

Processing and starting translation HL

60 minutes • D1.2.15 to D1.2.17 • Chapters 10, 11

Caps, tails and splicing, one gene giving several polypeptides, and how translation starts

BY THE END, STUDENTS CAN

- ☐ Describe how pre-mRNA is capped, tailed and spliced, and how alternative splicing makes several polypeptides from one gene D1.2.15, D1.2.16
- ☐ Describe how translation starts, and what the A, P and E sites do D1.2.17

TIMING

0-6	6 min	Do now	
6-18	12 min	Capped, cut and tailed	
18-30	12 min	Paper splice	
30-42	12 min	Starting the chain	
42-54	12 min	Be the ribosome	
54-60	6 min	Exit	
60 min		One lesson	

STARTER

6
min

Do now

"List what must happen to pre-mRNA before it leaves the nucleus, and why." Cold call, then the board.

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.

10 Capped, cut and tailed

CHAPTER 10 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. Pre-mRNA: **exons** and **introns**.
2. A **5' cap** is added.
3. A **poly-A tail** is added.
4. Introns are cut out and the exons **spliced** together.
5. Mature mRNA leaves the nucleus.

Switch the figure through All four exons and Leave out exon 2, and have the class say what will change before each.

Play the animation, From promoter to mature mRNA. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. Transcription factors bind the promoter. Only then can RNA polymerase bind and begin.
2. The RNA grows 5' to 3': every new nucleotide joins its 3' end.
3. In a eukaryote the first RNA is pre-mRNA: exons, with introns between them.
4. A 5' cap and a poly-A tail are added. The introns are cut out and the exons spliced together.
5. Spliced another way, the same gene gives a different polypeptide.
6. Capped, tailed and spliced, the mature mRNA leaves the nucleus.

Predict box: A gene has four exons. Exons 1 and 4 are always kept, and exons 2 and 3 can each be kept or left out. How many different mature mRNAs can it make? Hands up or mini whiteboards first.

Answer C: 4

Remember it: In Exit (Introns, Exons).

11 Starting the chain

CHAPTER 11 IN THE SLIDES

Step through the figure (6 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. The **small subunit** attaches at the mRNA's 5' end.
2. It moves to the **start codon**, AUG, where the **initiator tRNA** pairs.
3. The **large subunit** joins: the initiator tRNA is in the **P site**.
4. The next tRNA arrives in the **A site**.
5. A peptide bond joins the two amino acids.
6. The ribosome moves one codon; the empty tRNA leaves from the **E site**.

Play the animation, Start, then A, P and E. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. The small subunit attaches to the mRNA at its 5' end.
2. It moves towards the 3' end until it reaches the start codon, AUG. The initiator tRNA pairs with it.
3. The large subunit joins. The initiator tRNA sits in the P site.
4. Another tRNA arrives in the A site. A peptide bond joins methionine to its amino acid.
5. The ribosome moves one codon. The empty tRNA leaves from the E site; the chain's tRNA is now in P.
6. At the stop codon the chain is released and the subunits come apart.

Predict box: The first peptide bond has just formed, joining methionine to the second amino acid. Before the ribosome moves, which site holds the tRNA carrying both amino acids? Hands up or mini whiteboards first.

Answer A: A site

Remember it: Arrive Pass Exit (A site, P site, E site).

THE LESSON

12 Capped, cut and tailed

min

Chapter 10's step-through, then the HL transcription film, From promoter to mature mRNA (try its Cap and tail switch). Then chapter 10's predict box (four exons) and Introns stay In, Exons Exit.

12 Paper splice

min

Students splice a paper pre-mRNA two ways and translate both (activity below).

12 Starting the chain

min

Chapter 11's predict box (which site holds the chain) first, then the step-through and the HL ribosome film, Start, then A, P and E, then Arrive, Pass, Exit.

12 Be the ribosome

min

A role play of initiation and elongation (activity below).

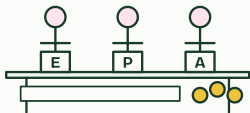


MODEL · HL

Paper splice

A paper pre-mRNA (the factory's split gene, printed in codons with exons and introns coloured), a paper cap and a tail. Students cut out the introns, tape the exons together, add the cap and the tail, then translate with the codon tool, The genetic code. Two groups splice differently (one leaves out exon 2) and compare their chains. Then leave intron 1 in and translate it: what happens?

Needs: printed strips, scissors and tape.



ROLE PLAY · HL

Be the ribosome

Three students stand as the E, P and A sites behind a bench, with an mRNA strip of codons on the bench (the demonstration gene with its leader). Others are tRNAs holding anticodon cards and an amino acid bead (or a coloured cube). The small subunit (one student with a card) starts at the 5' end and walks to AUG, the initiator tRNA steps into P, the large subunit (the three sites) arrives, tRNAs arrive at A, the chain of beads is passed from P to A, everyone shifts one codon, and the empty tRNA leaves from E. The class calls each move.

Needs: a bench, a codon strip, anticodon cards and beads on string.

PLENARY

6

min

Exit

"Explain why translation must start from the 5' end of the mRNA", or the D1.2 exam maker's 4-mark question on the initiation of translation.

WHAT STUDENTS GET WRONG

Introns are cut out of the DNA. Out of the RNA.

The initiator tRNA binds the A site. The P site.

The large subunit binds first. The small subunit binds the mRNA first.

STRETCH AND SUPPORT

Stretch: how many mature mRNAs could a gene with six exons make if exons 2 to 5 are each optional? ($2^4 = 16$) Why might a cell want that?

Support: play the factory's "Let the cell do it" on the board before pairs try a round.

IN THE GUIDE

10 [Capped, cut and tailed](#)

11 [Starting the chain](#)

A11 [The whole guide, with the figures that play](#)

PPTX [This lesson's slides, in the order of this plan](#)

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on D1.2 at higher level each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=D1.2&level=HL&paper=quiz&marks=15&src=ep



PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- [Tarsia puzzle, dominoes and picture reveal](#) on D1.2, built from its key terms and ready to print
- A [pub quiz](#) with rounds on D1.2, to present or run with no projector
- An [escape room](#) built from the [question bank](#) on D1.2

ALREADY ON THE SITE FOR D1.2

- Quiz: [Protein Synthesis \(HL\)](#)
- Quiz: [Protein Synthesis](#)
- Revision map: [D1.2 Protein synthesis](#), to fill in
- Exam questions: [D1.2 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.

- [D1.2 Protein Synthesis \(SL\)](#)
- [D1.2 Protein Synthesis \(HL\)](#)

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.