Respiring seeds: carbon dioxide and heat

Student activity • practical and reasoning

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

The question

What evidence distinguishes respiration from environmental temperature change?

Compare evidence for gas production and heat using matched seed preparations. Longer temperature records are prepared in advance and retain their real timestamps.

Equipment

- Prepared germinating and boiled-seed comparison sets
- Three observation jars with separated indicator cups or mesh supports
- Two insulated flasks with temperature probes and breathable plugs; ambient thermometer
- Student booklet and graph paper

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.

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

Plan, model or apparatus sketch

Draw and label the apparatus or biological model; identify one limitation.

Method and reasoning

Read the whole sequence before starting

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1. Observe matched, teacher-prepared vessels containing germinating seeds and boiled, fully cooled seeds. Record seed mass, starting temperature, setup time and ambient temperature.

2. For the gas comparison, use equal seed masses in separate jars above, not touching, equal volumes of hydrogencarbonate indicator. Include an indicator-only jar; keep light, temperature and observation time the same.

3. Record initial indicator colours and observe again after the teacher's pilot-checked interval. Keep the containers closed during observation and compare with the indicator-only reference.

4. Read the temperature records from the two insulated seed flasks over the same period, together with room temperature. The flasks have loose breathable plugs, not airtight seals.

5. Plot temperature against time for both flasks. Compare changes from their own starting values; check whether room-temperature changes could explain the pattern.

6. State conclusions supported by your observations and explain limits: microbes, imperfect insulation, unequal seed condition and indicator sensitivity. Do not invent a temperature rise or colour change.

Cleanup

- 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.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Hydrogencarbonate indicator responds to carbon dioxide concentration: a shift towards yellow relative to its air-equilibrated reference supports an increase. Heat evidence requires a temperature difference or rise compared with controls and ambient conditions. Boiled seeds must cool to the same initial temperature before use. Carbon dioxide and heat are separate measured outcomes.

Example / trial	Observation / evidence	Explanation / limit
CO_2 vessels: initial / final / controls		
Heat flasks: time / temperatures		
Conclusion / limitation		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Why use boiled seeds?

2. Why must the control cool before the experiment?

3. What does the indicator-only vessel check?

4. Why are heat flasks insulated but not airtight?

5. What could microbial growth do to the interpretation?

6. What should be reported if no clear change is seen?