Core practical: oxygen in air by rusting

Teacher / technician

YEAR 10 / LESSON 61 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Staff preparation and answer guidance. Keep separate from student sheets. Teacher-operated water-only iron-rusting demonstration, three replicates and later readings. No heated copper or phosphorus branch; no instant-result claim.

Coverage and delivery

Shared core: 2.9, 2.10 and 2.14. Iron-rusting demonstration with a later stable-volume reading. No heated copper or phosphorus procedure is used.

Allow about 60 minutes. Follow the student sequence and use the answers to check reasoning.

Requisition • one staff demonstration for 30

Item	Per pair / setup	Class total
Booklet / writing tools	1 per learner	30 sets
Observation eye protection	1 each	30; staff protection separately
100 cm^3 cylinder / clamp	Staff: 3 setups	3 cylinders and clamps
Uncoated iron wool / forceps	Staff: about 0.30 g per setup	1.2 g wool incl. spare; forceps
Deep trough / thermometer / labels	Staff demonstration	Suitable depth; 1 thermometer; labels

Immediate safety

Wear eye protection while observing. Staff handle sharp iron fibres, wet glassware and clamps. Report breakage; do not move the cylinders. No flames, hot copper, phosphorus or accelerant acids are used.

Preparation and delivery

Read alongside the student method

YEAR 10 / LESSON 61 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

1. Use one class demonstration with three replicate setups. Staff trial clean uncoated fine iron wool with water only; supply about 0.30 g per setup (0.90 g total; 1.2 g including spare). Do not use soap-filled pads or add acid to accelerate the reaction.

2. Loosely secure damp wool at each cylinder's closed end with forceps; remove excess free water. Keep it from falling into the trough. Use secure clamps and enough trough depth to equalise inner/outer levels without allowing air through the mouth.

3. Aim for roughly 70–90 cm^3 trapped gas per cylinder and record the actual initial reading. The small volume occupied by wool and its retained water is neglected in this school approximation; do not claim high-precision gas analysis.

4. Set up at least several days in advance for a follow-up comparison; corrosion rate varies with wool. Retain dates and follow until successive readings are unchanged within scale resolution. A pre-prepared example must be labelled separately from the newly started run.

5. Use the same room-temperature conditions and equal water levels before readings. Avoid moving clamps carelessly, compressing the gas, removing the mouth from water or permitting leaks. Staff handle fibre/glass hazards; no burner, hot tube or phosphorus is included.

6. Plan 15 minutes setup explanation, 20 data/calculation and 20 limitations/composition plus cleanup; book later readings. Staff collect iron fibres and glassware after the final reading. No measured result is supplied by this booklet.

Close of lesson

- Keep labelled setups secured for the follow-up.
- After final readings, staff collect iron fibres for the local solid-waste route, rinse equipment and wash hands.

Check before teaching

Check the cards, reference data and quantities against this requisition. Keep the staff answer guide separate until the checking stage. Supplied numerical practice datasets are labelled examples; they are not class measurements.

Answers and teaching notes

Expected explanations • do not give as experimental observations

YEAR 10 / LESSON 61 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

• (80.0−63.5)/80.0×100=20.625%, approximately 20.6%. This is an invented example only.

• Oxygen is consumed and becomes part of solid corrosion products; water enters the space as the gas amount decreases. Rusting needs water and oxygen; nitrogen is not consumed by this method.

• Equal liquid levels make trapped-gas pressure approximately atmospheric. Temperature and pressure changes alter volume independently of oxygen consumption.

• Rusting can be slow. A stable reading reduces the chance that reaction is merely incomplete, though it does not prove the absence of leaks or other bias.

• No. Nitrogen dominates, but argon and other gases remain, together with water vapour. Dry air is a compositional reference, not the exact damp residual mixture.

• Incomplete oxygen removal tends to underestimate the oxygen fraction. A warmer final reading makes final gas volume larger and also tends to underestimate it. Leaks, vapour/dissolution and neglected occupied volume introduce additional uncertainty.

References and provenance

Pearson Chemistry specification

RSC iron-wool oxygen experiment

Prepared 22 November 2026. Original wording, tables and questions. Sources inform the concepts and technique; the lesson scope and classroom quantities are explicitly described here. No laboratory trial or final school risk approval is claimed.