Respiring seeds: carbon dioxide and heat

Teacher / technician

YEAR 10 / LESSON 22 / BIOLOGY + SCIENCE (DOUBLE AWARD)

Staff preparation and answer guidance. Keep separate from student sheets. Two controlled observations, not a precise metabolic calorimeter. Microbial contamination and tissue changes in the killed control limit interpretation.

Coverage and delivery

Shared Biology / Double Award: 2.39. Core practical: carbon dioxide and heat.

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

Requisition • class of 30, working in 15 pairs

Item	Per pair / setup	Class total
Student booklets / graph paper	1 per learner	30 of each
Gas-comparison jars	live seeds, killed seeds, indicator only	3 vessels per demonstration set
Hydrogencarbonate indicator	equal 5 cm^3 portions	15 cm^3 per set plus spare
Seeds for gas comparison	equal 10 g portions	20 g per set
Insulated flasks / probes	live and killed-seed pair	2 flasks; 2 probes plus ambient sensor
Seed heat preparation	equal masses, each flask approximately half full	measure and record for actual flask capacity

Immediate safety

Observe closed indicator jars and do not taste seeds or indicator. Staff prepare boiled seeds and handle disinfectant stocks. Do not open mouldy or deteriorated material; tell the teacher. Handle glass and probe cables carefully.

Preparation and delivery

Read alongside the student method

YEAR 10 / LESSON 22 / BIOLOGY + SCIENCE (DOUBLE AWARD)

1. Start clean germination material in advance. Use the school-approved seed-disinfection protocol, checking the product and concentration; staff alone handle disinfectant. Rinse as the protocol specifies and do not mix disinfectant with acids.

2. Prepare a matched killed-seed control by boiling and cooling fully. Match mass, moisture, flask insulation and initial temperatures; use breathable cotton-wool plugs around probes.

3. Pilot the heat apparatus over the preceding 24–72 hours, recording actual timestamps and ambient temperature. Inspect daily and do not present mouldy material. Keep genuine records even if the temperature effect is small.

4. For gas jars, support seeds above 5 cm^3 indicator without contact. Pilot the short observation interval with the seed batch; retain a no-seed reference and equal headspace. Open only during staff setup and disposal.

Close of lesson

• Staff collect all seed preparations and deal with contaminated material using the school's biological-waste procedure.

• Return probes and clean the work area; 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 22 / BIOLOGY + SCIENCE (DOUBLE AWARD)

- They provide a non-germinating comparison, though boiling also changes tissue and is an imperfect control.
- Residual heat from boiling would confound evidence for respiration-related warming.
- Background indicator changes caused by the environment or handling without seeds.
- Insulation reduces heat loss; breathable plugs allow gas exchange and avoid restricting oxygen.
- Microbial respiration could contribute carbon dioxide and heat, so fresh clean seeds and careful preparation matter.
- Report the actual observations and limits; reconsider sensitivity, timing and seed viability rather than substituting expected results.

References and provenance

Pearson Biology specification

Pearson core practical guide: respiration

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.