

Transcription and Translation of genes

- Transcription
- Translation

Introduction:

- **Transcription** is synthesis of single stranded RNA from a double stranded DNA template. Its produces messenger RNA (mRNA).
- Transcription and Translation both process are the part of gene expression.
- In a eukaryotic cell the nuclear envelope separates transcription from translation.
- Extensive RNA processing occurs in the nucleus.

TRANSCRIPTION INTRODUCTION :

- Transcription is the synthesis of mRNA from a DNA template which occurs in 5'-3' direction.
- During transcription , a DNA sequence is read by an RNA polymerase which produce a complementary and antiparallel RNA strand.
- Transcription is the first step leading to gene expression.
- The result of the transcription is a mRNA which will then be used to create that protein via the process of translation

Transcription Prokaryotes Vs Eukaryotes.

- Prokaryotic transcription occurring in cytoplasm alongside translation and eukaryotic transcription occurring only in the nucleus where it is separated from the cytoplasm by the nuclear membrane.

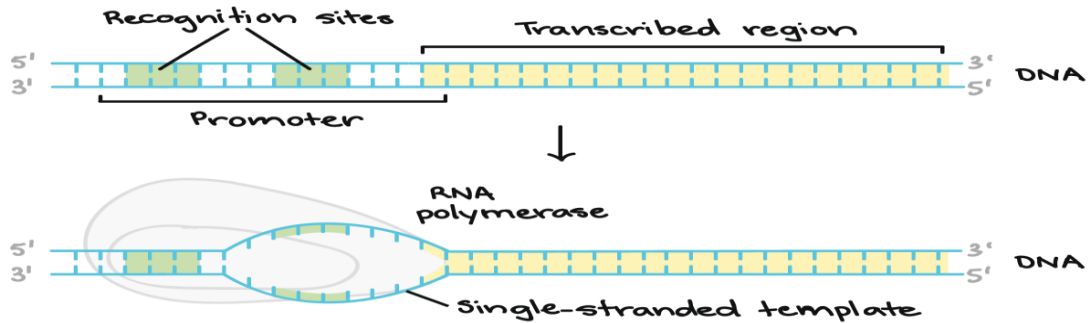
STAGES OF TRANSCRIPTION :

There are three stages involved in transcription :

- A. INITIATION
- B. ELONGATION
- C. TERMINATION

INITIATION:

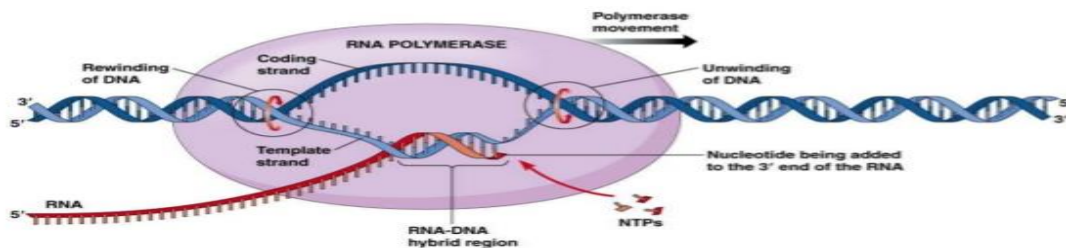
- RNA polymerase binds to specific DNA region and initiate transcription called as promoter site.
- After polymerase is bound to the promoter DNA, the two DNA strands unwind and the enzyme starts transcribing the template strand.
- The position of the first synthesized base of the RNA is called the start site .



ELONGATION:

- RNA polymerase moves along DNA template and sequentially synthesizes the RNA chain.
- DNA is unwinding ahead of the moving polymerase and the helix is reformed behind it.
- It unwinds 10-20 DNA bases at a time.
- RNA polymerase add nucleotides in the 5'-3' direction.
- The new section of RNA 'peels away' as the double helix reforms.

