What is density?

Why?
You’ve no doubt heard about density in science classes or in your everyday life. But what does it really mean for one object to be more dense than another?

Model 1: Mass and Volume

1. How many dots are in the following cubes?
   - A1
   - A2
   - B1
   - B2
2. Based upon Model 1, what is mass?

3. What can you infer about how much mass each dot represents?

4. As volume increases on the graph’s X-Axis, what changes about each cube? What evidence from Model 1 supports your thoughts?

5. Use the following data to calculate the volume for each of the cubes. Remember that the formula for calculating volume for a cube is length x width x height.

<table>
<thead>
<tr>
<th>Object</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>2 cm</td>
<td>2 cm</td>
<td>2 cm</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>3.174 cm</td>
<td>3.174 cm</td>
<td>3.174 cm</td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>2 cm</td>
<td>2 cm</td>
<td>2 cm</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>3.174 cm</td>
<td>3.174 cm</td>
<td>3.174 cm</td>
<td></td>
</tr>
</tbody>
</table>

6. According to your calculations, what would be the units for volume? Why?

7. With your group members, create your own definition of volume.

8. What is similar about objects A1 and A2?

9. What is similar about objects B1 and B2?

10. Based upon your prior knowledge for density and the ideas you summarized in questions 8 and 9, create a definition for density with your group members.
SUMMARIZING QUESTIONS

Instructions: Discuss these questions with your group. Write down your ideas. Leave space to add additional ideas or thoughts you gain from the Summarizing Discussion.

1. Which of the following objects is more dense? Which is less dense? Explain why

![Objects Image]

2. On the graph below, a line has been added to show the density of water. Based upon its density, explain which objects you think will sink and which will float and why.

![Graph Image]

3. Oil floats on top of water. Explain why and draw a picture (using dots like in Model 1) to show why this is the case.
How can you calculate density?

Why?
How can you calculate density using the mass and volume of an object?

Model 2: Density Calculations

<table>
<thead>
<tr>
<th>Object</th>
<th>Mass</th>
<th>Volume</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object C</td>
<td>8 grams</td>
<td>5.33 mL</td>
<td>1.5 grams/mL</td>
</tr>
<tr>
<td>Object D</td>
<td>20 grams</td>
<td>13.33 mL</td>
<td>1.5 grams/mL</td>
</tr>
</tbody>
</table>

4. Evaluate Model 2. What is the same between Object C and Object D? Why is this (based on their pictures?)

5. How was density calculated using the mass and volume values?

6. Come up with a formula for calculating density (based on the numbers in Model 2).

7. Do you think that objects C and D are made out of the same or different material? Explain using evidence from Model 2.
8. Complete the following table using data from the graph presented in Model 1, your volume calculations in question 5, and your inferences from Model 2.

<table>
<thead>
<tr>
<th>Object</th>
<th>Mass</th>
<th>Volume</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
</tr>
</tbody>
</table>

9. Calculate density for the following objects:
   a. A 114 gram box that has the dimensions: length = 3 cm, width = 3 cm, height = 7 cm
   
   b. A rock which has a mass of 60 grams and a volume of 20 mL
   
   c. An unknown liquid with a mass of 10 grams and a volume of 15 mL