LESSON MAKER PRO

# Density Detectives

*Use mass and water displacement to investigate objects.*

**HIGH SCHOOL · P.4.a**

**P.4.a** "Plan and carry out experiments to determine the density of objects."

NAME _____ DATE _____

### MEASURE, THEN DIVIDE

Measure an object's mass with a balance. For an irregular object, record the water level in a graduated cylinder before and after you fully submerge it. Subtract the first level from the second to find volume, then divide mass by volume to find density.

### WORKED EXAMPLE

A metal piece has a mass of 42 g. Water in a graduated cylinder rises from 30 mL to 44 mL when the piece is submerged. Find its density.

1. Find the volume: 44 mL - 30 mL = 14 mL.
2. Divide mass by volume: 42 g / 14 mL = 3 g/mL.

**Answer: 3 g/mL**

## PRACTICE 6 problems

**1** A solid object has a mass of 20 g and a volume of 5 mL. What is its density?

**ANSWER** _____

**2** A stone has a mass of 45 g and displaces 9 mL of water. What is its density?

**ANSWER** _____

**3** A metal piece has a mass of 64 g. When it is submerged, the water level rises from 50 mL to 58 mL. What is its density?

**ANSWER** _____

**4** Use the measurements in the table to find the bead's density.

**BEAD MEASUREMENTS**

| Mass (g) | Water before (mL) | Water after (mL) |
|---|---|---|
| 72 | 40 | 52 |

**ANSWER** _____

**5** A sample has a mass of 90 g. The water level rises from 70 mL to 88 mL when it is submerged. What are its volume and density?

**ANSWER** _____

**6** A metal part has a density of 7 g/mL and displaces 8 mL of water. What is its mass?

**ANSWER** _____

## APPLY IT Show your work

**1** A skateboard maker wants to check a metal part against stock metal with a density of 8 g/mL. The part's mass is 120 g. In a graduated cylinder, water rises from 25 mL to 40 mL when the part is submerged. What measurements are needed for this test, and does the part's density match the stock metal?

WORK SPACE

**ANSWER** _____

**2** A collector tests two metal game tokens. Token A has a mass of 54 g and raises the water level from 20 mL to 29 mL. Token B has a mass of 80 g and raises it from 20 mL to 36 mL. Find each token's density. Which token is denser?

WORK SPACE

**ANSWER** _____

## CHALLENGE One step up

To test an irregular metal object, you measure its mass while it sits in a dry cup. The cup and object together have a mass of 138 g; the empty cup has a mass of 66 g. You then submerge the object in a graduated cylinder, and the water rises from 110 mL to 122 mL. Find the object's density. Explain why you subtract twice.

WORK SPACE AND ANSWER

# Density Detectives



## PART 1 · PRACTICE

| # | PROBLEM | ANSWER |
|---|---|---|
| 1 | A solid object has a mass of 20 g and a volume of 5 mL. What is its density? | **4 g/mL** |
| 2 | A stone has a mass of 45 g and displaces 9 mL of water. What is its density? | **5 g/mL** |
| 3 | A metal piece has a mass of 64 g. When it is submerged, the water level rises from 50 mL to 58 mL. What is its density? | **8 g/mL** |
| 4 | Use the measurements in the table to find the bead's density. | **6 g/mL** |
| 5 | A sample has a mass of 90 g. The water level rises from 70 mL to 88 mL when it is submerged. What are its volume and density? | **Volume: 18 mL; density: 5 g/mL** |
| 6 | A metal part has a density of 7 g/mL and displaces 8 mL of water. What is its mass? | **56 g** |

## PART 2 · APPLY IT

1. **Measure the part's mass and the water levels before and after submerging it. Its density is 8 g/mL, so it matches the stock metal's density.** The water rise gives a volume of 40 - 25 = 15 mL. Divide 120 g by 15 mL to get 8 g/mL.
2. **Token A: 6 g/mL; token B: 5 g/mL. Token A is denser.** Token A displaces 9 mL, so 54 / 9 = 6 g/mL. Token B displaces 16 mL, so 80 / 16 = 5 g/mL.

## CHALLENGE

**The object's mass is 138 - 66 = 72 g, and its volume is 122 - 110 = 12 mL. Its density is 72 / 12 = 6 g/mL. The first subtraction removes the cup's mass; the second finds the water displaced by the object.**

Accept equivalent calculations with correct units. In the skateboard problem, a matching density supports the comparison but does not prove the two parts are the same material.