II) Elongation step of Transcription

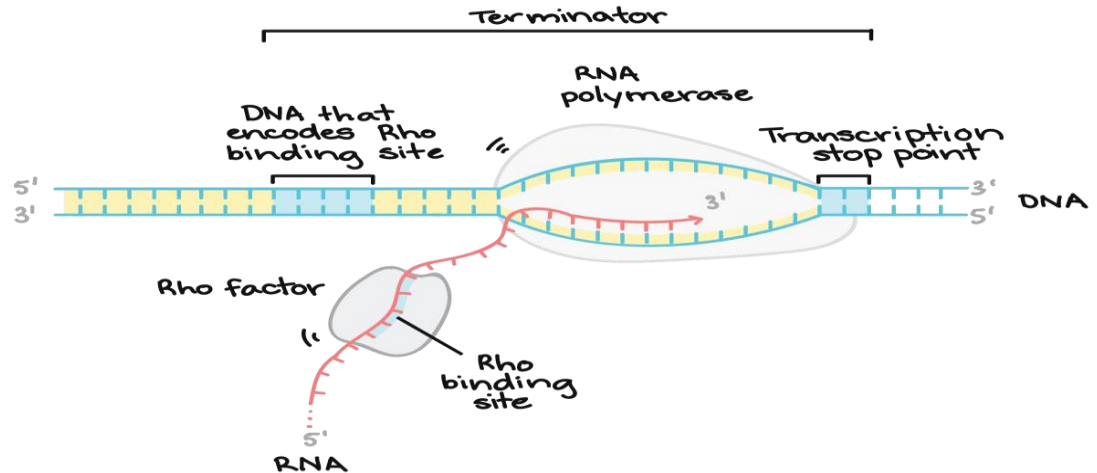


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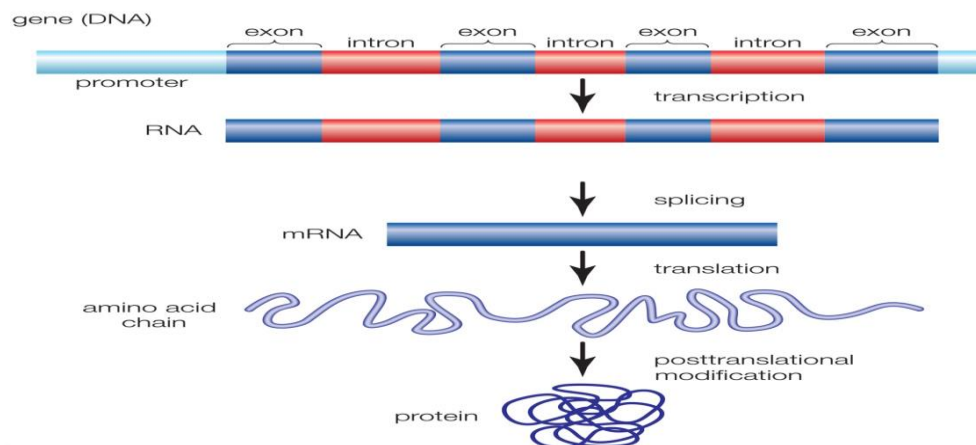
TERMINATION:

- Transcription stops when RNA polymerase reaches a section of DNA called the terminator.
- Terminator sequence = UAG .
- Next, the RNA strand is released and RNA polymerase dissociates from the DNA.



