

Diet, variety and denaturation

60 minutes • B1.2.3 to B1.2.5 • Chapters 3, 4, 5

Essential amino acids in the diet, and how heat and pH denature a protein

BY THE END, STUDENTS CAN

- ☐ Explain why some amino acids must come from food, and what that means for a vegan diet B1.2.3
- ☐ Explain why the number of possible polypeptides is practically endless B1.2.4
- ☐ Explain how heat and pH denature a protein, and why it then stops working B1.2.5

TIMING

0–5	5 min	Do now: agree or disagree	
5–15	10 min	The amino acid shelf	
15–30	15 min	Protein doodles	
30–45	15 min	Heat and acid	
45–55	10 min	A written question	
55–60	5 min	Exit and homework	
	60 min	One lesson	

STARTER

- 5 min** **Do now: agree or disagree**
- “Essential amino acids are more important than non-essential ones.” Students write one sentence to say why. Do not correct yet.

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.

03 Some amino acids you must eat

CHAPTER 03 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.

- Twenty jars feed the line, and the chain grows in **one order**, set by the gene.
- Eleven jars are filled by a pipe from the cells: **non-essential** amino acids, which your cells can make from other amino acids.
- Nine jars are filled only from the plate: **essential** amino acids, which must come from food.
- A varied plant plate: grain runs a little low in one jar and pulses in a different one, and together they fill every jar. A **vegan** diet covers all nine with **variety**.
- A day of rice only: one jar runs low.

Predict box: You eat plenty of protein, but it lacks one essential amino acid. What happens to the proteins that need it? Hands up or mini whiteboards first.

Answer A: They cannot be completed, because no other amino acid can take its place in the sequence

04 Twenty amino acids, endless chains

CHAPTER 04 IN THE SLIDES

Switch the figure through 2, 10, 51, 62, 100 and 146, and have the class say what will change before each.

Step through the figure (2 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. Type **ROSALIND FRANKLIN**: each letter is the code for one amino acid (the O is skipped: no amino acid has that letter). Its 15 amino acids are joined by 14 peptide bonds: one of 20^{15} (about 3×10^{19}) possible chains this long. A ribosome makes the chain one amino acid at a time, and it starts to fold as it comes out.
2. It folds into a shape of its own, held by **weak bonds** between its side chains.

Predict box: How many different dipeptides can be made from the 20 amino acids? Hands up or mini whiteboards first.

Answer D: 400, because there are twenty choices at each of the two positions

05 Heat and pH unfold a protein

CHAPTER 05 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. Raw egg white: clear and runny. Magnified, the proteins are **folded**, each on its own among the water molecules.
2. **Heat** makes the molecules jiggle harder and breaks the bonds that hold the folds.
3. The chains **unfold**: with the bonds gone, their shape is gone.
4. Unfolded chains **tangle** together and the egg white sets, white and solid. The proteins are **denatured**.

Play the animation, Heat it, change the pH. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

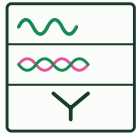
1. A new chain of amino acids among water molecules: as yet it has **no shape**.
2. A small molecule **fits** its pocket: one precise shape, one job.
3. Cooled again, it does not refold: the unfolded chains **tangle** together instead.

Predict box: When an egg sets in a hot pan, which bonds break? Hands up or mini whiteboards first.

Answer C: The weak bonds that hold the fold, while the peptide bonds stay intact

THE LESSON

10 min	The amino acid shelf Chapter 3's figure. Pairs then plan a day of vegan meals that covers all nine essential amino acids, without naming any. Rice and lentils, or hummus and bread, make a good start.
15 min	Protein doodles Students pick three proteins and make two drawings each: how does its shape suit its job? (activity below). Use chapter 4's examples as the fact cards.
15 min	Heat and acid The egg white demonstration (optional, below), or chapter 5's figure. Then the folding scene under it, Heat it, change the pH: let the film run once, then take the temperature past 65 °C and back to 37 °C (the chain stays unfolded and tangles), press Fresh protein and move the pH to 1.5 and to 12.5. Then the predict box: which bonds break?
10 min	A written question Set an SL written question from the B1.2 exam maker (in Practise and revise), such as drawing a dipeptide or explaining essential amino acids, and peer-mark it. Point out that the markscheme has more points than marks.

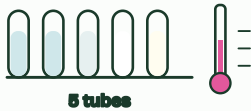


DRAWING

Protein doodles

Each student picks three proteins from lysozyme, insulin, antibodies, rhodopsin, collagen, spider silk, glucagon and a snake venom toxin. For each they write five keywords and make two drawings answering “how does its shape suit its job?” Finish with a gallery walk.

Needs: A4 paper, and a short fact card for each protein written by the teacher.



PRACTICAL (OPTIONAL)

Egg white, heat and acid

Put egg white in five tubes: room temperature, and 40, 60 and 80 °C water baths for five minutes, plus one with vinegar or lemon juice. Record clear or cloudy and runny or set, then cool the hot ones. Which change came back on cooling?

Needs: one egg, test tubes, water baths or a kettle and beakers, thermometers, vinegar.

PLENARY

5

min

Exit and homework

Homework: [the Check step](#). The [amylase home lab](#) (C1.1) makes good optional homework: denaturation you can time.

WHAT STUDENTS GET WRONG

“Essential” means more important. It means “must be eaten”.

Denaturation breaks the chain, or is caused by cold, or means the protein “dies”. It is the shape that goes.

Twenty amino acids, so twenty proteins. The order makes the protein.

STRETCH AND SUPPORT

Support: use the four Remember it tiles as starters.

Support: cut the figures’ captions up for students to put in order.

Stretch: why are there more possible proteins of 62 amino acids than atoms in the observable universe?

Stretch: how do the proteins of hot-spring microbes stay folded at temperatures that would denature ours?

IN THE GUIDE

- 3 [Some amino acids you must eat](#)
- 4 [Twenty amino acids, endless chains](#)
- 5 [Heat and pH unfold a protein](#)
- 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 B1.2, built from its key terms and ready to print
- A [pub quiz](#) with rounds on B1.2, to present or run with no projector
- An [escape room built from the question bank](#) on B1.2

ALREADY ON THE SITE FOR B1.2

- Quiz: [Proteins \(HL\)](#)
- Revision map: [B1.2 Proteins](#), to fill in
- Exam questions: [B1.2 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.

- [B1.2 Proteins](#)

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on B1.2 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=B1.2&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.