

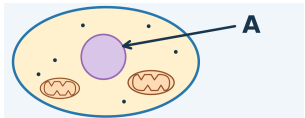
B1 Cell biology

Biology Paper 1 | AQA Combined Science Trilogy | Key ideas to remember

Cells have jobs

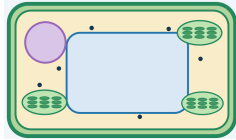
1 Cell parts and their jobs

Animal cell



A = nucleus

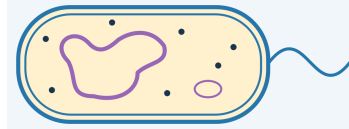
Plant cell



Nucleus: genetic material; controls activities.
Cytoplasm: most chemical reactions.
Membrane: controls what enters/leaves.
Mitochondria: aerobic respiration.
Ribosomes: make proteins.
Plant cells also: cellulose wall for support; chloroplasts for photosynthesis; permanent vacuole containing cell sap.

Use the same units

2 Bacteria and specialised cells



Bacteria: smaller than plant/animal cells; no nucleus. Circular DNA lies in cytoplasm; small DNA rings are **plasmids**. They have a membrane, wall and ribosomes.
Specialised cells: adapted for their job.

- Sperm: tail to swim; many mitochondria.
- Nerve cell: long to carry impulses.
- Muscle: contracts; many mitochondria.
- Root hair: large area for absorption.

Water moves by osmosis

3 Microscopes and magnification

Light microscope practical: thin specimen on slide; add stain and lower coverslip. Start on low power; focus, then increase magnification. Draw clear outlines and label.

Electron microscopes: greater magnification and resolution (finer detail).

Magnification = $\frac{\text{image size}}{\text{real size}}$

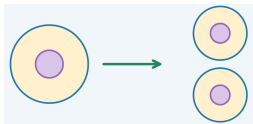
Use the same units first.

1 mm = 1000 μm ; 1 μm = 1000 nm.

Example: image 10 mm, real size 0.02 mm.

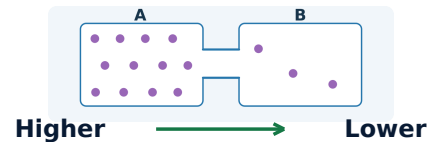
Magnification = $10 / 0.02 = \times 500$.

4 Cell division and stem cells



Cell cycle: cell grows; DNA is copied.
Mitosis: nucleus divides. Cytoplasm and membrane then divide, making **two genetically identical cells** for growth/repair.
Differentiation: becoming specialised.
Stem cells: can differentiate. Found in embryos, adult bone marrow and plant meristems.
Uses: replace damaged cells. Consider risks (such as viruses) and ethical issues.

5 Diffusion, osmosis, active transport



Diffusion: net particle movement from higher to lower concentration; no energy from respiration needed.

Osmosis: net water movement from a dilute to a more concentrated solution through a **partially permeable membrane**.

Active transport: lower to higher concentration; **needs energy** from respiration. Example: mineral ions into roots.

6 Exchange and the osmosis practical

Faster diffusion: larger surface area, higher temperature, steeper concentration gradient.

Exchange surfaces: large area and short diffusion distance. Blood flow/ventilation can maintain the gradient.

Potato practical: equal-sized pieces in a range of sugar/salt concentrations. Keep time and temperature the same. Blot dry before measuring mass; repeat and find means.

% change = $\frac{\text{final mass} - \text{initial mass}}{\text{initial mass}} \times 100$

Mass rises: net water enters. Mass falls: net water leaves.

B2 Organisation

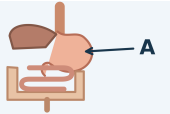
Biology Paper 1 | AQA Combined Science Trilogy | Key ideas to remember

Cells → tissues → organs

1 Organisation and digestion

Cells → tissues → organs → organ systems.

Digestion breaks large insoluble food molecules into small soluble molecules.



A = stomach. Food: mouth → oesophagus → stomach → small intestine → large intestine → anus.

Small intestine: absorbs digested food.

Large intestine: absorbs water.

Bile: made in liver, stored in gall bladder; neutralises stomach acid and emulsifies fats.

Enzymes speed reactions

2 Enzymes and digestion

Enzymes are biological catalysts.

A substrate fits the enzyme's active site.

Enzyme	Breaks down	Products
Amylase	Starch	Sugars
Protease	Protein	Amino acids
Lipase	Lipids	Fatty acids + glycerol

Temperature: rate rises to an optimum. Too hot → active site changes (**denatured**).

pH: each enzyme has an optimum.

Bile is **not an enzyme**. It increases the fat surface area for lipase.

Blood and plants transport

3 Required practicals: food and enzymes

Test	Positive result
Starch: iodine	Blue-black
Reducing sugar: Benedict's + heat	Green, yellow, orange or brick-red precipitate
Protein: Biuret	Lilac/purple
Lipid: Sudan III	Red-stained oil layer

Amylase and pH: use buffers; mix amylase with starch. Test samples with iodine at regular intervals. Time until iodine stays brown (no starch left). Keep temperature and concentrations the same; repeat. **Rate** $\propto$ **1/time**.

