Density Lab Worksheet

Density, water displacement, and the king's crown · Logical Home Schooling

Name: _____ **Date:** _____ **Period:** _____

In this lab you will use the Density Lab to weigh samples, measure their volume by water displacement, and calculate their density. You will use density to identify mystery metals, predict whether objects float, and test whether a king's crown is pure gold.

Lab link: www.logicalhomeschooling.com/density-lab.html

Objectives

By the end of this lab you will be able to:

- Measure mass with a tared balance and volume with a graduated cylinder, reading the meniscus correctly.
- Find the volume of an irregular object by water displacement.
- Calculate density and percent error, and use density to identify a material.
- Predict whether an object floats or sinks by comparing its density with water's.

Materials: a computer or tablet with the lab open, a calculator, a pencil, this worksheet. Time: about 50 minutes. Your numbers will be different from your classmates', because every sample has a random size.

Key formulas. density = mass ÷ volume · volume of sample = final volume − starting volume · percent error = |your value − accepted value| ÷ accepted value × 100. 1 mL = 1 cm^3.

Part 1: Pre-lab

1. In your own words, what is density?

   _____

2. Two cubes are exactly the same size. Cube A has a mass of 80 g and cube B has a mass of 20 g. Which is denser? Explain.

   _____

3. A gold nugget has a lumpy, irregular shape. Why can't you just measure it with a ruler to find its volume? How does dropping it in water help?

   _____

   _____

4. What is a meniscus, and where should you read it?

   _____

5. Why do you press **Tare** before you weigh a sample in a weighing boat?

   _____

Part 2: Stage 1, Gold, silver, and copper

Complete each sample in the lab, then copy your data from the lab's data table.

Sample	Mass (g)	Start (mL)	End (mL)	Volume (mL)	Density (g/mL)	Accepted (g/mL)	% error
Gold						19.32	
Silver						10.49	
Copper						8.96	

1. Show your density calculation for gold, with units.

2. Your percent errors probably aren't zero. Name two things in a real lab that could cause small errors in density.

Part 3: Stage 2, Mystery metals

Sample	Mass (g)	Start (mL)	End (mL)	Volume (mL)	Density (g/mL)	Identity
A						
B						
C						
D						

1. Sample B looks shiny and gold-colored. How does density prove it is not real gold?

2. If you measured a piece of Sample A that was twice as big, what would happen to its mass, its volume, and its density?

Part 4: Stage 3, The overflow can

Sample	Mass (g)	Water collected (mL)	Density (g/mL)	Identity
Block X				
Block Y				

1. Why does the water that spills out have the same volume as the block?

2. Suppose a student forgot to fill the can all the way to the spout. Would the collected volume be too big or too small? Would the calculated density be too high or too low? Explain.

Part 5: Stage 4, Float or sink?

Object	Density (g/mL)	My prediction	Result	Fraction under water
Cork	0.24			
Pine block	0.50			
Ice cube	0.92			
PVC pipe piece	1.38			
Aluminum can tab	2.70			

1. Write a rule that predicts whether an object floats or sinks in water.

2. Compare each floating object's density with the fraction of it that stayed under water. What pattern do you notice? Use it to explain why only the "tip of the iceberg" shows.

3. Steel has a density of about 7.9 g/mL, but a steel ship floats. Explain how.

Part 6: Stage 5, The king's crown

Object	Mass (g)	Water collected (mL)	Density (g/mL)
King's crown			
Pure gold bar			

1. Is the crown pure gold? Give two pieces of evidence from your data.

2. The crown and the gold bar have the same mass. Explain why one of them can push aside more water than the other.

3. **Bonus:** if the crown is a mix of gold (19.32 g/mL) and silver (10.49 g/mL), estimate what percent of its volume is gold. Use: percent gold = (crown density − 10.49) ÷ (19.32 − 10.49) × 100.

Part 7: Practice problems

Answer these **without** the lab. Show your work and units.

1. A metal sample has a mass of 54.0 g and a volume of 20.0 mL. What is its density, and what metal might it be?

2. What volume does 100.0 g of gold take up?

3. What is the mass of 15.0 mL of silver?

4. The water in a graduated cylinder rises from 42.0 mL to 49.5 mL when a 66.5 g sample is added. Find its density and identify the metal.

5. Density is called an intensive property, which means it does not depend on how much of a substance you have. Use your lab data to explain why that makes density useful for identifying materials.

Conclusion

Write 3 to 5 sentences explaining how you measured density in this lab and how density helped you identify materials and solve the mystery of the crown.