

Enzymes and metabolism Why do cells need enzymes?	Enzymes and metabolism Why do organisms need many different enzymes?
Enzymes and metabolism Anabolism vs catabolism	Enzymes and metabolism Why is the whole enzyme structure needed for the active site to work?
Enzymes and metabolism Induced fit	Enzymes and metabolism Why is molecular motion needed for catalysis?
Enzymes and metabolism Denaturation	Enzymes and metabolism Why does rate rise with temperature below the optimum?

Enzymes are specific, so each reaction in the network of metabolism needs its own enzyme; controlling enzymes controls metabolism.

Enzymes are catalysts that speed up reactions so they happen fast enough at body temperature, without being used up.

The active site is only a few amino acids, held in the right positions by interactions throughout the 3D structure.

Anabolism: building macromolecules by condensation (protein synthesis, glycogen, photosynthesis). Catabolism: hydrolysis in digestion, oxidation in respiration.

Substrate and active site must collide. Sometimes large substrates or membrane-embedded enzymes are immobilised, so only the other moves.

Both substrate and enzyme change shape when the substrate binds to the active site.

More kinetic energy, so more frequent substrate-active site collisions, and more with enough energy to react.

A change to the 3D structure of an enzyme (high temperature or extreme pH) so the active site no longer binds the substrate.

Enzymes and metabolism

Why does rate level off at high substrate concentration?

Enzymes and metabolism

How do you find the initial rate from a curve?

Enzymes and metabolism

Activation energy

Cell respiration

Structure of ATP

Cell respiration

Properties that suit ATP as energy currency

Cell respiration

Three uses of ATP in cells

Cell respiration

ATP ↔ ADP energy transfers

Cell respiration

Cell respiration

Draw a tangent at time zero and calculate its gradient (change in product $\div$ time).

All active sites are occupied; enzyme concentration becomes limiting.

A nucleotide: adenine, ribose and three phosphate groups. Full name: adenosine triphosphate.

Energy needed to break bonds in the substrate to start a reaction. Enzymes lower it; the overall energy change is unchanged.

Active transport, synthesis of macromolecules (anabolism), movement of cells or chromosomes.

Soluble, stable without enzymes, cannot cross membranes freely, releases a useful amount of energy, rapidly regenerated.

A system for producing ATP within the cell using energy released from carbon compounds, mainly glucose and fatty acids.

Hydrolysis of ATP to ADP + phosphate releases energy; making ATP from ADP + phosphate requires energy.

Cell respiration

Word equations for respiration in humans

Cell respiration

Where do aerobic and anaerobic respiration happen?

Cell respiration

How does a respirometer measure respiration rate?

Cell respiration

Variables affecting respiration rate

Photosynthesis

What energy transformation happens in photosynthesis?

Photosynthesis

Word equation for photosynthesis

Photosynthesis

Where does the hydrogen in glucose come from?

Photosynthesis

Oxygen in photosynthesis

Anaerobic: cytoplasm only. Aerobic: starts in the cytoplasm, then mitochondria (which are required).

Aerobic: glucose + oxygen $\rightarrow$ carbon dioxide + water. Anaerobic: glucose $\rightarrow$ lactate.

Temperature, oxygen concentration, substrate availability, type and activity of organism.

Alkali absorbs CO_2 , so oxygen uptake moves a liquid drop; distance $\times$ tube area $\div$ time $\div$ mass gives rate.

carbon dioxide + water $\rightarrow$ glucose + oxygen

Light energy is transformed to chemical energy in carbon compounds, supplying most energy for ecosystems.

A by-product from the splitting of water, released by plants, algae and cyanobacteria.

From splitting water molecules, using light energy.

Photosynthesis

Rf value

Photosynthesis

Colours of photosynthetic pigments on a chromatogram

Photosynthesis

What happens when a pigment absorbs light?

Photosynthesis

Absorption spectrum vs action spectrum

Photosynthesis

How can light intensity, CO₂ and temperature be varied?

Photosynthesis

Limiting factor

Photosynthesis

FACE vs greenhouse CO₂ enrichment

Carotene orange-yellow, xanthophyll yellow, chlorophyll a blue-green, chlorophyll b yellow-green.

Distance moved by pigment $\div$ distance moved by solvent front. No units; between 0 and 1.

Absorption: % light absorbed at each wavelength. Action: rate of photosynthesis at each wavelength. Both peak in blue and red.

An electron in the pigment molecule is excited to a higher energy level; only wavelengths matching the energy gap are absorbed.

The factor furthest from its optimum, which limits the rate of photosynthesis.

Light: lamp distance or filters. CO₂: sodium hydrogencarbonate concentrations.
Temperature: water baths.

FACE: CO₂ released over field plots, realistic but less controlled. Greenhouse: enclosed, controlled but less natural.