

Topic 4: Bioenergetics

AQA GCSE Biology 8461 · spec 4.4 · sheets 4.1–4.2

Two reactions, one energy story

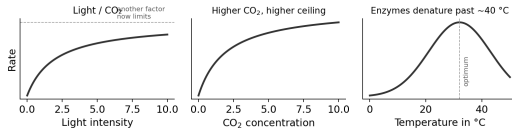
- Photosynthesis stores light energy in glucose; respiration releases it.
- Photosynthesis is endothermic; respiration is exothermic.
- Both word equations and the symbol equation are exam certainties.

The photosynthesis equations

- Word: carbon dioxide + water $\xrightarrow{\text{light}}$ glucose + oxygen.
- Symbol: $6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2$.
- Endothermic — energy transferred from the environment to chloroplasts by light.

Limiting factors

Rate of photosynthesis against each single factor

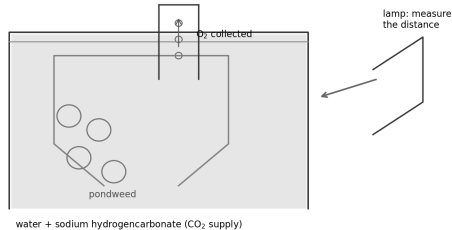


- Light, CO₂ and temperature each limit the rate.
- Light or CO₂ graph: rises then flat — another factor now limits.
- Temperature: rises to an optimum, then falls as enzymes denature.

Inverse square law and greenhouses

- (HT) light intensity $\propto 1/d^2$: double the distance, quarter the intensity.
- (HT) 40 bubbles/min at 10 cm $\rightarrow$ about 10 at 20 cm.
- Growers add the cheapest limiting factor, up to where extra yield stops paying.

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.

Five uses of glucose

- Respiration; stored as insoluble starch.
- Cellulose for cell walls; amino acids for proteins (nitrates needed).
- Lipids stored in seeds.

Respiration compared

- Exothermic, continuous, in all living cells.
- Aerobic: glucose + oxygen $\rightarrow$ CO₂ + water, much more energy, mitochondria.
- Anaerobic: muscle $\rightarrow$ lactic acid; yeast $\rightarrow$ ethanol + CO₂ (fermentation).

Exercise and oxygen debt

- Heart rate, breathing rate and breath volume all increase.
- Muscles go anaerobic when oxygen supply falls short; lactic acid builds.
- (HT) the liver converts lactic acid back to glucose — the oxygen debt.

Metabolism

- Metabolism = the sum of all reactions in a cell or body.
- Glucose → starch, glycogen, cellulose; glycerol + fatty acids → lipids.
- Amino acids → proteins (and back to urea); plus respiration and photosynthesis.

Check yourself

- Checklist before you call this topic done.
- Both equations written cold; endothermic vs exothermic said correctly.
- Limiting-factor graphs read; (HT) inverse-square doubling; RP6 with controls.
- Anaerobic equations for muscle and yeast; exercise and metabolism strands.