Your notes

GCSE Biology: revision notes

Enzymes

Contents

1. Start here: what an enzyme does
2. Levels of organisation
3. What enzymes are
4. The lock and key model
5. Temperature and pH
6. Required practical: the effect of pH on amylase
7. Exam tip
8. Common mistakes
9. Worked examples
10. Key terms
11. Quick questions
12. What to do next

Start here: what an enzyme does

- Your body needs reactions to happen fast, like breaking down food, at only 37 °C. **Enzymes** make that possible.
- An **enzyme** is a biological **catalyst**: a protein that speeds up a reaction without being used up.
- Each **enzyme** only works on one substance, its **substrate**, because the **substrate** has to fit the enzyme's active site, like a key in a lock.

Levels of organisation

- Cells are the basic building blocks of living things.
- A **tissue** is a group of cells with a similar structure and function, such as muscle **tissue**.
- An **organ** is a group of **tissues** working together to do a specific job, such as the stomach.
- An **organ system** is a group of **organs** working together, such as the digestive system.

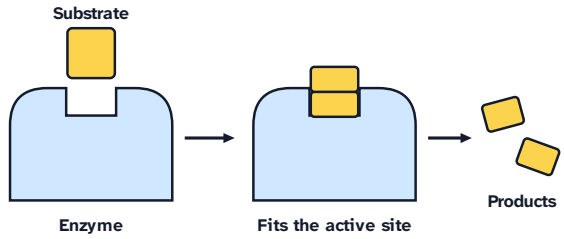
What enzymes are

- **Enzymes** are biological **catalysts**: they speed up reactions in living things without being used up.
- **Enzymes** are large proteins made of chains of amino acids folded into a particular shape.

- Each **enzyme** has an **active site** with a unique shape that fits only one **substrate**, so enzymes are specific.

The lock and key model

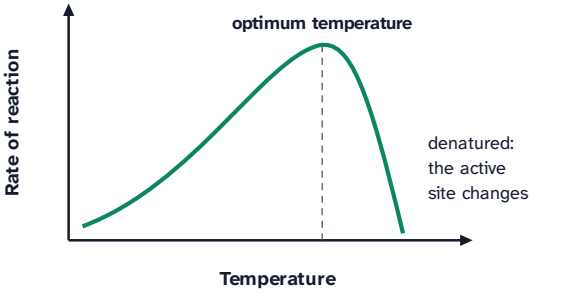
- The **substrate** fits into the **active site** like a key into a lock, forming an **enzyme**–substrate complex.
- The reaction happens and the products are released, leaving the **enzyme** free to catalyse another reaction.
- If the shape of the **active site** changes, the **substrate** no longer fits and the **enzyme** stops working.



The enzyme is unchanged and can be used again

Temperature and pH

- Rate of reaction increases with temperature up to the **optimum**, because particles collide more often and with more energy.
- Above the **optimum**, bonds holding the **enzyme**'s shape break, the **active site** changes shape and the enzyme is denatured.
- Each **enzyme** has an **optimum** pH. Pepsin in the stomach works best at about pH 2; amylase works best at about pH 7.
- A pH far from the **optimum** also changes the shape of the **active site** and denatures the **enzyme**.



Required practical: the effect of pH on amylase

- Put a drop of iodine solution in each well of a spotting tile; iodine turns blue-black when starch is present.
- Mix amylase, starch solution and a pH **buffer** in a water bath at a set temperature, and start a stopwatch.

Your notes

- Every 10 seconds, add a drop of the mixture to a fresh well of iodine. When the iodine stays orange-brown, all the starch has been broken down.
- Repeat with **buffers** of different pH. Keep the temperature, volumes and concentrations the same.
- Rate of reaction can be worked out as 1000 ÷ time (in seconds), or as change ÷ time.

Your notes

Exam tip

- Above the **optimum** temperature, say the **active site** changes shape, so the **substrate** no longer fits. That chain of ideas gets the marks.
- On a rate graph, describe the shape first, with numbers. Then explain it.

Common mistakes

- Saying **enzymes** are 'killed'. They aren't alive: they're **denatured**.
- Saying the **enzyme** and **substrate** are the same shape. They're complementary.
- Saying cold denatures **enzymes**. It only slows them down.

Worked examples

In the amylase practical, all the starch is broken down after 40 seconds at pH 6. Calculate the rate of reaction.

For this practical, rate = 1000 ÷ time (in seconds). **1000 ÷ 40**

Answer: 25 s^{-1} (a shorter time means a faster rate)

Key terms

Enzyme	A protein that acts as a biological catalyst, speeding up reactions without being used up.
Catalyst	A substance that speeds up a reaction without being changed by it.
Active site	The part of an enzyme where the substrate binds; its shape matches the substrate.
Substrate	The molecule an enzyme acts on.
Lock and key model	The idea that the substrate fits the active site of an enzyme like a key fits a lock.
Denatured	When an enzyme's active site changes shape so it no longer works.
Optimum	The temperature or pH at which an enzyme works fastest.
Tissue	A group of cells with a similar structure and function.
Organ	A group of different tissues working together to do a job.

Organ system	A group of organs working together to do a job.
Buffer	A solution that keeps the pH constant.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What are enzymes?
2. What type of molecule is an enzyme?
3. Why does each enzyme only work on one substrate?
4. What happens to an enzyme at a very high temperature?
5. What is the optimum pH of pepsin, the stomach protease?
6. In the amylase practical, what does iodine show?
7. What colour is iodine when there is no starch?
8. Why is a water bath used in the amylase practical?

Answers

1. Biological catalysts
2. Protein
3. The active site only fits one substrate shape
4. It is denatured
5. About pH 2
6. Whether starch is still present
7. Orange-brown
8. To keep the temperature constant

What to do next

Practise 12 questions on this topic

Try 6 exam questions, with mark schemes

Read the lesson, one step at a time

Free revision for GCSE and KS3 at lycolearn.co.uk. Some notes are for one exam board only, and say so in brackets.

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