RNA Processing :

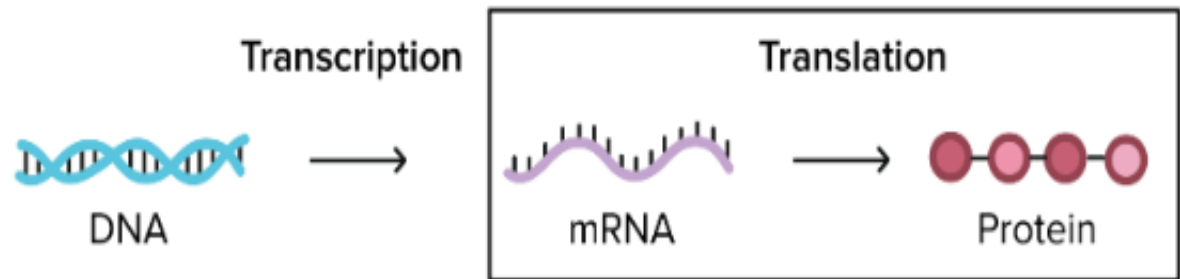
- The original transcript from the DNA is called as pre-m RNA.
- It contains transcript of both intron and exons.
- Intron:- it is non-coding sections of nucleic acid found between coding regions.
- Exons:-coding regions of nucleic acids
- Pre-mRNA never leaves the cell's nucleus.
- The introns are excised and exons are joined together to form mRNA.
- The introns are removed by a process called splicing to produce messenger RNA (mRNA)



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Translation

- It is the 1st stage of protein biosynthesis from mRNA.
- Process of **Translation** involves formation of polypeptide (PROTEIN) by decoding mRNA produced in transcription.
- It occurs in ribosome which are present in cytoplasm. It begins after mRNA enters in cytoplasm.
- It uses tRNA as the interpreter of mRNA.



PHASES IN TRANSLATION

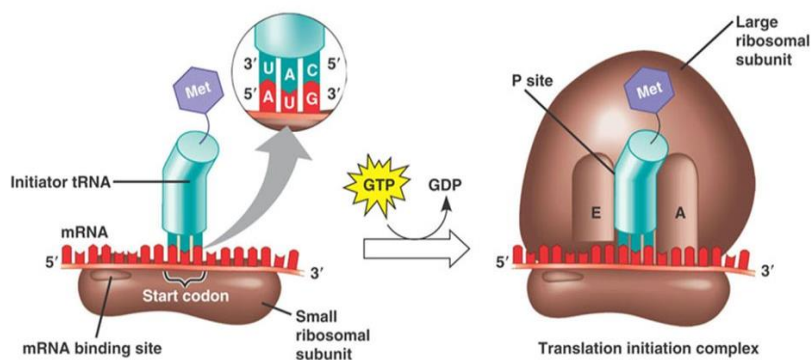
Translation proceed in four phases:

1. INITIATION
2. ELONGATION
3. TRANSLOCATION
4. TERMINATION

INITIATION :

- The initiation stage of translation brings together mRNA, tRNA bearing the first amino acid of the polypeptide, and two subunits of a ribosome
- The components involved are the large and small subunits of ribosome, mRNA, initiator tRNA in its charged form and three factors (IF1,IF2,IF3) and GTP.
- The tRNA has a amino acid linked to it is term as Charged tRNA.

