

Enzymes

IGCSE Biology 0610 · Topic 5 revision notes

Everything from the 2 lessons of this topic on a few pages: the key idea of each lesson, the diagram to remember, the points to learn and the traps examiners set. Read it, cover it, test yourself.

1. Enzymes as biological catalysts

2. Temperature, pH and enzyme activity

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1 Enzymes as biological catalysts

Syllabus 5.1

A **catalyst** is a substance that increases the rate of a chemical reaction and is not changed by the reaction. **Enzymes** are proteins that are involved in all metabolic reactions, where they act as **biological catalysts**. Each enzyme has an **active site** whose shape is complementary to its substrate; the substrate fits, reacts and leaves as products, and the enzyme is free to be used again.

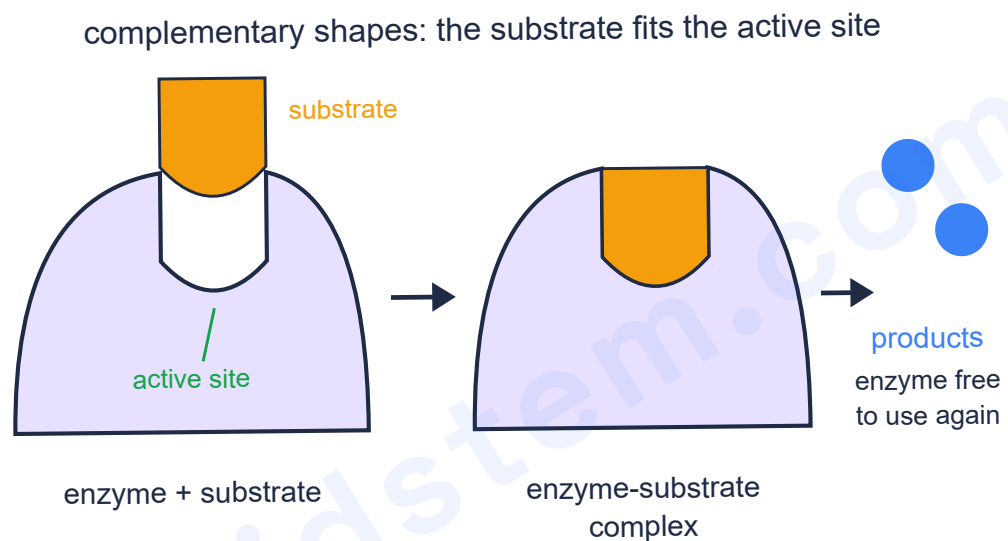


Fig. 1: the substrate fits the complementary active site, an enzyme-substrate complex forms, then the products leave and the unchanged enzyme can work again

Fit, react, release.

- ✓ **Catalyst:** increases the rate of a reaction and is not changed by the reaction.
- ✓ **Enzyme:** a protein that acts as a biological catalyst in all metabolic reactions.
- ✓ **Active site:** shape complementary to the substrate; say *complementary*, not *the same*.
- ✓ **Extended:** $\text{substrate} + \text{enzyme} \rightarrow \text{enzyme-substrate complex} \rightarrow \text{products} + \text{unchanged enzyme}$.

Watch out!

An enzyme is not used up and is not a reactant. Do not write that the enzyme "is broken down" or "becomes the product": it leaves the reaction unchanged and catalyses the next one.

The active site is complementary to the substrate, not "the same shape" as it. Say *complementary*: the two shapes fit together like a key in a lock.

2 Temperature, pH and enzyme activity

Syllabus 5.1

Enzyme activity rises with temperature up to an **optimum temperature**, then falls quickly as the enzyme is **denatured**: the shape of its active site changes, so the substrate no longer fits. Each enzyme also has an **optimum pH**; on either side of it activity falls, and far from it the enzyme is denatured. Denaturation is permanent.

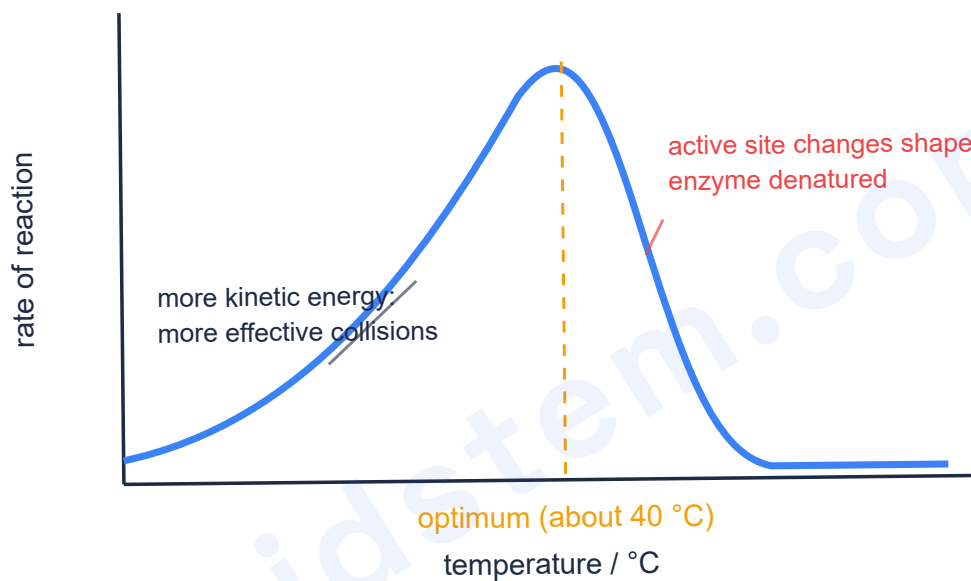


Fig. 1: the rate rises to a peak at the optimum temperature, then falls steeply as the enzyme is denatured

Rise, peak, crash.

- ✓ **Below the optimum (Extended):** more kinetic energy, more frequent effective collisions, more enzyme-substrate complexes.
- ✓ **Above the optimum:** active site changes shape, substrate no longer fits, enzyme denatured; permanent.
- ✓ **pH:** each enzyme has its own optimum; on either side, shape and fit get worse; far away, denatured.
- ✓ **Rate** = $1 \div \text{time taken}$. Low temperature slows an enzyme but does not denature it.

Watch out!

Low temperature does not denature an enzyme. At 10 °C the molecules simply move slowly and collide less often; warm it up and it works again. Only high temperatures (and extreme pH) denature. Also avoid saying the enzyme is "killed": enzymes are molecules, not living things.

The optimum pH is not always 7. Pepsin works best in acid and is denatured at pH 7. Read the optimum off the graph for the enzyme in the question.