Al- Mustaqbal University
College of Science
Medical Physics Department
First Stage

General biology

Lecture : 7

Translation

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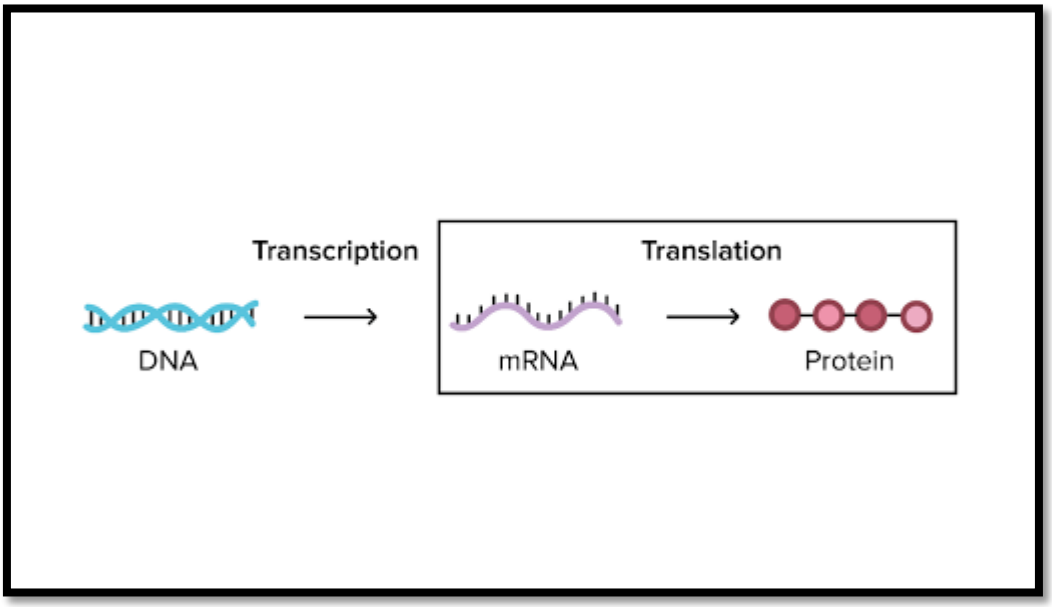
Translation: The Process of Protein Synthesis from mRNA

1. Introduction to Translation

Translation is the process by which messenger RNA (mRNA) is used to synthesize proteins. During this process, the genetic code carried by mRNA is translated into a specific sequence of amino acids, ultimately forming a protein. Translation occurs in the cytoplasm, where ribosomes read the mRNA and coordinate the assembly of amino acids into a polypeptide chain. This is the second step in gene expression, following transcription.



Figar (1) Translation

2. The Role of Ribosomes in Translation

Ribosomes are the molecular machines that facilitate translation. They consist of two subunits: a large subunit and a small subunit. Ribosomes read the mRNA sequence three nucleotides at a time, known as a codon. Each codon specifies an amino acid that will be added to the growing polypeptide chain. Ribosomes move along the mRNA, coordinating the binding of transfer RNA (tRNA) molecules that bring the appropriate amino acids.

3. The Role of tRNA in Translation

Transfer RNA (tRNA) molecules play a crucial role in translation by bringing amino acids to the ribosome. Each tRNA molecule has an (anticodon) that is complementary to the mRNA codon. The tRNA's (amino acid attachment site) binds to the appropriate amino acid, ensuring that the correct amino acid is incorporated into the protein. tRNAs are recycled in the process to participate in multiple rounds of translation.

