

Fit, collisions and shape

60 minutes • C1.1.4 to C1.1.8 • Chapters 4, 5, 6, 7

The active site and induced fit, collisions, specificity and denaturation, and the three graphs

BY THE END, STUDENTS CAN

- ☐ Explain how a few amino acids, held in place by the whole folded protein, make an active site, and how induced fit works C1.1.4, C1.1.5
- ☐ Explain why substrate and active site must collide, and how enzymes fixed in membranes still meet their substrates C1.1.6
- ☐ Explain how the shape of the active site makes an enzyme specific, and why denaturation stops it working C1.1.7
- ☐ Sketch and explain the effects of temperature, pH and substrate concentration on the rate, using collision theory and denaturation C1.1.8

TIMING

0-5	5 min	Do now: what is wrong with this?	
5-17	12 min	Lock and key, then induced fit	
17-23	6 min	Who moves?	
23-31	8 min	Fit, or no fit	
31-45	14 min	Sketch, then check	
45-55	10 min	Timed written question	
55-60	5 min	Exit	
	60 min	One lesson	

STARTER

5 min Do now: what is wrong with this?

"The enzyme was killed by the heat, and it died in the fridge too." Students write two corrections each, then compare. Keep the corrections 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.

04 A pocket held in shape

CHAPTER 04 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.

- Only a few amino acids will form the site, far apart in the chain.
- Folding brings them together: the **active site**.
- The substrate binds: an **enzyme-substrate complex**.
- Both change shape: **induced fit** strains the substrate's bonds.
- Products leave; the enzyme is unchanged.

Predict box: An enzyme has 300 amino acids, and only about six touch the substrate. A mutation changes one amino acid far from the active site, and the enzyme stops working. How? Hands up or mini whiteboards first.

Answer B: It changed how the chain folds, so the site lost its shape

Remember it: Bind Bend Break Bye (Binding, Induced fit, Reaction, Release).

05 Meeting by chance

CHAPTER 05 IN THE SLIDES

Switch the figure through In solution, Enzyme fixed in a membrane and Substrate held still, and have the class say what will change before each.

Predict box: Lactase sits fixed in the membrane of cells lining your small intestine. It cannot move. How does lactose reach its active site? Hands up or mini whiteboards first.

Answer D: Lactose molecules move at random and collide with it

06 Lose the shape, lose the fit

CHAPTER 06 IN THE SLIDES

Switch the figure through Its substrate, A different molecule, Too hot and Wrong pH, and have the class say what will change before each.

Predict box: Pepsin digests protein in the stomach at about pH 2. Carried on into the small intestine at about pH 8, what happens to it? Hands up or mini whiteboards first.

Answer A: It denatures: its active site changes shape and charge

07 Three graphs to know

CHAPTER 07 IN THE SLIDES

Step through the figure (4 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. Temperature: faster collisions, then **denaturation**.
2. pH: each enzyme has its own **optimum**.
3. Substrate: the rate rises, then **levels off**.
4. More enzyme raises the maximum.

Play the animation, Watch it happen: collisions, substrate and heat. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. Molecules move at **random**, and most collisions miss the active site.
2. A **successful collision**: it binds and reacts, and the enzyme is unchanged.
3. Too hot: enzymes **denature**. Active sites lose their shape, and the rate falls.

Predict box: On a graph of rate against substrate concentration, the curve levels off. Why? Hands up or mini whiteboards first.

Answer C: Nearly every active site is already busy

Remember it: Tigers Prefer Steak (Temperature, pH, Substrate concentration).

THE LESSON

12
min

Lock and key, then induced fit

The plasticine models below, then [chapter 4's](#) figure and predict. Students first make a rigid site and a key, then a soft site that closes and pinches the substrate. Finish with the Bind, Bend, Break, Bye tiles.

6
min

Who moves?

[Chapter 5](#): the lactase predict first, then the three states of the figure. Students say who moves in each state before the readout appears.

8
min

Fit, or no fit

[Chapter 6's](#) states, then the pepsin predict. Link back to what students saw in B1.2 when a protein unfolded, and name the two causes: heat and pH.

14

min

Sketch, then check

Chapter 7: students sketch all three graphs before the figure plays (Sketch, then check, below) and mark their own sketches against it. Take the plateau predict on whiteboards with a one-sentence reason. Then the collisions film, which sits after chapter 7: students call out what will happen before each slider move. Tigers Prefer Steak. Set Make a gif for homework.

