

B4 Bioenergetics

Biology Paper 1 | AQA Combined Science Trilogy | Learn the core, then try the Higher Tier box

Photosynthesis: carbon dioxide + water → glucose + oxygen

Light energy in

Aerobic respiration: glucose + oxygen → carbon dioxide + water

Energy transferred

Recognise: glucose $C_6H_{12}O_6$ carbon dioxide CO_2 water H_2O oxygen O_2

1 Photosynthesis and glucose

Chloroplasts contain **chlorophyll**, which absorbs light. Photosynthesis is **endothermic**. It needs light; respiration continues day and night.

Five uses of glucose:

- Respiration: transfers energy.
- Starch: insoluble plant storage.
- Fat / oil: storage.
- Cellulose: strengthens cell walls.
- Amino acids → proteins: also need **nitrate ions** from soil.

2 Pondweed practical



Change **lamp distance**; allow the plant to adjust. Measure gas in a fixed time.

Rate = volume ÷ time.

Control temperature, CO_2 and plant size.

Repeat to calculate a mean.

Bubbles vary in size: gas volume is better.

3 Respiration

Aerobic: uses oxygen; mainly in mitochondria. More energy per glucose.

Anaerobic muscles:

glucose → lactic acid

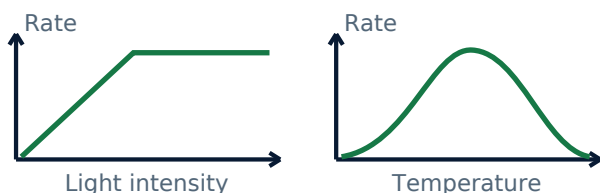
Anaerobic yeast / plants:

glucose → ethanol + carbon dioxide

Both types are **exothermic**. Anaerobic respiration transfers less energy: glucose is not fully oxidised.

Fermentation: CO_2 raises dough; ethanol is used in drinks.

4 Rate of photosynthesis



More light or CO_2 can raise the rate until it levels off. Less chlorophyll absorbs less light.

Temperature: rate rises to an optimum; excessive heat denatures enzymes.

A limiting factor restricts the rate.

5 Exercise and metabolism

Exercise: heart rate, breathing rate and breath volume rise. More oxygen reaches muscles. If supply is insufficient, anaerobic respiration contributes; lactic acid builds up.

Metabolism = all cell/body reactions.

Glucose → starch / glycogen / cellulose.

Amino acids → proteins.

Glycerol + 3 fatty acids → lipid.

Excess amino acids → urea in the liver; kidneys excrete it.

6 Higher Tier only

Compare curves at the **same light**. If extra CO_2 alone raises the rate, CO_2 was limiting.

Intensity $\propto 1 / \text{distance}^2$

Double distance → quarter intensity.

Half distance → four times intensity.

Extra profit = extra income – extra cost.

Oxygen debt: extra oxygen after exercise to deal with accumulated lactic acid.

Lactic acid: muscles → blood → liver, where it is converted to glucose.