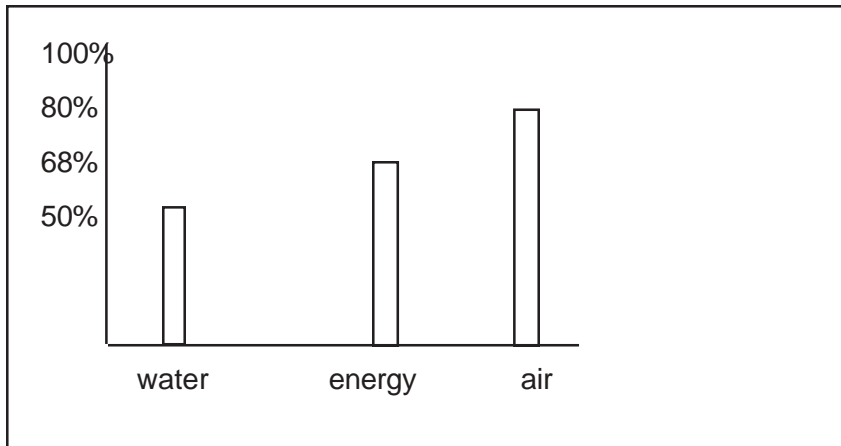
Students will:

- distinguish among solids, liquids, and gases.
- identify unique properties of each state of matter.
- perform calculations on whole numbers, fractions and decimals using paper, pencils and calculators.

**Get to Glass Worksheet Answer Key:**

1. 1 ton=2251 lbs., 5 tons=11,255 lbs., 62 tons=139,562 lbs.,  
87 tons=195,837 lbs., 93 tons=209,343 lbs.

2.



3. Producing 2 tons of virgin glass=48,000 gallons of water/2=24,000 gallons saved by recycling.

4. a) 10 gallons X 43 tons=1720 gallons saved by recycling.

b) 1.2 tons of raw materialsX69 tons recycled=82.8 tons of materials saved.

c) 83 tons. 80 tons.

d) 82.8 tonsX2000 lbs=165,600 lb.

5. a) 400 bottlesX4 hours=1600 hours.

b) 400 X .75=300 bottlesX 4 hours=1200 hours. 400X .25=100 bottles X 4 hours=400 hours.



# Making and Molding Glass Experiment

## The Making of Glass

The following activity simulates the making of glass, substituting sugar for sand. Glass is manufactured by heating sand, lime and soda until the mixture melts. After it cools, it is poured into molds and injected with air. By participating in this activity, students will gain an understanding of the heat and energy required to melt and make the glass mixture, and of the process involved in glass manufacturing and recycling.

### Materials:

- 1 cup sugar**
- Electric frying pan or hot plate and pan**
- Sheet of glass**
- 1/4 cup water**

Heat the water. When it boils pour in the sugar. Stir this mixture vigorously over heat until the sugar is dissolved, about 5 minutes.

Carefully pour the mixture onto the sheet of glass. (If the glass is small enough, set it inside a cookie sheet to prevent runaway). Allow to cool, about 15 minutes. Then hold up the two sheets of glass so students can see through them. By allowing it to set overnight, the "glass" will become frosted.

## The Molding of Glass

The following activity simulates the molding of glass. All bottles and jars were once made by glass blowers who blew bubbles with the molten glass mixture and formed them into shapes which hardened as they cooled. Injecting air into the molten glass mixture in a mold forms manufactured bottles and jars. By participating in the following activity, students will understand how glass is molded during the recycling process.

### Materials:

- Stiff straw or glass tubing**
- Balloon**
- Wide-mouthed jar**
- Rubber band to hold the balloon to the straw**

Fix the balloon onto the end of the tube or straw with the rubber band. Put the balloon into the jar and ask students to blow up the balloon to fill the jar, which acts as a mold.



Notice how this pile of crushed glass (also known as glass cullet) resembles a pile of sand, the natural resource from which it was created.



# Worksheet: Get to Know Glass

Student Name: \_\_\_\_\_

## Producing one ton of glass from virgin fiber requires the following resources:

1,300 lb. of sand  
400 lb. of soda ash  
400 lb. of limestone  
151 lb. of feldspar  
24,000 gallons of water  
15 million BTU's of energy  
melts at 2,800 degrees Fahrenheit

## Recycling one ton of glass yields the following statistics:

requires 32% less energy  
requires 50% less water  
creates 20% less air pollution  
Saves 10 gallons of oil  
Saves 1.2 tons of raw materials  
melts at 2,500 degrees Fahrenheit

- √ By recycling one bottle you save enough energy to run a 100 watt light bulb for 4 hours.
- √ Recovered 81,670 tons of glass in Oregon in 1999.
- √ Glass containers make up about 3% of all the materials in the landfill in Oregon.
- √ Bottles can be made of up to 50% recycled glass.
- √ Each person in the U.S. uses about 400 bottles and jars a year.

1. How many pounds of sand, soda ash, limestone, and feldspar added together would it take to make 5 tons of glass? 62? 87? 93?

2. Draw a bar graph illustrating how much less energy and water is used and how much less air pollution is created by recycling glass. ( Use three bars for water, air, and energy, and put the percentages on the y axis). Hint: Remember that you are comparing this to virgin production which will have a value of 100% on this graph.





3. Knowing that recycling glass saves 50% of the water used in virgin production, how many gallons will be used to recycle 2 tons of glass?
  
4. a. How many gallons of oil can be saved by recycling 43 tons of glass?  
  
b. How many tons of raw materials are saved by recycling 69 tons of glass?  
  
c. Round your answer in part b to the nearest ones place. The nearest tens place.  
  
d. Knowing that there are 2000 lbs. in one ton, how many pounds of raw materials are saved? (Hint: multiply your answer in tons by 2000 lbs. to do the conversion).
  
5. a. Knowing that the average person in the U.S. uses 400 bottles in a year and that recycling one bottle will power a 100 watt bulb for 4 hours, how many hours will the bulb run if you recycle all 400 of your bottles?  
  
b. How long will it run if you only recycle 75% of the bottles? 25%?
  
6. Write out all of the numbers listed in the glass facts in word form and create at least one math problem of your own using the information given.



7. (Optional) Based on the “Making and Molding Glass experiment” or the video: “Lifecycle of Glass”, describe in your own words how glass is made into new glass at the recycling plant.