

Transcription

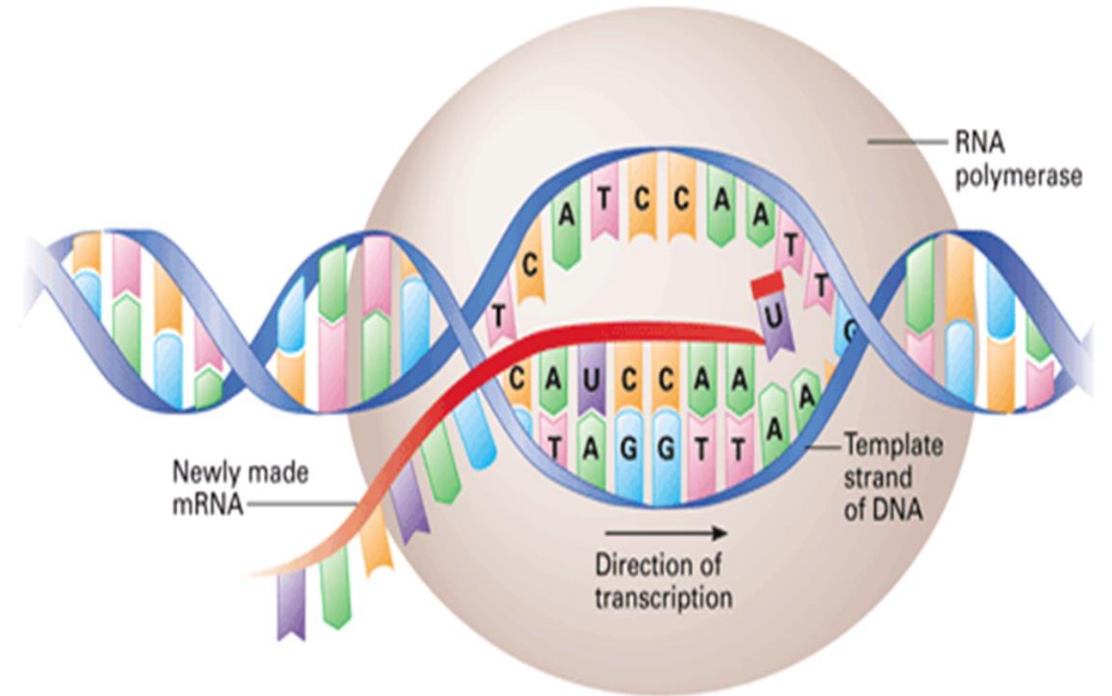
DNA



Transcription /DNA → RNA/



RNA



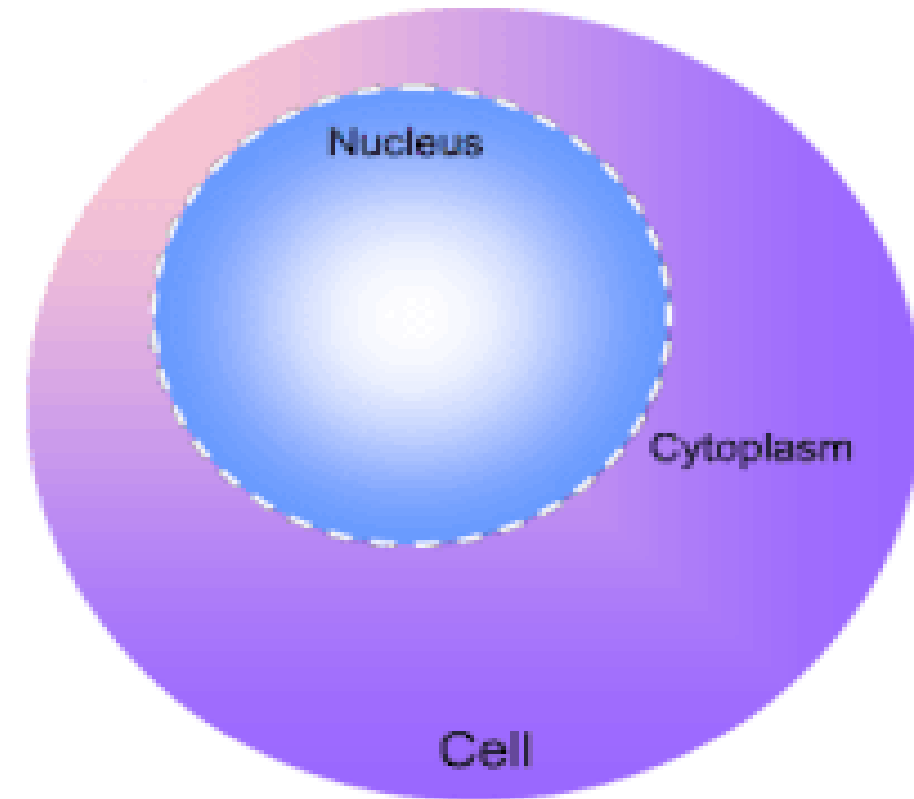
By:

