Density Measurement Kit Instructions
MC-SGKIT

Included Materials:

- 4 density cylinders: aluminum, brass, copper, steel
- spring scale
- graduated cylinder

Optional Materials:

- thread
- metric ruler

With this kit, you will learn how to define the terms “density” and “specific gravity” and use measurements of weight and volume to calculate an object’s density.

Procedure A:

Density is the mass or weight of a material per volume. For these experiments you will work with weight density. Weight density is commonly measured as grams per milliliter (g/ml) or grams per cubic centimeter (g/cc).

The **specific gravity** of any material is the ratio of the density of the material to the density of water at specific conditions. The density of water at 4°C is 1.000 gram/ml.

1. Tie a piece of thread around each of the four metal cylinders with a loop at one end so you can easily hang the cylinders from the spring scale.
2. Hold the spring scale by its loop and zero it by moving the tab up or down until the scale reads “0”.
3. Determine the weight of each metal cylinder. Hang a metal cylinder from the scale and record its weight in grams on the chart below. Read the spring scale to the nearest mark for each cylinder. Repeat this step for all four cylinders.
4. Determine the volume of each metal cylinder. Fill the graduated cylinder about 1/2 full of water. Place it on a table and read the level in the graduated cylinder to the nearest mark. Record your reading. Place a metal cylinder in the graduated cylinder and read the water level again to the nearest mark. The difference between the two readings is the volume of water displaced by the metal cylinder. Repeat this step for all four cylinders.
5. Calculate density and specific gravity of each metal. Divide the weight of each cylinder (in grams) by the volume of the cylinder (in milliliters or cubic centimeters). This is the density of the metal that makes up the cylinder. The specific gravity of each metal is the density of the metal divided by the density of water. Since the density of water is 1.000 g/cc at 4°C, the specific gravity is the same number as the density at that temperature, but without any units. Record the specific gravity of each metal. (For the purposes of this lab, it is fine to assume a temperature of 4°C, though your room is probably warmer than that.)
6. Analyze your results. Compare the calculated density of each cylinder to the typical density of that metal. List some reasons why the densities you calculated from the weight and volume you measured are higher or lower than the actual densities.

Alternate Procedure B:

1. Determine the weight of each metal cylinder. Hang a metal cylinder from the scale and record its weight in grams on the chart below. Read the spring scale to the nearest half-mark for each cylinder. Repeat this step for all four cylinders.
2. Determine the volume of each metal cylinder. Fill the graduated cylinder about 1/2 full of water. Place it on a table and read the level in the graduated cylinder to the nearest half-mark. Record your reading. Place a metal cylinder in the graduated cylinder and read the

water level again to the nearest half-mark. The difference between the two readings is the volume of water displaced by the metal cylinder. Repeat this step for all four cylinders.

3. Calculate density of each metal. Divide the weight of each cylinder (in grams) by the volume of the cylinder (in milliliters or cubic centimeters) to get density.
4. Analyze your results. List some reasons why the densities you calculated this time are different from those calculated in procedure A. Which procedure results in the more accurate densities?

Alternate Procedure C:

1. Determine the volume of each metal cylinder. Measure the length of each cylinder to the nearest 0.1 cm. Measure the diameter of each cylinder to the nearest 0.1 cm. Calculate the volume of each cylinder using the following formula.

   Volume (cc or ml) = $(\text{Diameter in cm}/2)^2$ x 3.1416 x (Length in cm)

2. Calculate the density of each metal. Divide the weight from Procedure B of each cylinder (in grams) by the calculated cylinder volume (in milliliters or cubic centimeters) to get density.
3. Analyze your results. Compare the densities from this procedure with those determined with procedure C. Which procedure produced the more accurate results? Why?

	Aluminum	**Brass**	**Copper**	**Steel**
Typical Density, g/ml	2.7	8.6	8.9	7.8

Procedure A Data

Weight, grams				
Grad. cyl. reading w/o cylinder, ml				
Grad. cyl. reading with cylinder, ml				
Volume of cylinder, ml				
Density of cylinder material, g/ml				
Specific gravity of cylinder material				

Procedure B Data

Weight, grams				
Grad. cyl. reading w/o cylinder, ml				
Grad. cyl. reading with cylinder, ml				
Volume of cylinder, ml				
Density of cylinder material, g/ml				

Procedure C Data

Cylinder length, cm				
Cylinder diameter, cm				
Volume of cylinder, cc or ml				
Density of cylinder material, g/ml				