Measuring Mass and Volume

In this investigation, you will use what you learned in section 4.3 to determine the mass and volume of some common classroom objects (Figure 1). First you will estimate the mass and volume of these objects. Then you will check your estimates using direct measurement or the displacement of water.

Figure 1
How would you determine the mass and volume of these objects?

Question

What is the mass and volume of common classroom objects?

Materials

- safety goggles
- variety of regular solids (for example, textbook, dice, and block of wood)
- variety of small irregular solids (for example, small rock, small spoon, and metal nut)
- balance or scale
- ruler
- 100-mL graduated cylinder or large measuring cup
- water
**Procedure**

1. **Conduct an Investigation**

   **Analyze and Evaluate**

   1. Which masses or volumes were you able to estimate most accurately? Why?

   2. Which masses or volumes did you estimate least accurately? Why?

   3. You used the displacement of water to measure the volumes of irregular solids.
      a) Explain why “displacement of water” is an appropriate name for this method.
      b) Why is this method an example of indirect measurement?

   4. Determine the actual volume of each rectangular solid in cm³. Record your measurements, calculations, and results on your table, under “Actual volume.”

   5. Determine the actual volume of each irregular solid in mL using displacement. Remember to tilt the graduated cylinder or measuring cup and gently slide the solid into the water. Record your measurements, calculations, and results in your table, under “Actual volume.”

   **Procedure**

   1. Estimate the mass of each object in grams. Record your estimates in your notebook in a table like the one below.

   **Data Table for Investigation 4.4**

<table>
<thead>
<tr>
<th>Object</th>
<th>Estimated mass (g)</th>
<th>Actual mass (g)</th>
<th>Estimated volume (cm³ or mL)</th>
<th>Actual volume (cm³ or mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>textbook</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eraser</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   2. Use the balance or scale to determine the actual mass of each object in grams. Record your results in your table, under “Actual mass.”

   3. Estimate the volume of each object in either cm³ or mL. Record your estimates in your table.

   4. Determine the actual volume of each rectangular solid in cm³. Record your measurements, calculations, and results on your table, under “Actual volume.”
Apply and Extend

4. Describe two everyday situations in which the measurement of mass or volume is important.

5. Imagine that you are provided with a scale, a sample of modelling clay, a piece of string, a graduated cylinder, and some water (Figure 2). How could you use these materials to prove that you can change the shape of the clay without changing the volume of the clay?

Figure 2

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CHECK YOUR UNDERSTANDING

1. Why did you slide each object into the graduated cylinder rather than dropping it in? Would your results have changed if you had not slid all the objects into the cylinder in the same way? Would you have still obtained fair measurements? Explain your answer.

2. When would the displacement of water not be a good method for finding the volume of an irregular object?