4 Heart, blood and vessels



Right ventricle → lungs. Left ventricle → body; thicker muscle. Valves stop backflow.

Arteries: away from heart; thick walls.

Veins: towards heart; valves.

Capillaries: very thin walls for exchange.

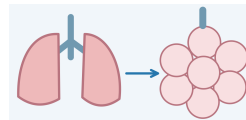
Red cells: haemoglobin carries oxygen.

White cells: defend against pathogens.

Platelets: help blood clot.

Plasma: liquid carrying cells and dissolved substances, e.g. glucose, CO₂ and urea.

5 Lungs, health and disease



Alveoli: large area, thin moist walls, good blood supply. Oxygen diffuses into blood; carbon dioxide diffuses out.

Coronary heart disease: fatty deposits narrow coronary arteries, reducing oxygen to heart muscle. Stents hold arteries open; statins lower cholesterol.

Cancer: uncontrolled cell division. Malignant tumours invade/spread.

Risk factors: smoking, diet, alcohol.

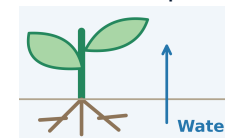
Correlation alone does not prove causation.

6 Leaves and plant transport

Palisade cells: many chloroplasts.

Spongy mesophyll: air spaces for diffusion.

Stomata: pores; guard cells control opening.



Xylem: water + mineral ions upwards from roots.

Phloem: dissolved sugars to where needed (translocation).

Transpiration: water vapour lost from leaves. Faster with more light, higher temperature, more air movement or lower humidity.

Potometer: measures water uptake, an estimate of transpiration rate.

B3 Infection and response

Biology Paper 1 | AQA Combined Science Trilogy | Core knowledge for both tiers

Pathogen: a disease-causing microorganism. Bacteria may release **toxins**; viruses reproduce **inside living cells**.

Disease / cause	Main signs or effects	How it spreads	Control to remember
Measles Virus	Fever and red rash; complications can be serious.	Inhaled droplets from coughs or sneezes.	Vaccination; reduce contact while infectious.
HIV Virus	Early flu-like illness; immune damage can lead to AIDS.	Sexual contact / infected body fluids, e.g. shared needles.	Condoms; do not share needles. Antiretroviral drugs control HIV.
TMV Virus	Mottled leaves; less photosynthesis and growth.	Contact with infected material, hands or tools.	Clean tools; remove infected plants.
Salmonella Bacterium	Fever, cramps, vomiting and diarrhoea.	Bacteria swallowed in contaminated food.	Food hygiene; thorough cooking; vaccinate poultry.
Gonorrhoea Bacterium	Pain when urinating; yellow/green discharge.	Sexual contact.	Condoms; suitable antibiotics. Resistant strains are harder to treat.
Rose black spot Fungus	Dark spots; yellow leaves fall. Less photosynthesis.	Spores carried by wind or water.	Fungicides; remove and destroy affected leaves.
Malaria Protist	Repeated bouts of fever; can be fatal.	Infected mosquito bites. The mosquito is the vector.	Mosquito nets; reduce mosquito breeding.

1 Defend the body

Skin / clots: block entry.
Nose hairs + mucus: trap particles.
Cilia: move mucus to the throat.
Stomach acid: kills many pathogens.

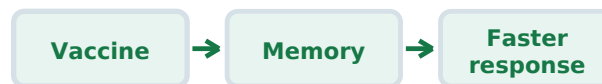


→ **White blood cells**

Phagocytosis: engulf and digest.
Antibodies: bind specific antigens.
Antitoxins: neutralise toxins.

2 Vaccination and medicines

Vaccine antigens trigger antibodies and immune memory. Next time: correct antibodies are made faster. Many immune people reduce transmission.



Antibiotics: bacteria, not viruses.
Painkillers: symptoms, not pathogens.
Resistance: susceptible bacteria die; resistant survivors reproduce.

3 Discover and test drugs

Willow → aspirin
Foxglove → digitalis
Penicillium → penicillin (Fleming)
Preclinical: cells, tissues, animals.
Clinical: volunteers and patients; start with very low doses.
Check **toxicity, efficacy and dose**.
Placebo: no active drug.
Double-blind: participants and assessors do not know allocation.
Peer review: other scientists check.

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

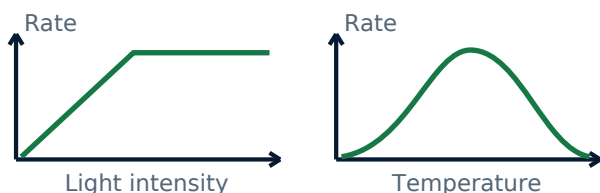
Anaerobic yeast / plants:

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.