Dr/ Aya El-Hanafy

**Associate Professor of biochemistry &
Molecular Biology**

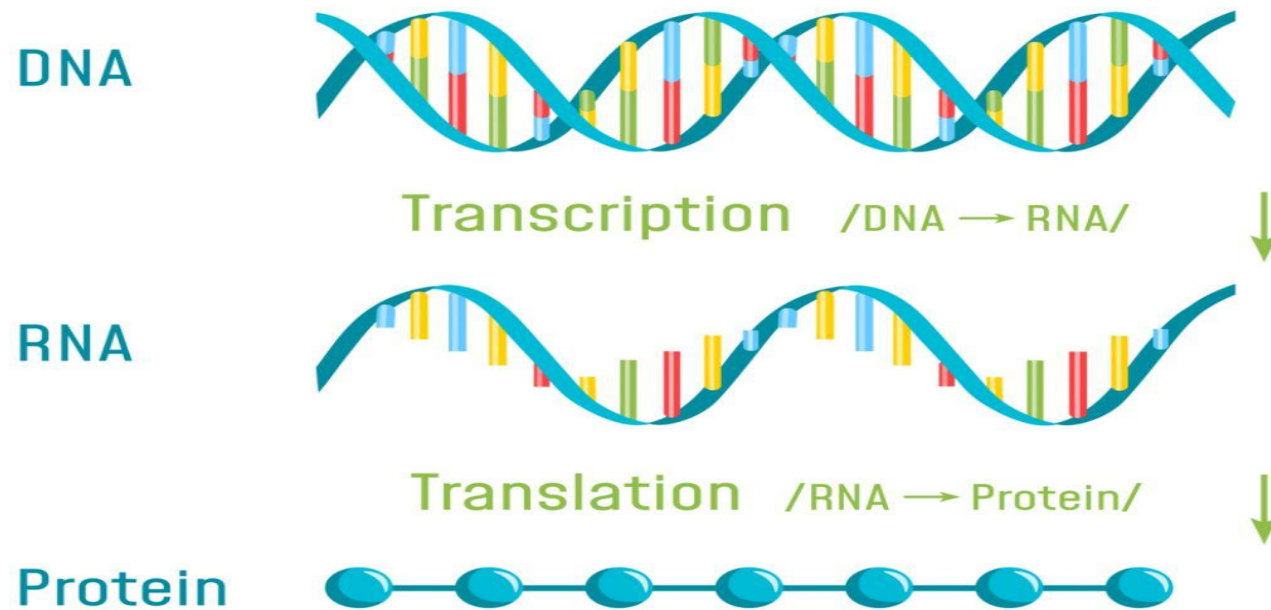
Central Dogma of Molecular Biology

- ❑ The biological information flows from **DNA** to **RNA**, and from them to **proteins**.
- ❑ This is **central Dogma** of life.
- ❑ DNA in a cell must be duplicated (replicated), and passed down to daughter cells.