4. The Stages of Translation

a. Initiation

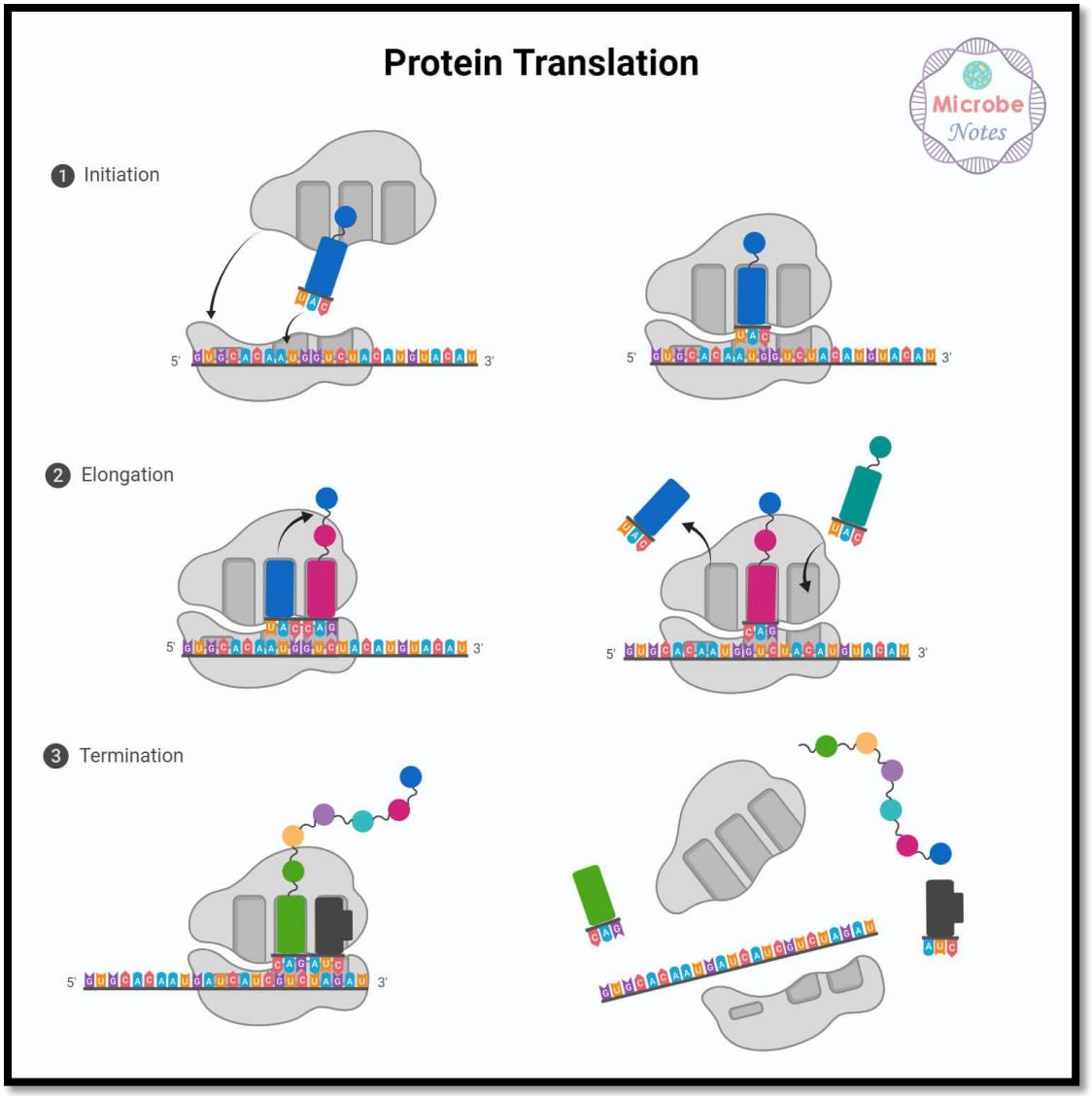
The process of translation begins with the (initiation stage), where the small ribosomal subunit binds to the mRNA at the (5' cap) in eukaryotes. The first tRNA, carrying the amino acid methionine (AUG codon), then binds to the start codon on the mRNA. The large ribosomal subunit then joins the small subunit, forming the complete ribosome. This assembly marks the start of protein synthesis.

b. Elongation

During the (elongation stage), the ribosome moves along the mRNA, reading each codon and recruiting the corresponding tRNA. Each tRNA brings an amino acid, and the ribosome forms a peptide bond between adjacent amino acids, creating a growing polypeptide chain. The ribosome continues to move along the mRNA, adding amino acids in the order specified by the mRNA sequence. This process continues until a stop codon is encountered.

c. Termination

The (termination stage) occurs when the ribosome reaches a stop codon in the mRNA sequence. Stop codons do not code for amino acids and signal the end of protein synthesis. A release factor binds to the stop codon, causing the ribosome to release the newly synthesized polypeptide chain and dissociate from the mRNA. The polypeptide then undergoes folding and modifications to become a functional protein.



Figar (2) The Stages of Translation

5. Post-Translational Modifications

After translation, newly synthesized proteins may undergo several (post-translational modifications) to become functional. These modifications include phosphorylation, glycosylation, acetylation, and ubiquitination. These changes can affect the protein's activity, stability, location, or interactions with other molecules, and are essential for the protein to perform its biological function.

6. The Importance of Translation in Gene Expression

Translation is a vital process in cellular function because it is responsible for synthesizing proteins, which perform most of the biological activities in cells. These proteins include enzymes, structural components, hormones, and receptors. Proper translation is essential for cell growth, development, and response to environmental stimuli. Errors in translation or its regulation can lead to diseases such as cancer and genetic disorders.

References

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https://www.youtube.com/watch?v=9iJmyMtaqfY