Light and net leaf gas exchange

Student activity • practical and reasoning

YEAR 10 / LESSON 35 / BIOLOGY ONLY

The question

How does light change the carbon-dioxide balance around a leaf?

Use matched light and dark vessels with no-leaf controls. Interpret the indicator as evidence of net carbon-dioxide change.

Equipment

- Four identical clear vessels with closures and leaf supports
- 20 cm^3 supplied hydrogencarbonate indicator
- Matched fresh leaf pieces, foil, timer, thermometer and LED light
- Eye protection and supplier colour reference

Wear eye protection, avoid indicator or plant sap contact, and do not taste materials. Keep water away from electrical equipment. Use fresh plant material and a short observation period; do not keep sealed biological setups for prolonged incubation.

Course coverage: Biology only: 2.45B. Core practical: light and net gas exchange.

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. Label four identical small transparent vessels: leaf in light, leaf in darkness, no leaf in light, no leaf in darkness. Use equal indicator volumes and matched headspaces.

2. Place 5 cm^3 of air-equilibrated hydrogencarbonate indicator in each. Support matched fresh leaf pieces above the liquid without contact; record their areas and initial indicator colour.

3. Close the vessels for the short trial. Wrap the dark pair fully in foil and keep all four at the same temperature under an LED source; do not place them in direct warming sunlight.

4. Observe after the teacher’s pilot-checked interval, typically 30–60 minutes. Record actual time, temperature and colour against the supplied reference; unwrap the dark vessels only for reading.

5. Compare each leaf vessel with its no-leaf control, and compare the light and dark pairs. Record unexpected or unchanged colours honestly.

6. Interpret the net carbon-dioxide balance. Explain why this is not a direct measurement of gross photosynthesis and why indicator colour alone does not quantify a precise rate.

Cleanup

- Return indicator and plant material through the school’s designated waste routes.
- Rinse vessels, wipe surfaces and wash hands.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Air-equilibrated hydrogencarbonate indicator is normally red/orange; increased carbon dioxide shifts it towards yellow, while decreased carbon dioxide shifts it towards purple. Use the actual supplier reference and starting colour. The signal depends on net exchange, indicator chemistry, headspace and time.

Example / trial	Observation / evidence	Explanation / limit
Light leaf / no-leaf comparison		
Dark leaf / no-leaf comparison		
Interpretation / limits		

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 no-leaf controls in both conditions?

2. Why match leaf area and headspace?

3. What can a yellow shift in darkness support?

4. Why might a leaf in strong light produce a purple shift?

5. Does no colour change mean no respiration?

6. Why keep temperature the same?