Protein Assembly Line

Trace how ribosome parts work together during translation

GEN.2A.3 "Develop a model to show the relationship between the components involved in the mechanics of translation at the ribosome."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each place where two components interact, circle the A, P, and E site labels, and number the steps that move a tRNA or the ribosome.

How a Ribosome Builds a Chain

1. Inside a cell, a ribosome reads a messenger RNA (mRNA) strand to build a protein. The mRNA passes through the ribosome from its 5′ end toward its 3′ end. Every three bases form a codon, which helps specify which amino acid is added next. A transfer RNA (tRNA) carries an amino acid and has an anticodon that pairs with a matching codon. These paired sequences point in opposite directions: a codon written 5′ to 3′ pairs with an anticodon written 3′ to 5′. The ribosome holds the mRNA and tRNAs close enough for these interactions.

2. Think of the ribosome as a workstation with three tRNA sites named A, P, and E. A tRNA carrying the growing amino acid chain sits in the P site. A new tRNA enters the A site when its anticodon pairs with the codon there. The ribosome forms a peptide bond between amino acids, transferring the growing chain to the amino acid on the A-site tRNA. Then the ribosome advances one codon along the mRNA. The chain-carrying tRNA shifts to P; the now empty tRNA shifts from P to E and exits.

3. This cycle repeats until a stop codon reaches the A site. No tRNA with a matching anticodon adds an amino acid at a stop codon. Instead, a release factor binds in the A site, and the finished chain is freed from the tRNA in the P site. The ribosome's parts then separate. A useful model shows the mRNA passing through the ribosome, the sites in their order along the reading direction, and the chain changing hands. Arrows can show the ribosome's movement, while labels distinguish codon-anticodon pairing from the peptide bond that connects amino acids.

2 ANSWER WITH EVIDENCE

Use the passage

1. A sketch places the tRNA carrying the growing chain in the A site and the incoming tRNA in the P site. How should you correct their positions?

2. A model draws a peptide bond between two mRNA codons. Where should that bond go, and what pairs with each codon?

3. After a peptide bond forms, a sketch leaves the empty tRNA in the P site. Show how both tRNAs move when the ribosome advances.

4. A sketch shows an amino acid-carrying tRNA in the A site at a stop codon. What should the sketch show instead, and what happens to the chain?

3 YOUR TURN

Your own words

In two panels, model a ribosome reading mRNA 5′-UUC-GGA-UGA-3′, using this key: UUC codes for phenylalanine (Phe), GGA codes for glycine (Gly), and UGA is a stop codon. Show the P- and A-site contents before the peptide bond forms and after the ribosome shifts one codon; label both tRNA anticodons, the growing chain, and what ends translation.

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PART 1 · READ AND MARK

Underline each place where two components interact, circle the A, P, and E site labels, and number the steps that move a tRNA or the ribosome. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A sketch places the tRNA carrying the growing chain in the A site and the incoming tRNA in the P site. How should you correct their positions?	**Put the chain-carrying tRNA in the P site and the incoming tRNA in the A site.**
2	A model draws a peptide bond between two mRNA codons. Where should that bond go, and what pairs with each codon?	**Draw the peptide bond between amino acids. Each mRNA codon pairs with a tRNA anticodon.**
3	After a peptide bond forms, a sketch leaves the empty tRNA in the P site. Show how both tRNAs move when the ribosome advances.	**The empty tRNA moves from P to E and exits. The tRNA carrying the chain moves from A to P.**
4	A sketch shows an amino acid-carrying tRNA in the A site at a stop codon. What should the sketch show instead, and what happens to the chain?	**A release factor binds in the A site, and the chain is freed from the P-site tRNA.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1: Along mRNA 5′-UUC-GGA-UGA-3′, the P site holds a Phe-tRNA paired with UUC by anticodon 3′-AAG-5′. The A site holds a Gly-tRNA paired with GGA by anticodon 3′-CCU-5′. Panel 2: After the peptide bond forms and the ribosome shifts, the P site at GGA holds the Gly-tRNA carrying the Phe-Gly chain. The empty Phe-tRNA moves toward E. A release factor binds at UGA in the A site and frees the chain.

Accept sketches with equivalent spatial layouts if the mRNA direction, site changes, anticodon pairings, and release factor are correct. The stop codon must not be shown adding an amino acid.