



GLASS CHIP DENSITY

QUICK PEEK

In this lesson, students learn more about forensic science as they calculate the density of seven glass samples to determine which sample matches the “unknown”.

SUGGESTED GRADE

LEVELS: 9-12

ILLINOIS STATE LEARNING GOALS

SCIENCE

11.A, 12.C, 13.A

MATH

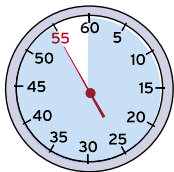
6.A, 6.B, 6.C, 7.A, 7.C, 8.B

LANGUAGE ARTS

3.B, 4.B

OBJECTIVES

- ★ Students calculate the density of 7 glass samples.
- ★ Students will understand that the size of a sample does not affect its density.
- ★ Students will construct a table and accurately record data.
- ★ Students will compare the density between glass samples to determine which sample matches the “unknown”.



PACE YOURSELF:

55 MINUTES



PREPARE YOURSELF

You will need 6 types of glass fragments. Sources for glass fragments might include junkyards, glass recycling bins, and auto repair shops.

Decide which glass fragment will be the unknown. You may want to change the unknown each hour if you teach this lesson to more than one class.

Divide students into lab groups.

Provide an example of the data table on the board (see page 3 for example).



MATERIALS

Per Group:

- An “unknown” glass sample
- 6 glass samples labeled A, B, C, D, E and F
- Graduated cylinder
- Scale or triple-beam balance
- Tweezers
- Water
- Paper towels
- Calculator

Per Student:

- Writing utensil
- Paper for data table



WHAT YOU NEED TO KNOW...

Different kinds of **glass** have different physical characteristics which allow us to distinguish them from one another. Investigators can use glass fragments as evidence to help place a suspect at the scene of a crime.

Glass is a hard, brittle substance made of silicon oxides (sand), lime, soda, and oxides. The metal oxides found in most window glass are sodium, calcium, magnesium, and aluminum. Automobile headlights and other heat-resistant glass, such as Pyrex, contain boron oxides.

The **density** of water equals one gram per milliliter.

Forensic scientists use the physical properties of glass to associate one type of glass fragment with another. Density is one of these physical properties. Density refers to a material's mass per unit volume, and can be summarized in the formula:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Because different types of glass contain different combinations of metal oxides, they have different densities.

Density is affected by changing the temperature of a liquid. In general, when you increase the temperature, the density will decrease.

The density of a substance remains constant, no matter what the size of the substance. This means scientists can use the density of a piece of glass to help identify it. Scientists follow a simple three-step method for determining the density of a sample:

- ★ Weigh the sample to find its mass.
- ★ Determine the volume of the sample.
- ★ Divide the mass of the sample by its volume.



WARM UP!

1. Ask students what they know about forensic science. Discuss that forensic science is the application of many sciences to answer questions of interest to the legal system.
2. Ask students how forensic scientists could use glass in solving a crime.
Possible ideas: Chips of glass from a broken window may fall into a perpetrator's trouser cuff or shoes. A forensic scientist can identify these chips as part of the broken window. Similarly, parts of a broken headlight found at the scene of a hit-and-run can be used to identify the suspected vehicle.



THE "HOW TO"

1. Place the "unknown" glass sample on a scale and determine its mass in grams. Record this mass on a Data Table that you create to organize your data.
2. Remove this sample from the scale. Repeat step 1 with the 6 other pieces of glass.
3. Place 20 milliliters of water in a graduated cylinder. Then add the "unknown" glass sample to the water. Read the new volume on the cylinder in milliliters. Take the new volume and subtract 20 to find the volume of the piece of glass. Record this information in your data table.
4. Repeat step 3 for the other glass samples.
5. Divide the mass of each sample by its volume to determine the sample's density. Record the densities for the glass pieces in your data table.

Materials with a density of less than one will float on water. Materials with a density of greater than one will sink.

We use **buoyant force** to talk about things that float. It's easy to remember because buoys float. Less dense objects are pushed upwards and more dense objects are pushed downwards.

SUGGESTED DATA TABLE:

Density of Glass Chips			
Sample	Mass	Volume	Density



WHAT'S GOING ON HERE?

The density of glass varies greatly because of the atoms that make up the glass. Less tightly packed atoms have larger spaces between them. These spaces collectively make up free volume. of a material and determine its density. Objects (in this case, glass) with tightly packed atoms will be more dense than objects with atoms that are more loosely packed.



DID THEY GET IT?

POSTLAB QUESTIONS (*can be answered in a whole group discussion or individually*):

1. From your experimental results, which of the glass samples (A-F) matched the “unknown”?
2. Water has density of 1 g/ml. Based on your work, does glass have a density greater than 1 g/ml or less than 1 g/ml? Explain your answer.
3. If you were able to identify the “unknown” glass as the type found at the sight of a hit-and-run accident and were also able to match the “unknown” glass to a suspect’s car, does this evidence positively prove that this suspect is guilty? Explain your answer.
4. All of the glass samples you tested were not the same size. When determining density, does the size of the sample make a difference? Why or why not?