

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.

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Why does rate level off at high substrate concentration?

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How do you find the initial rate from a curve?

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Activation energy

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Intracellular vs extracellular enzyme reactions: examples

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Why do metabolic reactions always release heat?

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Linear vs cyclical pathways: examples

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Non-competitive inhibition

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Competitive inhibition (example)

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

All active sites are occupied; enzyme concentration becomes limiting.

Intracellular: glycolysis (cytoplasm), Krebs cycle (matrix). Extracellular: chemical digestion in the gut.

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

Linear: glycolysis. Cyclical (starting molecule regenerated): Krebs cycle (oxaloacetate) and Calvin cycle (RuBP).

They are not 100% efficient in energy transfer. Mammals and birds use this heat to keep a constant body temperature.

Inhibitor resembling the substrate binds reversibly to the active site; overcome by high substrate. Example: statins.

Inhibitor binds reversibly to an allosteric site, causing a conformational change that alters the active site; extra substrate does not help.

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What do statins inhibit?

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Feedback inhibition (example)

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**Mechanism-based inhibition
(example)**

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**How are some bacteria resistant to
penicillin?**

End product inhibits an early enzyme at its allosteric site. Isoleucine inhibits threonine deaminase.

An enzyme in the liver (HMG-CoA reductase) in the pathway that synthesises cholesterol.

They have a changed transpeptidase whose active site penicillin cannot bind, but which still cross-links the cell wall.

Irreversible binding that chemically changes the active site. Penicillin inactivates bacterial transpeptidases.