Student Exploration: Density Experiment: Slice and Dice

Vocabulary: density, mass, matter, volume

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. What do you think would happen if you threw a block of polystyrene (Styrofoam™) into the water? ___________________________________________________________

2. What would happen if you broke the Styrofoam up into lots of pieces, then threw the pieces into water? ____________________________________________________________

3. What would happen if you threw a big rock into water? _____________________________

4. What would happen if you broke the rock into little pieces, then threw the pieces into water? ____________________________________________________________

Gizmo Warm-up
The Density Experiment: Slice and Dice Gizmo™ allows you to compare different-sized pieces of the same material.

1. Check that Polystyrene is selected. Drag the whole polystyrene piece into the water.

   Does it sink or float? __________________________

2. Click Reset, and then click Slice to cut the polystyrene into pieces. Drag each piece into the water and then back to the block.

   What happens? __________________________

3. How do you think the amount of a material affects its tendency to sink or float? __________

   __________________________
Activity A: Slice and dice

Get the Gizmo ready:
- Click Reset. Check that Polystyrene is selected.
- A calculator is recommended for this activity.

Introduction: The **density** of a material is the amount of **mass** per unit of **volume**. Density is calculated by dividing an object’s mass by its volume.

**Question:** How does density depend on the amount of material?

1. **Form hypothesis:** How do you think cutting up a material will affect its density? __________

2. **Collect data:** Click **Slice**. Choose a piece of polystyrene and drag it onto the **Material investigation** tray. Record the mass and volume, then calculate the density by dividing the mass by the volume. Replace the piece, and then repeat for the remaining pieces.

<table>
<thead>
<tr>
<th>Piece</th>
<th>Mass (g)</th>
<th>Volume (cm$^3$)</th>
<th>Density (g/cm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 (if available)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. **Analyze:** What do you notice about the density of the polystyrene pieces? ________________

4. **Predict:** What do you think is the density of the whole block of polystyrene? ________________

5. **Test:** Click **Reset**. Drag the whole (uncut) block of polystyrene onto the **Material investigation** tray. Record its mass and volume and calculate the density.

   Mass: ________________  Volume: ________________  Density: ________________

6. **Apply:** An archaeologist finds a golden figurine. How could she determine if the figurine is solid gold without cutting it? ____________________________________________________________________

_________________________________________________________________________
Activity B: Sink or float?

Get the Gizmo ready:
- Click Reset.

Question: The density of water is 1.0 g/mL, which is equivalent to 1 g/cm$^3$. How does an object’s density affect whether it sinks or floats in water?

1. Form hypothesis: How do you think an object’s density relates to whether it sinks or floats?
   
   __________________________________________________________________________

2. Collect data: Measure the mass and volume of each known material, and calculate its density. Then drag each material into the water to see whether it sinks or floats.

<table>
<thead>
<tr>
<th>Material</th>
<th>Mass</th>
<th>Volume</th>
<th>Density</th>
<th>Sinks or floats?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polystyrene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slate</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

3. Analyze: How does an object’s density determine if it will sink or float? ________________
   
   __________________________________________________________________________

4. Apply: Find the density of Unknown A and Unknown B. Based on their densities, predict whether each will sink or float. Then, test your prediction using the Gizmo.

<table>
<thead>
<tr>
<th>Material</th>
<th>Mass</th>
<th>Volume</th>
<th>Density</th>
<th>Sinks or floats? (prediction)</th>
<th>Sinks or floats? (actual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown B</td>
<td></td>
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</tbody>
</table>

5. Extend your thinking: Compare the three floating materials. How does the density of each material relate to how high it floats in the water? ________________________________________________________________________
   
   __________________________________________________________________________
   
   __________________________________________________________________________