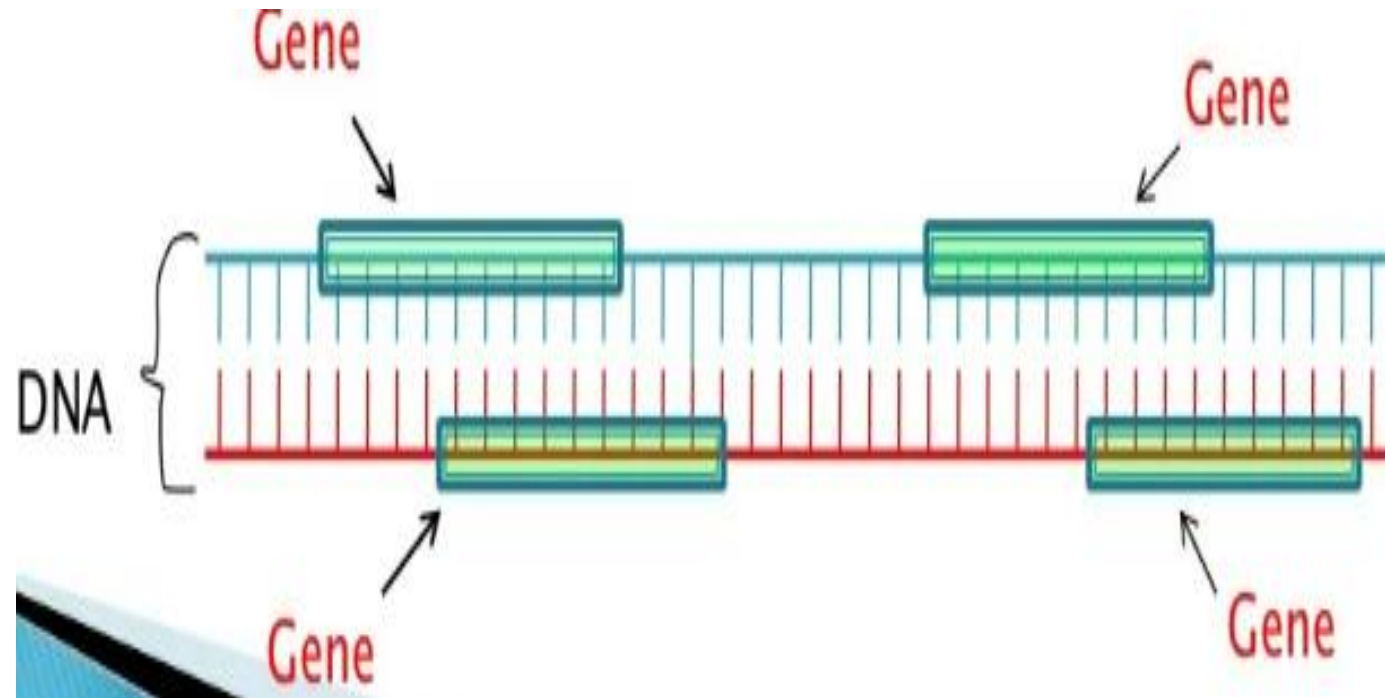
Transcription

Definition: It is the synthesis of RNA molecule from DNA template
-RNA then enters in translation process to synthesize the protein.



