Lab # 7: All That Glitters Density Lab
Chemistry 1

Purpose: It is not always easy to tell one form of matter from another. This activity will show you how to differentiate between different forms of matter by examining density, one of the physical properties of matter.

\[
\text{density} = \frac{\text{mass}}{\text{volume}}
\]

Measure:
1. Obtain one of the three pieces of metal.
2. Measure the mass of the metal piece on a balance.
3. Record the mass in your data table.
4. Place about 50-mL water in a 100-mL graduated cylinder.
5. Record the exact volume of the water in your data table. Be sure to consider significant figures.
6. Gently place the piece of metal in the graduated cylinder. Be careful not to splash any water.
7. Record the new volume in the table below. Be sure to consider significant figures.
8. Repeat this process beginning at Step 1 for the two other metal samples.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Mass (g)</th>
<th>Volume of water (mL)</th>
<th>Volume of water with metal (mL)</th>
<th>Volume of metal (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-inch long gold-colored rod</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-inch long silver-colored rod</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-inch long silver-colored rod</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Answer the following questions:
1. The fourth column of the table is for the volume of the metal. How can you determine the volume of the metal from the data you have collected?

2. Determine the volume of the three metal samples and enter the values in the table.
3. How does the volume of the 2-inch long gold-colored rod compare with the 2-inch long silver-colored rod?

4. How does the volume of the 2-inch long silver-colored rod compare with the 4-inch long silver-colored rod?
5. Which of the two metals has a greater mass in the same volume? Explain your thinking.

6. The gold-colored rod has a higher density than the silver-colored rod. Explain what this tells you about the atoms in the gold-colored sample compared to the atoms in the silver-colored sample.

7. Density is a characteristic of the substance, not of the size and shape. Density (D) in grams per mL is determined by taking the mass (M) in grams and dividing by the volume (V) in mL; \( D = \frac{M}{V} \). Both samples of the silver-colored metals have the same density. Use your measurements to prove this. Consider significant figures in your calculation.

8. The densities of several metals are given in the table below. Use your measurements to identify the gold-colored and silver-colored metals.

Densities of metals

<table>
<thead>
<tr>
<th>copper</th>
<th>zinc</th>
<th>gold</th>
<th>aluminum</th>
<th>brass</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.0 g/mL</td>
<td>7.1 g/mL</td>
<td>19.3 g/mL</td>
<td>2.7 g/mL</td>
<td>8.4 g/mL</td>
</tr>
</tbody>
</table>

Post-Lab Questions  SHOW YOUR WORK!

1. Explain how placing a piece of metal in a graduated cylinder with water allows you to determine its volume.

2. You have a piece of aluminum that occupies a volume of 30.0 mL and has a mass of 81.0 grams. What is its density?
3. The density of mercury is 13.6 g/mL. If you have a sample of mercury with a mass of 306.0 grams, how many mL of mercury do you have? Consider significant figures.

4. Archeologists discover a silver crown in an ancient tomb. When they place the crown in a tub of water it displaces 238.1 mL of water. The density of silver is 10.5 g/mL. Assuming the crown is really silver, what is the mass of the crown?

5. When Alexander the Great plundered the empire of Persia his soldiers took a great deal of gold with them. However, it is said that they buried much of it in the sand when it became a hardship to carry. Use the density value of gold to determine how much a block of gold 1 cubic meter in volume would weigh in pounds. Here are some conversions for you:
   1 gram = 0.002 pounds
   1 mL = 1 cubic centimeter
   1 cubic meter = 1,000,000 cubic centimeters