

Photosynthesis

International Baccalaureate · IB Diploma · Biology · HL

Scope and prerequisites

This handout covers selected HL 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.

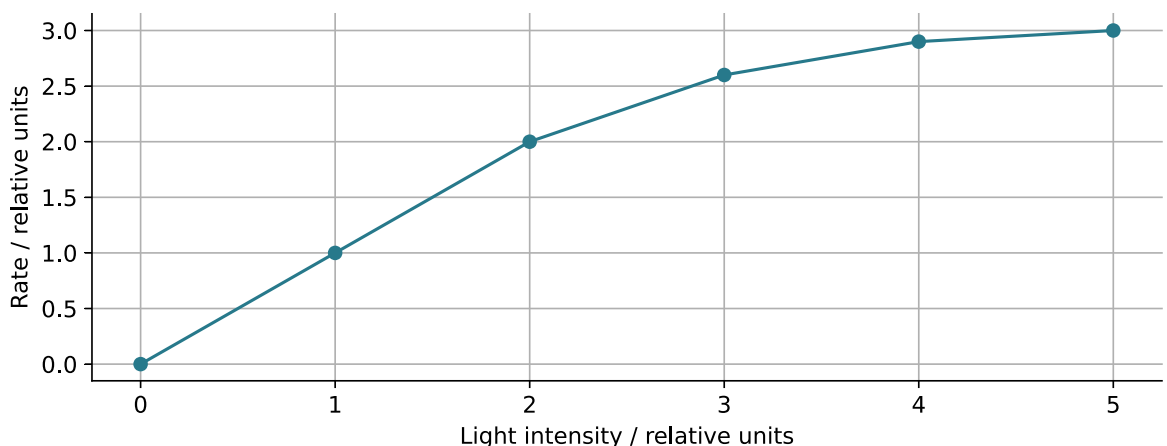
Photosynthesis and limiting factors

■ What would explain this observation?

- A brighter lamp does not always produce more oxygen from pondweed. Another factor may limit the process when light is already sufficient.
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■ Build the model

- **Photosynthesis** transfers energy from light into chemical stores.
- Carbon dioxide and water form carbohydrate, releasing oxygen.
- Chlorophyll absorbs light; light intensity, temperature and carbon dioxide supply can affect rate.
- **limiting factor** : A factor whose shortage restricts rate.
- photosynthesis: Light-driven formation of carbohydrate.



Rate rises with light intensity, then levels off as another factor limits it

■ Choose evidence that can test it

- Change only one factor when testing a limiting factor.
- At low light, extra light may increase rate.
- At a plateau, the changed factor is no longer the main limit in that range; the graph alone does not identify which other factor is limiting.

In the lab: Measure collected gas volume over a fixed time instead of assuming all bubbles have the same volume. Control temperature, plant size and carbon dioxide supply. Allow the plant to adjust before each reading and repeat.

■ Work from known quantities

- Known: 6.0 cubic centimetres of gas are collected in 3.0 minutes.
- Use $\text{rate} = \text{volume}/\text{time}$.
- $\text{Rate} = 6.0/3.0 = 2.0$ cubic centimetres per minute.
- Bubble counts can be a rough proxy, but bubbles of different size make comparisons less reliable.

Your turn: 9.0 cubic centimetres of gas are collected in 3.0 minutes. Find the rate.

■ Check the conclusion and its limits

- Moving a lamp changes light and may also change temperature.
- A photosynthesis experiment needs control of heating, not just a ruler.

Not true: All oxygen bubbles have exactly the same volume. Bubbles from pondweed vary in size and composition, so a bubble count is only a rough proxy for gas volume. Measuring collected volume, as in the calculation above, is more reliable.

Key:

- Photosynthesis transfers energy from light into chemical stores.
- Change only one factor when testing a limiting factor.
- Watch for: moving a lamp changes light and may also change temperature.

■ Write from a gas rate of 2.5 cubic centimetres per minute

- 10.0 cubic centimetres of gas are collected in 4.0 minutes.
- Find the rate. At a plateau, the factor you changed is no longer the main limit.