Density: measuring mass and volume

Student activity • investigation and reasoning

YEAR 11 / LESSON 73 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

How can repeated dimension measurements improve an estimate of density?

Measure three small rectangular solids and calculate density from mass and geometric volume.

Equipment

- Three small rectangular blocks, balance and ruler or calliper
- Booklet and calculator

Keep blocks on the bench and away from edges; do not stack or drop them. Check for sharp edges. Use callipers gently without trapping fingers. No heavy blocks or liquid displacement are required.

Course coverage: Shared Physics / Double Award: 5.1, 5.3, 5.4. Density from direct mass and volume measurements.

Plan, model or apparatus sketch

Draw the apparatus or model and label the measured quantities and their units.

Method and reasoning

Read the whole sequence before starting

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1. Work in ten groups of three. Select three smooth rectangular blocks no heavier than 200 g each, and label them A, B and C. Zero a balance and measure the mass of each dry block in grams.

2. Measure each block's length, width and height in centimetres using a suitable ruler or staff-approved calliper. Repeat dimensions at another position and note visible irregularity.

3. Record all dimensions in the calculation space. Use representative dimensions to calculate V = length × width × height in cm^3 and explain any averaging used.

4. Calculate density in g cm^{-3} using mass divided by volume. Convert to kg m^{-3} by multiplying by 1000, showing the conversion explicitly.

5. Repeat the balance reading after removing and replacing one block. Compare relative measurement uncertainties and explain why a small thickness can dominate volume uncertainty.

6. Compare the blocks without claiming a material identity from one rounded density alone. State the limits of the rectangular model if edges are rounded or faces uneven.

Cleanup

- Return blocks to trays and clear and zero balances.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Practice example only: 54 g and dimensions 5.0 × 2.0 × 2.0 cm give 20 cm^3 and 2.7 g cm^{-3} = 2700 kg m^{-3}. A block's mass is not its weight; density is not determined by mass alone.

Block	Mass / g	Volume / cm^3	Density / g cm^{-3}
A			
B			
C			

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. What is the density equation?

2. Find the practice volume.

3. Find the practice density in g cm^{-3}.

4. Convert it to kg m^{-3}.

5. Why repeat dimension readings?

6. Can equal-mass blocks have different densities?