Protein biosynthesis

Three main stages: initiation, elongation, and termination.
These steps occur in the ribosome, which facilitates the reading of the mRNA and the assembly of a protein.

1. Initiation

This is the first phase of translation, where the ribosome assembles around the mRNA to begin protein synthesis.

- **mRNA binds to the ribosome:**

  The mRNA strand, attaches to the small ribosomal subunit.

- **Start codon (AUG):**

  ✓ The ribosome scans the mRNA until it reaches the start codon, which is AUG.

  ✓ This codon codes for the amino acid methionine, which always begins protein synthesis.

- **Initiator tRNA:**

  A special transfer RNA (tRNA), called initiator tRNA, carries the amino acid methionine and its anticodon pairs with the AUG codon on the mRNA.

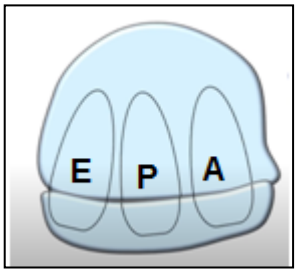
- **Large ribosomal subunit:**

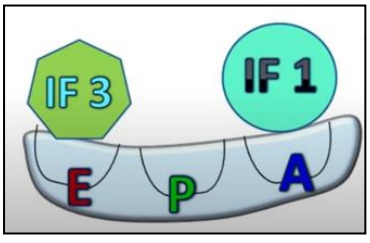
  The large ribosomal subunit then binds to form a complete ribosome, with the tRNA occupying the P site (one of the three binding sites for tRNA in the ribosome).

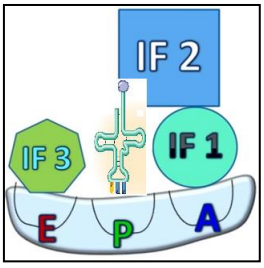
- **Initiation factors:**

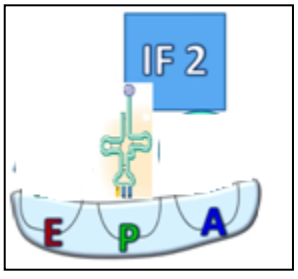
  These proteins help guide the assembly of the ribosome and ensure that everything is in the right position.

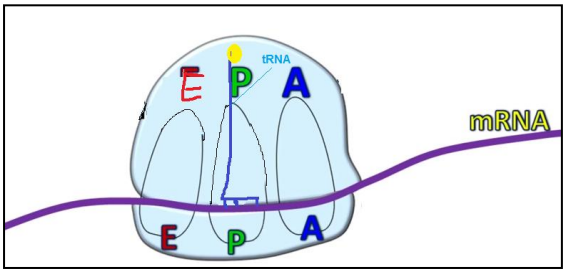
Now the ribosome is ready to elongate the polypeptide chain by adding more amino acids.











2. Elongation

In this stage, the ribosome moves along the mRNA and assembles the amino acids into a growing polypeptide chain.

- **Codon recognition:**

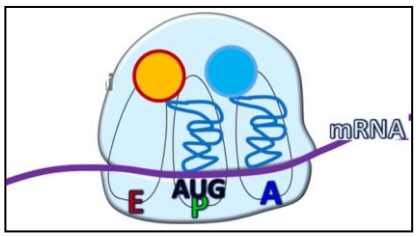
  A tRNA carrying an amino acid enters the A site of the ribosome, where its anticodon pairs with the mRNA codon (a set of three nucleotides that code for a specific amino acid).

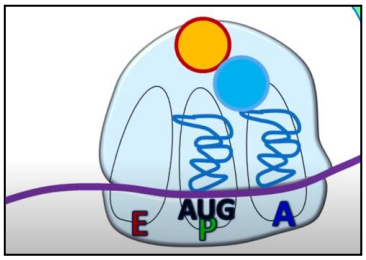
- **Peptide bond formation:**

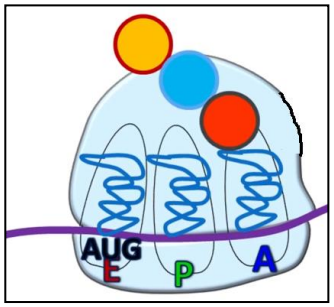
  The ribosome catalyzes the formation of a peptide bond between the amino acid in the A site and the growing chain in the P site. This bond links the amino acids together.

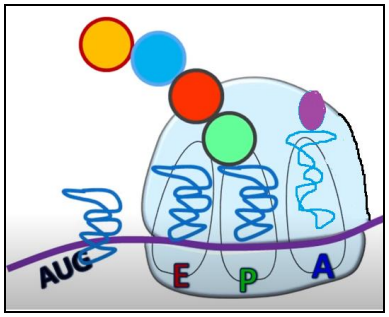
- **Translocation:**
  - ✓ After the peptide bond forms, the ribosome moves (or translocates) by one codon along the mRNA.
  - ✓ The tRNA that was in the P site moves to the E site (Exit site), where it is released.
  - ✓ The tRNA in the A site, now carrying the growing peptide chain, moves to the P site, making room for the next tRNA to enter the A site.
- **Cycle repeats:**
  - ✓ This process continues, with each new tRNA bringing a specific amino acid based on the next mRNA codon.

The polypeptide chain grows longer with each addition.









3. Termination

This phase ends the process of translation when the entire protein has been synthesized.

Stop codon:

- The ribosome continues elongating the polypeptide chain until it reaches a stop codon on the mRNA.
- The stop codons are UAA, UAG, or UGA, which do not code for any amino acids.

Release factors:

- Instead of a tRNA, a protein known as a release factor binds to the stop codon.
- This triggers the ribosome to release the newly synthesized polypeptide chain.

Disassembly:

- The ribosome subunits separate, and the mRNA is released. The ribosome components can be reused for another round of translation.