Apparent Weight Underwater Lab

Liquid density and the force supporting a specimen

Name _____ Period _____ Date _____

Compare support in air and underwater. Investigate how liquid density changes rope tension, then use a graph to determine specimen volume.

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

Model and measurements

Keep the specimen on its prepared rope. It is stationary and fully submerged in Part B, with the rope taut and no tank contact. Use g = 9.8 m/s².

$\Sigma F_y = ma_y$ $B = \rho g V_{sub}$

T is rope tension and B is buoyant force. Weight mg remains unchanged. Keep specimen mass at 2.0 kg and its size unchanged.

Predict before running

Will the rope support more or less force when liquid density increases? Predict and explain.

Part A Compare immersion levels

1. Set Specimen mass to 2.0 kg and Liquid density to 1,000 kg/m³. Test the Liquid fill heights below.
2. In Properties → Specimen → Fluid properties, read Submerged fraction and Rope / spring reading (T).
3. Run to 0.30 s with Auto-pause after (clock beside Run) or Step. Read T while stationary. Reset between trials.

Fill height (m)	Submerged (%)	Tension T (N)
0.60		
0.90		
1.40		

A1. Use two trials to compare immersion and rope tension. Which trial gives the specimen's weight?

A2. Explain why a smaller rope reading underwater does not mean the specimen's mass or weight decreased.

Part B Design and collect

Suggested time 16 minutes

Investigation question How does rope tension depend on liquid density for one fully submerged specimen?

Keep mass at 2.0 kg and Liquid fill height at 1.40 m. Choose at least five liquid densities from 600 to 1,400 kg/m³, spread across the range.

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 check full immersion and obtain a stationary rope-tension reading?

B5. Write a procedure another group could follow.

Record your measurements

Mass m = 2.0 kg Same specimen volume Fill height = 1.40 m

Trial	Liquid ρ (kg/m³)	Tension T (N)
1		
2		
3		
4		
5		
Extra		

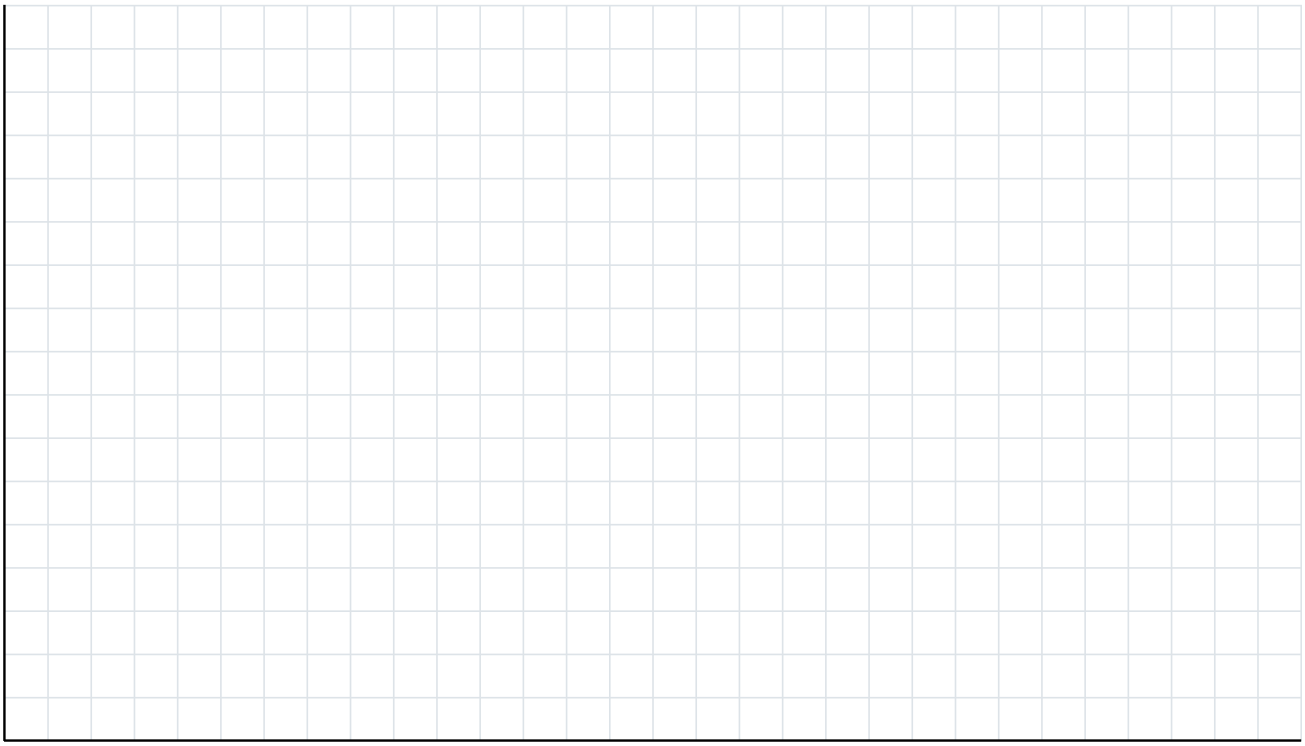
Part C Build and analyze a linear graph

Suggested time 14 minutes

C1. The relationship is $T = mg - \rho gV$. Describe how T depends on ρ while m and V stay fixed.

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 volume and interpret the intercept.

Part D Explain and predict

Suggested time 8 minutes

D1. A student claims, “The apparent weight is smaller because gravity becomes weaker underwater.” Evaluate the claim using force balance.

D2. Does your graph support the force model? Compare inferred volume with Physical volume in Fluid properties, and compare the intercept with mg.

D3. Choose an unused liquid density within your range. Predict T from your fit, then run the new trial to 0.30 s and measure T. Compare.

New ρ (kg/m³)	Predicted T (N)	Measured T (N)

Comparison