Calculating Density 4.5

Look at **Figures 1** and **2**. In both photos, the oil is floating on the water. This property of oil makes it possible to clean up an oil spill and to skim the oil from a boiling pot of eulachons [YOO-luh-kons]. Why does oil float? Oil must be lighter than water, but what does this mean? A litre of oil is certainly not lighter than a glass of water.

To compare fluids using the words "light" and "heavy," you must examine the same volume of each fluid. Thus, a litre of oil is lighter (has less mass) than a litre of water. When you compare the masses of the same volume of different substances, you are comparing their densities. **Density** is the mass per unit volume of a substance. Oil floats on water because it is less dense than water.

Figure 1
An oil spill being contained.

Figure 2
Eulachon oil being skimmed from a pot.

LEARNING TIP

Make connections to your prior knowledge. Ask yourself, "What do I already know about floating and sinking? How does this information fit with what I already know?"

TRY THIS: RANK BY DENSITY

Skills Focus: observing, predicting, measuring

1. Find six identical opaque containers, such as plastic film containers. Fill the containers with different materials, such as water, sand, tiny pebbles, syrup, shampoo, and wood chips (**Figure 3**).
2. Close the containers and mix them up so you do not know which one is which. Number the containers.
3. Rank the containers in order from highest density to lowest density. You may use any method you choose to determine your ranking, but you cannot open the containers. Record your ranking.
4. Which densities were you able to estimate quite accurately? Which were harder to estimate? Why?

Figure 3

Using Density

Density is a property of matter that can be calculated. It is the mass of a substance per unit volume of this substance. It is expressed as grams per cubic centimetre (g/cm^3) or grams per millilitre (g/mL).

Density is calculated by dividing the mass of an amount of substance by its volume. The formula is

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Each substance has its own unique density. Water has a density of 1.0 g/mL. Liquids and solids that float on water have a density of less than 1.0 g/mL. Liquids or solids that sink in water have densities of more than 1.0 g/mL.

Table 1 lists the densities of some common substances. Notice that western red cedar has a lower density than water. Therefore, western red cedar floats in water, as do most types of wood (**Figure 4**). Crude oil also has a lower density than water, which is why oil spills stay afloat in the ocean. Copper has a higher density, however, so it sinks in water. The densities of two substances can be used to predict which will float and which will sink.

LEARNING TIP

Make connections to your prior knowledge. Ask yourself, "How does this information on density fit with what I already know?"

Table 1 Densities of Some Common Substances

Substance	Density (g/mL)
wood (western red cedar)	0.37 (approximate)
crude oil	0.86–0.88 (approximate)
pure water	1.00
copper	8.92

Figure 4
What property of wood allows forest companies to transport logs in this way?

CHECK YOUR UNDERSTANDING

1. What is density? How is it calculated?
2. Use the "Actual mass" and "Actual volume" columns of your data table for Investigation 4.4 to calculate the density of each object.
3. Calculate the density of each kind of wood.
   a) a child's block made of birch wood with a volume of 510 cm^3 and a mass of 306 g
   b) a pine log with a mass of 96 000 g and a volume of 240 000 cm^3
   c) a sculpture made of ebony with a volume of 81 cm^3 and a mass of 96 g