

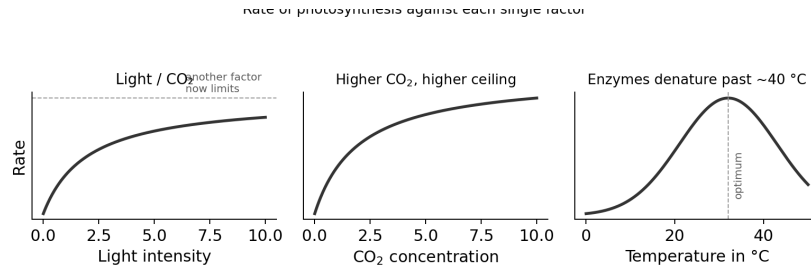
Exercise walk-through

4.1

Photosynthesis and limiting factors (4.4.1, RP6)

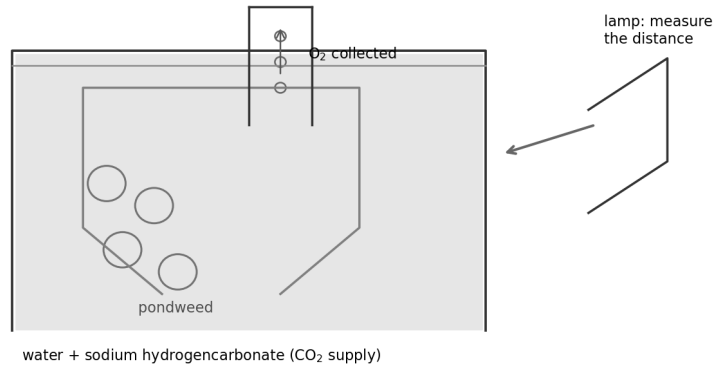
AQA · GCSE · Biology

Limiting factors



- Light, CO₂ and temperature each limit the rate.
- Light or CO₂ graph: rises then flat — another factor now limits.
- Temperature: rises to an optimum, then falls as enzymes denature.

RP6 pondweed



- Pondweed in water, lamp at measured distances.
- Count oxygen bubbles per minute; rate = bubbles $\div$ time.
- Control temperature and CO₂ (sodium hydrogencarbonate); repeat and take a mean.

Exercises 2.1·2.3

2.1 Write the word equation for photosynthesis.

[1]

2.2 Photosynthesis is endothermic. State the source of the energy and where in the cell the reaction happens.

[2]

2.3 Sketch the graph of rate of photosynthesis against temperature, labelling the optimum.

[2]

Exercises 2.1·2.3

2.1 Write the word equation for photosynthesis. [1]

2.1 Carbon dioxide + water $\rightarrow$ glucose + oxygen, with light energy.

2.2 Photosynthesis is endothermic. State the source of the energy and where in the cell the reaction happens. [2]

2.2 Light (energy transferred from the environment); in the chloroplasts.

2.3 Sketch the graph of rate of photosynthesis against temperature, labelling the optimum. [2]

2.3 Curve rising to a peak then falling; optimum labelled at the peak.

Exercises 3.1·3.2

3.1 A student grows pepper plants in a greenhouse. Explain two ways the student could increase the rate of photosynthesis, and one economic problem of each. [6]

3.2 (*HT*) A lamp is 15 cm from pondweed. The lamp is moved to 45 cm. Explain, with a calculation factor, how the light intensity changes. [3]

Exercises 3.1·3.2

3.1 A student grows pepper plants in a greenhouse. Explain two ways the student could increase the rate of photosynthesis, and one economic problem of each. [6]

3.1 Any two, each with method and economic problem: add electric lighting to increase light intensity – cost of electricity may exceed the value of extra crop; burn fuels or heat to raise CO₂ concentration – fuel cost / CO₂ release; heat the greenhouse toward the optimum temperature – heating cost.

3.2 (*HT*) A lamp is 15 cm from pondweed. The lamp is moved to 45 cm. Explain, with a calculation factor, how the light intensity changes. [3]

3.2 Distance triples, so intensity falls to $(1/3)^2 =$ one ninth.

Exercise 3.3

3.3 Describe how a student could investigate the effect of light intensity on the rate of photosynthesis using pondweed, including how the rate is calculated and two control variables.

[6]

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3.3 Pondweed in a beaker of water with sodium hydrogencarbonate, under an inverted funnel collecting bubbles in a test tube; lamp at measured distances, e.g. 10, 20, 30 cm, left to adjust for a few minutes each time; count bubbles per minute, repeat and take a mean; rate = bubbles $\div$ time (or volume of gas per minute); controls: same temperature – water bath/thermometer; same CO₂ concentration and same pondweed length/water volume.