Cell respiration

International Baccalaureate · IB Diploma · Biology · SL

Scope and prerequisites

This handout covers selected SL topics for the course first assessed in 2025; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

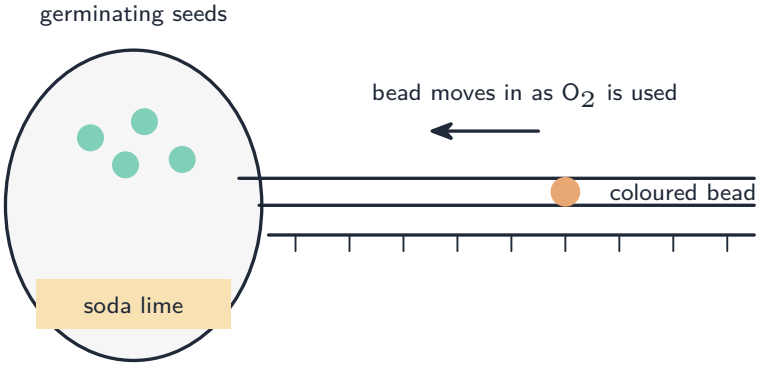
Respiration , ATP and energy transfers

What would explain this observation?

- A muscle can use oxygen while you exercise without producing a flame. **Respiration** transfers energy through a controlled series of reactions.

Build the model

- Aerobic respiration uses oxygen and releases carbon dioxide and water from organic substrates.
- Energy released can support **ATP** formation.
- ATP hydrolysis can be coupled to processes such as active transport and muscle contraction.
- respiration: Cell reactions that transfer energy from substrates.
- ATP: A molecule that couples energy transfers in cells.



Soda lime absorbs CO_2, so the bead moves only as oxygen is used

■ Choose evidence that can test it

- Anaerobic processes allow ATP production when oxygen supply cannot support the required aerobic rate, but give less ATP per glucose.
- In humans lactate can accumulate; yeast can produce ethanol and carbon dioxide.

In the lab: A respirometer can measure oxygen uptake when carbon dioxide is absorbed. Control temperature with a water bath and use a comparison containing inert material. Keep absorbent separated from organisms and follow the school risk assessment.

■ Work from known quantities

- Known: oxygen uptake is 0.80 cubic centimetres in 4.0 minutes for 2.0 g of tissue.
- Rate per mass = volume / (time × mass).
- Rate = $0.80/(4.0 \times 2.0) = 0.10$ cubic centimetres per minute per gram.
- Normalizing allows a fairer comparison of samples of different mass.

Your turn: 0.60 cubic centimetres are used in 3.0 minutes by 2.0 g of tissue. Find the mass-specific rate.

■ Check the conclusion and its limits

- Breathing ventilates the lungs; respiration consists of chemical reactions in cells.
- A moving respirometer marker can also reflect temperature or pressure changes.

Not true: Breathing and cellular respiration are the same process. Breathing is ventilation - moving air in and out of the lungs. Cellular respiration is the set of chemical reactions in cells that transfers energy from glucose. The names overlap but the processes are different.

Key:

- Aerobic respiration uses oxygen and releases carbon dioxide and water from organic substrates.
- Anaerobic processes allow ATP production when oxygen supply cannot support the required aerobic rate, but give less ATP per glucose.
- Watch for: breathing ventilates the lungs; respiration consists of chemical reactions in cells.

■ **Write from a rate of 0.14 cubic centimetres per minute per gram**

- 0.84 cubic centimetres are used in 3.0 minutes by 2.0 g of tissue.
- Find the mass-specific rate. Breathing is not cellular respiration.