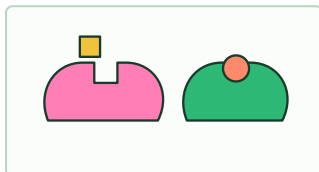
10

min

Timed written question

A written question on the effect of temperature or pH from the C1.1 exam maker, timed at 7 minutes, peer-marked against the markscheme.

ACTIVITIES

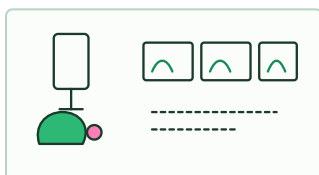


MODEL

Lock and key, then induced fit

Pairs make an enzyme and its substrate twice from plasticine. The first time, a rigid notch and a key that slots in. The second time, a soft site that closes round the substrate and pinches it at the bond to break. A photo of each for notes, and one sentence each on what the second model explains that the first does not. Keep the enzyme: an allosteric site is added to it in lesson 4.

Needs: plasticine in two colours, a plastic knife, phones for photos.

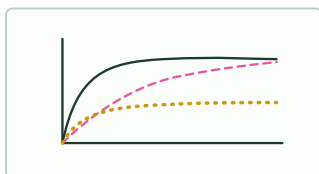


ANIMATION

Make a gif

Homework, from chapter 7. Pairs make a 10 to 20 second stop-motion or gif of one factor: temperature, pH or substrate concentration. It shows enzymes and substrate interacting, how the factor changes the collisions, the shape or the saturation, and ends with the sketch graph. A good one has short sentences with the key words, sums up the point at the end, leaves time to read each frame and looks clear. Plasticine, paper cut-outs or doodles, and any free gif or stop-motion app.

Needs: phones, plasticine or paper.



DRAWING

Sketch, then check

Lesson 2: students sketch the three graphs of chapter 7 from memory, then play the figure and correct their sketches in another colour.

Lesson 5: on one set of axes, draw rate against substrate concentration with no inhibitor, then a line for something competing for the active site, then one for something changing the active site's shape. Check against chapter 12's graph.

Needs: mini whiteboards, two colours of pen.

PLENARY

5

min

Exit

One sentence each: why the rate rises as an enzyme warms towards its optimum, and why it falls beyond it.

WHAT STUDENTS GET WRONG

The active site is the whole enzyme, rigid like a lock. It is a few amino acids, and they move (induced fit).

Enzymes are alive and are killed by heat; cold denatures them. They denature with heat; cold only slows them.

The optimum is always 37 °C. It depends on the enzyme.

The rate levels off because the substrate runs out. The active sites are busy: saturation.

Higher temperature always means faster. Only up to the optimum.

STRETCH AND SUPPORT

Support: the figures' captions as cut-up cards to put in order; the dotted key terms as a glossary; a writing frame for "explain the effect of temperature" (rise, optimum, fall, each with its reason).

Support: the Tigers Prefer Steak and Bind, Bend, Break, Bye tiles as starters.

Stretch: the DNA polymerase used in PCR comes from a bacterium of hot springs (D1.1). Predict its temperature curve, and say what about its structure might keep it folded.

IN THE GUIDE

- 4 [A pocket held in shape](#)
- 5 [Meeting by chance](#)
- 6 [Lose the shape, lose the fit](#)
- 7 [Three graphs to know](#)
- A11 [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 C1.1, built from its key terms and ready to print
- A [pub quiz](#) with rounds on C1.1, to present or run with no projector
- An [escape room](#) built from the [question bank](#) on C1.1

ALREADY ON THE SITE FOR C1.1

- Lesson: [Enzymes & Metabolism HL \(HL\)](#)
- Lab: [The Enzyme in Your Spit](#)
- Summary doodle: [Enzymes & Metabolism](#)
- Quiz: [Enzymes](#)
- Quiz: [Enzymes & Metabolism \(HL\)](#)
- Revision map: [C1.1 Enzymes and metabolism](#), to fill in
- Exam questions: [C1.1 in the exam maker](#), a paper with its markscheme

CARD SETS ON SPLYCR

- Open a set to host it as a class game, or make a copy to edit.
- [C1.1 Enzymes and Metabolism](#)

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on C1.1 at standard level each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=C1.1&level=SL&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.