

# GLASS CHIP ANALYSIS

## AT A GLANCE

Students will use the physical properties of glass to compare one type of glass fragment with another.

### OBJECTIVES

Students will:

- Measure the mass of glass samples
- Measure the volume of glass samples
- Calculate the density of glass samples

### KEY VOCABULARY

**Glass:** a hard, brittle substance made of silicon oxides (sand), lime, soda, and oxides.

**Density:** a measure of the compactness of a substance.

**Volume:** The amount of space occupied by a three-dimensional object

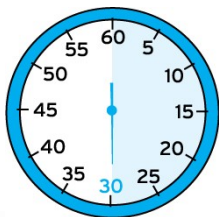
**Mass:** quantity of matter of an object

### SUGGESTED GRADE

**LEVELS:** 5—12

### PACE YOURSELF

30 MINUTES



### NATIONAL SCIENCE EDUCATION STANDARDS

#### 5-8:

NS 5-8.1 Science as Inquiry

NS 5-8.2 Physical Science

NS 5-8.6 Science in Personal and Social Perspectives

#### 9-12:

NS 9-12.1 Science as Inquiry

NS 9-12.2 Physical Science

NS 9-12.6 Science in Personal and Social Perspectives



### ADVANCE PREPARATION

1. You will need 6 types of glass fragments. Sources for glass fragments might include junkyards, glass recycling bins, and auto repair shops.
2. Decide which glass fragment will be the “unknown”. You may want to change the unknown between class periods if you teach this lesson to more than one group of students.
3. Provide an example of the data table on the board.
4. Prepare students to work with glass samples that may be sharp.



### MATERIALS

#### Per Group:

An “unknown” glass sample (this will need to match one of the six)

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



### WHAT YOU NEED TO KNOW

**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.



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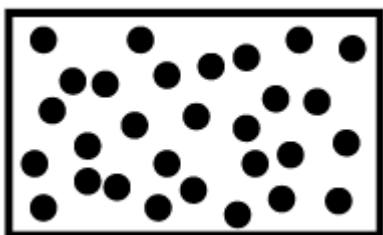
Different kinds of glass have different physical characteristics that distinguish them from one another. Investigators can use glass fragments as evidence to help place a suspect at the scene of a crime.

Forensic scientists use the physical properties of glass to associate one type of glass fragment with another. **Density** is the term used to describe the relationship between the **mass** of an object and its **volume**. It can be determined by using this equation:

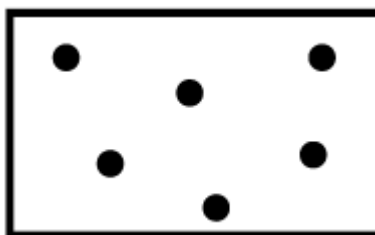
$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

The density of a substance remains constant no matter what the size of the substance, allowing forensic investigators to 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



high density



low density

The density of glass varies greatly because of the atoms that make up the glass. Because different types of glass contain different combinations of metal oxides, they have different densities. Something with high density has a lot of mass per unit of volume (lots of something for the amount of space it occupies), and something with low density has a lot of volume per unit of mass (lots of space for a small amount of stuff).



The image on the left shows an apartment building in Hong Kong. This is an example of high density housing—a lot of people (mass) living in a small amount of space (volume). The picture on the right shows a farmhouse in a field, a great example of low density housing—a lot of space (volume) for a small number of people (mass).

# GLASS CHIP ANALYSIS



## ACTIVITY

1. Create a data table to organize the data you will collect during the experiment.
2. Place the “unknown” glass sample on a scale and determine its mass in grams. Record this in your data table.
3. Remove this sample from the scale.
4. Use the displacement method to determine the volume of the glass sample.
5. Place 20 milliliters of water in a graduated cylinder.
6. Then add the unknown glass sample to the water. Read the new volume on the cylinder in milliliters.
7. Take the new volume and subtract 20 milliliters to find the volume of the piece of glass. Record this information in your data table.
8. Repeat *Step 2-4* for the other glass samples.
9. 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.

Density of Glass Chips			
SAMPLE	MASS (g)	VOLUME (ml)	DENSITY (g/ml)



## CHECK FOR UNDERSTANDING

1. How is mass measured? How is volume measured?
2. Why is the density the best way to determine which sample of glass matches the unknown?
3. What is the formula for calculating density?



## ET CETERA

In addition to matching density, physical matches can also help forensic scientists determine if a piece of glass came from a crime scene. Due to the random nature of breaking or tearing, a questioned or unknown piece can be identified as coming from a known source. The forensic scientist puzzle-pieces together the broken pieces to make an identification. This is commonly done with things like glass, plastic, metal, and duct tape.