Initiation

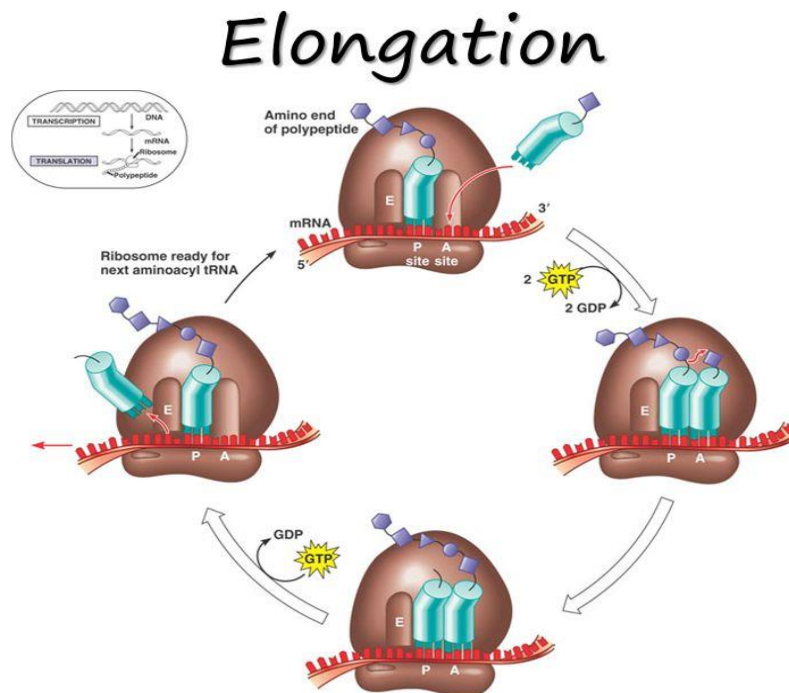


- IF1 and IF3 bind to free 30S subunit.
- IF2 complexed with GTP then bind to the small subunit. It will assist the charged initiator tRNA to bind.
- The assembled ribosome has 2 tRNA binding sites. These are called A-site (acceptor) for aminoacyl and P-site(donor)for polypeptide.

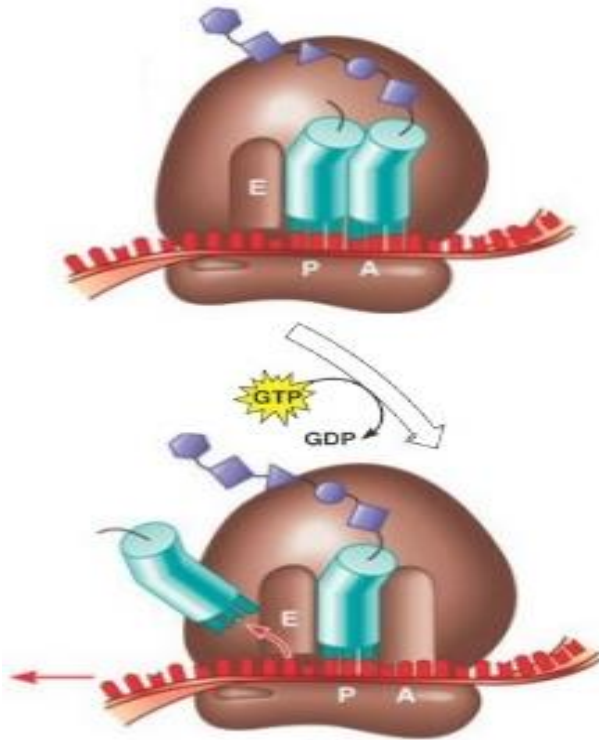
- The A-site is where incoming aminoacyl-tRNA molecules bind and P-site where the growing polypeptide chain usually found
- One major outcome of initiation is the placement of initiator tRNA in the P-site.
- Start codon :- AUG
- Start anticodon :- UAC
- The small ribosomal subunit attaches to 5' end of mRNA.

ELONGATION:

- In this amino acid are added one by one to the first amino acid called as amino acid delivery.
- In codon recognition , mRNA codon in the A site forms hydrogen bond with the tRNA anticodon.
- In peptide bond formation, the ribosome catalyzes the formation of the peptide bond between the amino acids. The polypeptide extending from the P-site moves to A-site to attach to the new Amino Acid.
- In elongation process three elongation factors (EF-T4,EF-T5,EF-G) which will bind with GTP or GDP.



- **TRANSLOCATION :**
- The t-RNA with the polypeptide chain in the A site is translocated to the P site.
- tRNA at the P site moves to the E site and leaves the ribosome.
- The ribosome moves down the mRNA in the 5'-3' direction



TERMINATION:

- Protein factors called release factors interact with the stop codons and cause release of the completed polypeptide chain.
- Stop codon- UAA,UAG,UGA.RF1 recognizes the codons UAA,UAG.
- RF2 recognizes UAA, UGA. RF3 helps either RF1 and RF2 to carry out the reaction

Translation: Termination

