Density and Displacement Lab

Use displaced water and weight to determine density

Name _____ Period _____ Date _____

Practice measuring displaced volume, then investigate mass and volume for one material. Use a graph to determine specimen density.

Time 50 minutes • Open buildphysics.com/?experiment=fluid-density

Model and measurements

Keep the specimen material unchanged and water density at 1,000 kg/m³. Use g = 9.8 m/s². Measure displaced volume with the specimen fully submerged and clear of the tank.

$\rho = \frac{m}{V}$ $W = mg$

W is the scale's support force in air. V is the volume of water displaced. For full immersion, V equals the specimen's outside volume.

Predict before running

Will pushing a fully submerged specimen deeper make it displace more water? Predict and explain.

Part A Compare immersion positions

1. Keep Specimen front-to-back depth at 0.025 m. Drag Unknown specimen partly underwater, then fully underwater at two different depths.
2. In Properties → Unknown specimen → Fluid properties, read Submerged fraction. In Properties → Water tank → Live values, read Displaced volume.
3. Record the actual fraction and displaced volume for each position while paused.

Position	Submerged fraction (%)	Displaced V (m³)
Partly submerged		
Fully submerged shallow		
Fully submerged deeper		

A1. Use two measured volumes to explain when displacement gives the specimen's full volume.

A2. Why does deeper immersion change pressure but not the displaced volume of this rigid, fully submerged specimen?

Part B Design and collect

Suggested time 16 minutes

Investigation question How does specimen mass depend on displaced volume for the same material?

Choose at least five front-to-back depths from 0.020 to 0.090 m, spread across the range. Keep the specimen width, height, and material unchanged.

B1. Identify the independent and dependent variables.

B2. What will you keep constant? How will you do this?

B3. List your settings. Why is this set useful?

B4. How will you measure weight in air and the volume of water displaced by full immersion?

B5. Write a procedure another group could follow.

Keep When resizing set to Keep material density fixed in the specimen's Fluid properties. Weigh on Specimen scale using Measured support force, then immerse and read the tank's Displaced volume. Calculate m = W/g.

Record your measurements

Same material and specimen width and height Water density = 1,000 kg/m³

Trial	Front-to-back d (m)	Weight W (N)	Displaced V (m³)	Mass m (kg)
1				
2				
3				
4				
5				
Extra				

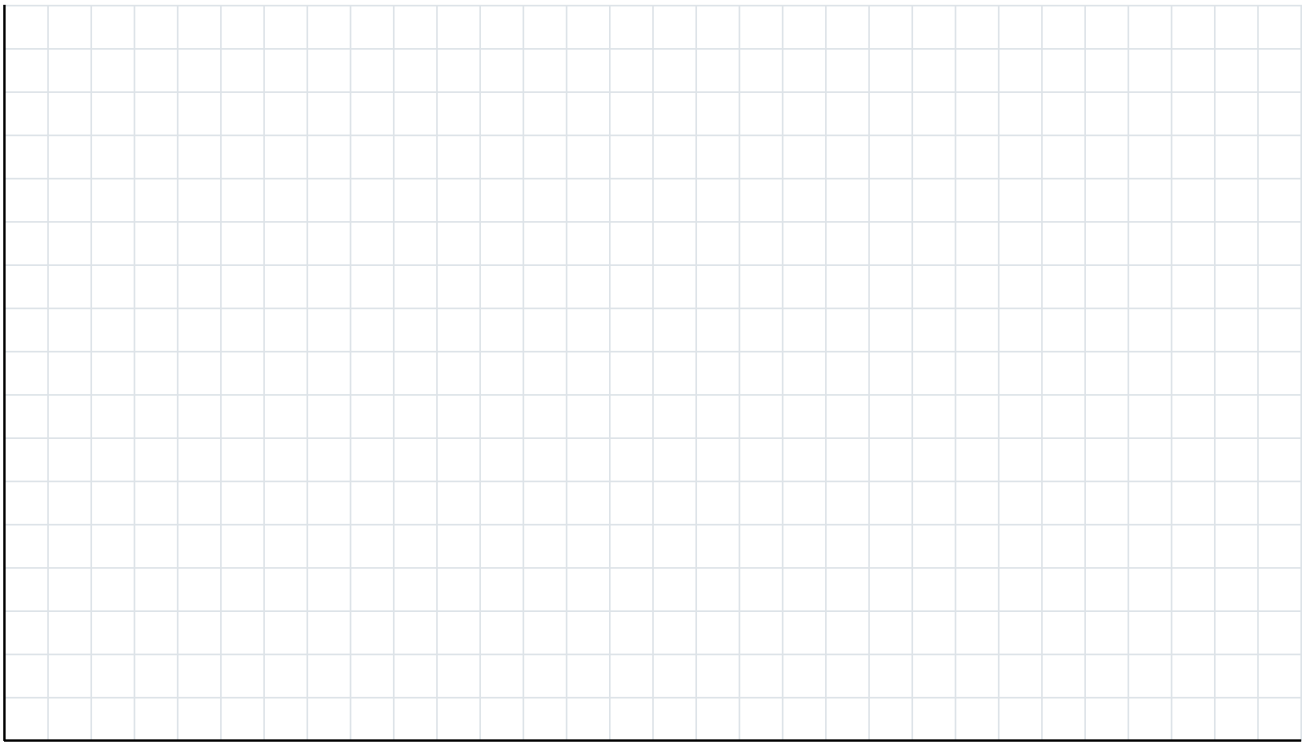
Part C Build and analyze a linear graph

Suggested time 14 minutes

C1. The relationship is $m = \rho V$. Describe how m depends on V for one material.

C2. Choose graph quantities and units. Explain why your graph should be a straight line.

C3. Plot your data and draw a best-fit line. Label both axes with quantities and units.



C4. Find slope and units using two separated points on your fitted line. Determine specimen density and interpret the intercept.

Part D Explain and predict

Suggested time 8 minutes

D1. A student claims, “A larger specimen must have a greater density.” Evaluate the claim using two trials.

D2. Does your graph support one material density? Compare its slope with m/V from two trials and discuss the intercept.

D3. Choose an unused specimen depth in your range. Measure its displaced volume and predict mass from your fit. Then weigh the specimen in air and compare.

New d (m)	Predicted m (kg)	Measured m (kg)

Comparison