Rock and Boat Worksheet

Objectives
- To demonstrate understanding of Archimedes’ principle.
- To answer an objective question based on understanding of volume, mass, density and weight.

Challenge Question
You have a large rock on a boat that is floating in a pond. You throw the rock overboard and it sinks to the bottom of the pond. Does the water level in the pond rise, drop or remain the same?

Definitions
- volume
- mass
- density
- buoyancy
- pressure
- weight

Relationship Questions
1. What is the relationship between volume, mass and density?

2. What is the relationship between mass and weight?
Materials
• clear bucket filled with water
• model boat
• large rock
• sticky notes and pen, to mark the water level
• large poster-sized paper

Procedure
1. Fill the clear bucket with water.
2. Place the boat in the water so it floats.
3. Place the rock on the boat ensuring that the boat is still floating.
4. Mark the water level with a sticky note labeled “rock in boat.”
5. Take the rock off of the boat and place it in the water.
6. Mark the water level with a sticky note labeled “rock in water.”

Questions
1. How does Archimedes’ principle apply to the rock and boat?

2. What variables need to be defined to solve this problem?

3. Derive an equation for \( v_{\text{disp}_r} \) the volume of the water displaced by the rock in the boat.
   Hint: use Archimedes’ principle to begin.

4. Derive an equation for \( v_{\text{disp}_s} \) the volume of the water displaced when the rock is fully submerged.
5. Compare $V_{w_{disp\,b}}$ to $V_{w_{disp\,s}}$ to mathematically and physically explain whether the water level rises, drops or remains the same when the rock is thrown overboard.

6. What role does the boat play in this activity? Do we need to account for the volume of water displaced by the boat? Why or why not?

7. What would change if we used:
   a. A boat with a rounded hull (bottom)?
   b. A larger rock?
   c. Molasses instead of water?

8. BONUS: Provide a few examples of how these principles are used in real-world science, engineering and/or technology.