

What an enzyme does

60 minutes • 3.1.A • Chapters 1, 2

Specificity from shape and charge, and lowering the activation energy, with a clay model and a gas demo

BY THE END, STUDENTS CAN

- ☐ Explain how the shape and charge of an active site make an enzyme specific to its substrate 3.1.A
- ☐ Explain how an enzyme speeds up a reaction by lowering its activation energy, and why it leaves ΔG unchanged 3.1.A

TIMING

0-5	5 min	Do now: sugar in a bowl	
5-15	10 min	The active site	
15-30	15 min	Modeling clay enzymes	
30-42	12 min	Activation energy	
42-54	12 min	Demo: catch the oxygen	
54-60	6 min	Exit	
	60 min	One lesson	

STARTER

5 min Do now: sugar in a bowl

A spoonful of sugar can sit in a bowl for a year, burns in a flame in seconds, and your cells use it in minutes. Pairs write what each case needs. Keep the answers for the end of the lesson.

ON THE BOARD, FROM THE GUIDE

Open the guide on the projector at each chapter (the links work in this PDF). Every figure plays from its own buttons, and the lesson's slides have the same figures, step by step, in the order of this plan.

01 The active site fits one substrate

CHAPTER 01 IN THE SLIDES

Switch the figure through Substrate, Look-alike and Wrong shape, and have the class say what will change before each.

Predict box: A molecule has exactly the substrate's shape, but its two charges are the other way round. What happens at the active site? Hands up or mini whiteboards first.

Answer C: It is pushed away, because like charges repel

02 Enzymes lower the activation energy

CHAPTER 02 IN THE SLIDES

Step through the figure (5 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. The reactant must pass over a **hump** before it can become products. Here the products end up lower: this reaction releases energy.
2. At the top of the hump the bond is stretched and about to break. Getting there takes the **activation energy**, and at 37 °C few collisions have that much.
3. With the enzyme the route is **lower**: the active site holds the substrate in place and strains its bond, so less energy is needed.
4. The start and the finish have not moved, so **ΔG is the same** with or without the enzyme. The enzyme changes the route, never the destination.
5. A lower peak means **many more** molecules have enough energy to cross it each second, so the reaction runs far faster.

Predict box: An enzyme is added to a reaction with $\Delta G = -20$ kJ/mol. What is ΔG now? Hands up or mini whiteboards first.

Answer B: -20 kJ/mol: the enzyme does not change it

THE LESSON

10 min The active site

Chapter 1's figure on the board. Offer the enzyme each molecule and have students say, before you click, whether it binds and why. Draw out the double check: shape and charge. Name the parts with the tap labels.

15 min Modeling clay enzymes

Pairs build an enzyme and its substrate, first as a rigid lock and key, then remodeled to show induced fit (activity below). Ask which model explains the evidence that the site changes shape as the substrate binds.

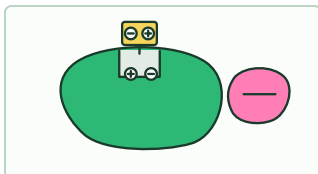
12 min Activation energy

Play chapter 2's figure a step at a time. Students sketch it, labeling the activation energy with and without the enzyme and ΔG . Push on the predict box: what does the enzyme not change?

12 min Demo: catch the oxygen

Catalase and hydrogen peroxide, the gas collected two ways (activity below). Students list every way the first method loses gas, then judge which method they would trust for the circus next lesson.

ACTIVITIES

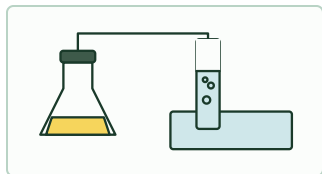


MODEL

Modeling clay enzymes

Pairs shape an enzyme with a pocket and a substrate to fit it, then add a + and a - sticker to each so the charges line up. First the site is rigid (lock and key). Then they rebuild it with soft walls that close around the substrate (induced fit). Last, one partner makes a look-alike with the stickers swapped, and the other explains why it is not held.

Needs: modeling clay in two colors per pair, small + and - stickers, [chapter 1's](#) figure on the board.



DEMO

Catch the oxygen

Add yeast suspension to 3% hydrogen peroxide in a flask, bung it, and collect the gas over water in an upturned measuring cylinder. Repeat with a gas syringe. Students list what the first method misses: gas lost before the bung goes in, bubbles that stick in the tube, oxygen dissolving, a meniscus that is hard to read.

Needs: 3% hydrogen peroxide, yeast suspension (or potato or liver), conical flask with bung and delivery tube, measuring cylinder and trough of water, 100 cm³ gas syringe, stopwatch, eye protection.

PLENARY

6

min

Exit

Chapter 1's predict box on paper before you reveal it (a molecule with the substrate's shape but its charges the other way round), then back to the sugar: the flame supplies activation energy, the cell supplies an enzyme.

WHAT STUDENTS GET WRONG

"An enzyme makes a reaction happen that otherwise would not." It only lowers the activation energy; ΔG and the end point are unchanged, and an uphill reaction still needs coupling.

"The substrate is the same shape as the active site." Complementary, not the same, and charge matters as much as shape.

"Exergonic means fast." Sugar in the bowl is exergonic and lasts a year: activation energy decides speed.

STRETCH AND SUPPORT

Support: a printed, pre-drawn energy diagram to annotate during chapter 2, and the free-response table with the rows to compare already highlighted.

IN THE GUIDE

- 1 The active site fits one substrate
- 2 Enzymes lower the activation energy
- All The whole guide, with the figures that play
- PPTX This lesson's slides, in the order of this plan

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on Unit 3, built from its key terms and ready to print
- A pub quiz with rounds on Unit 3, to present or run with no projector
- The Kelp Light Habitat escape room, or an escape room built from the question bank on Unit 3

ALREADY ON THE SITE FOR UNIT 3

- Lesson: Enzymes
- Lesson: Environmental Impacts on Enzyme Function
- Lesson: Cellular Energy
- Quiz: Enzymes
- Quiz: Environmental Impacts on Enzyme Function
- Quiz: Cellular Energy
- Exam questions: Unit 3 in the exam maker, a paper with scoring guidelines

CARD SETS ON SPLYCR

Open a set to host it as a class game, or make a copy to edit.

- Unit 3: Cellular Energetics (part 1)
- Unit 3: Cellular Energetics (part 2)
- Unit 3: Cellular Energetics (part 3)

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on 3.1 to 3.3 each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?program=ap&units=U3&ced=3.1,3.2,3.3&paper=quiz&marks=15&src=ep



How this was made. The course structure, the activities and the teaching choices come from my own classroom, my presentations and my years of teaching IB and AP Biology. I use Claude, an AI, to help write and build the interactive guides, lesson plans, slides and practice questions, and to draw the diagrams and code the interactives. I direct the work and review it against the IB and AP specifications before it goes live.