Physical Science **Name:**
Density

Perhaps someone has tried to trick you with this question: "Which is heavier, a pound of lead or a pound of feathers?" Many people would instinctively answer "lead." When they give this incorrect answer, these people are really thinking of density. If a piece of lead and a feather of the same volume are weighed, the lead would have a greater mass than the feather. It would take a much larger volume of feathers to equal the mass of a given volume of lead.

Density is the relationship of the mass of an object to its volume. Density is usually reported in units of grams per cubic centimeter (g/cm3). For example, water has a density of 1.00 g/cm3. Since a cubic centimeter contains the same volume as a milliliter, in some cases you may see density expressed as g/mL.

$$\text{Density} = \frac{\text{mass}}{\text{volume}} \quad \text{or} \quad D = \frac{M}{V}$$

To solve density problems, list the known and unknown values, then use one of the following.

- When a problem requires you to calculate density, use the density equation:

$$D = \frac{M}{V}$$

- You can solve for mass by multiplying both sides of the density equation by volume.

$$D\,V = \frac{M\cancel{V}}{\cancel{V}} \quad \text{or} \quad \boxed{M = D\,V}$$

- You can solve for volume by dividing both sides of the equation above by density.

$$\frac{M}{D} = \frac{\cancel{D}\,V}{\cancel{D}} \quad \text{or} \quad \boxed{V = \frac{M}{D}}$$

Example: What is the mass of an object that has a density of 8 g/cm^3 and a volume of 64 cm^3?

Known: D = 8 g/cm^3
V = 64 cm^3

Unknown: M = ?

Equation to use:

$$D\,V = \frac{M\cancel{V}}{\cancel{V}}$$

$$M = D\,V$$

"Plug and chug": M = (8 g/cm^3) (64 cm3)
= 512 g

PRACTICE PROBLEMS
List the known and unknown values; try to derive the equation without looking at the examples.

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1. A piece of tin has a mass of 16.52 g and a volume of 2.26 cm^3. What is the density of tin?

Known:

Unknown:

2. A man has a 50.0 cm^3 bottle completely filled with 163 g of a slimy green liquid. What is the density of the liquid?

Known:

Unknown:

3. Different kinds of wood have different densities. The density of oak wood is generally 0.7 g/cm^3.
If a 35 cm^3 piece of wood has a mass of 25 g, is the wood likely to be oak?

4. The density of pine is generally about 0.5 g/cm^3. What is the mass of a 800 cm^3 piece of pine?

5. What is the volume of 325 g of metal with a density of 9.0 g/cm^3?

6. Diamonds have a density of 3.5 g/cm^3. How big is a diamond that has a mass of 0.10 g?

7. What mass of water in grams will fill a tank 100 cm long, 50 cm wide, and 30 cm high? The density of water is 1g/mL or 1g/cm^3.

8. A graduated cylinder is filled with water to a level of 40.0 mL. When a piece of copper is lowered
into the cylinder, the water level rises to 63.4 mL. Find the volume of the copper sample. If the density of the copper is 8.9 g/cm^3, what is its mass? (Hint: 1 mL = 1 cm^3)

9. A sealed 2500 cm^3 flask is full to capacity with 0.36 g of a substance. Determine the density of the
substance.

10. Water has a density of 1g/cm^3. What is the mass of 75 mL of water? (Hint: 1mL = 1cm^3)