Transcription

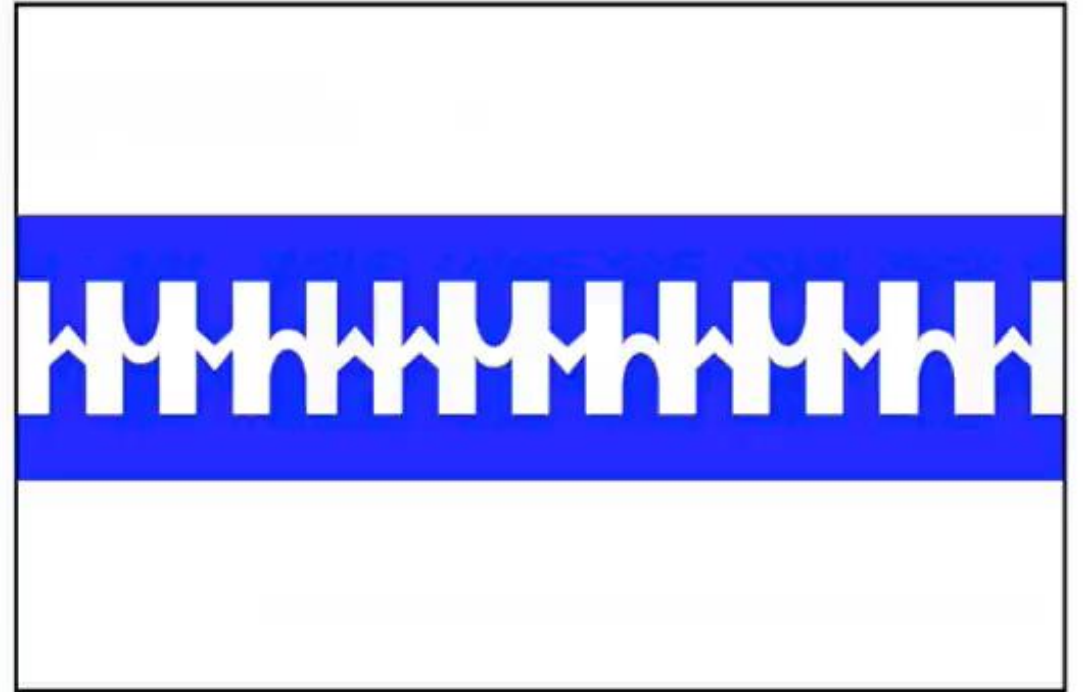
- In replication, the entire DNA molecule is copied
- But during transcription, only genes are transcribed
- **A Gene:** is a segment of DNA that codes RNA and protein and can be present at any strand of DNA



Transcription

Requirements for transcription

1. DNA Template.
2. Four ribonucleoside triphosphate (ATP, GTP, UTP and CTP).
3. RNA polymerase enzymes.
4. Transcription elements & Transcription factors



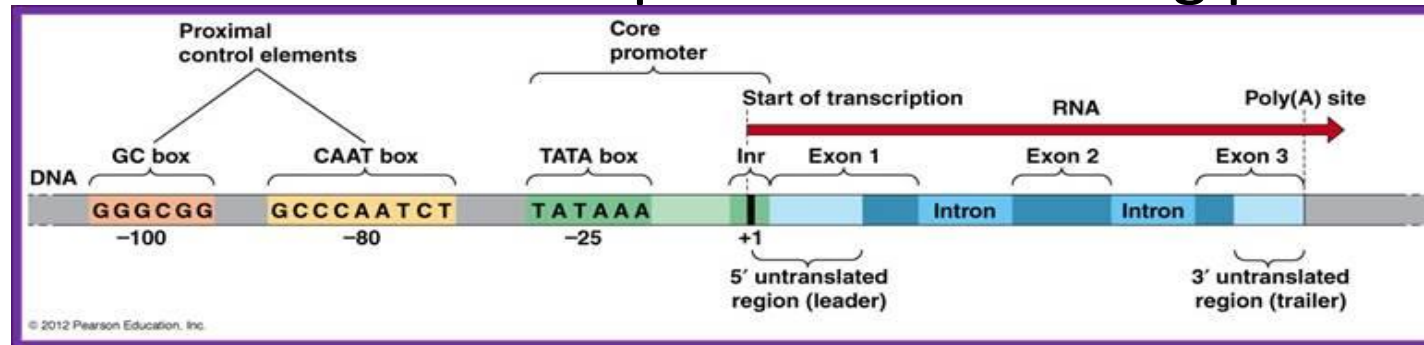
DNA template

A- Promotor:

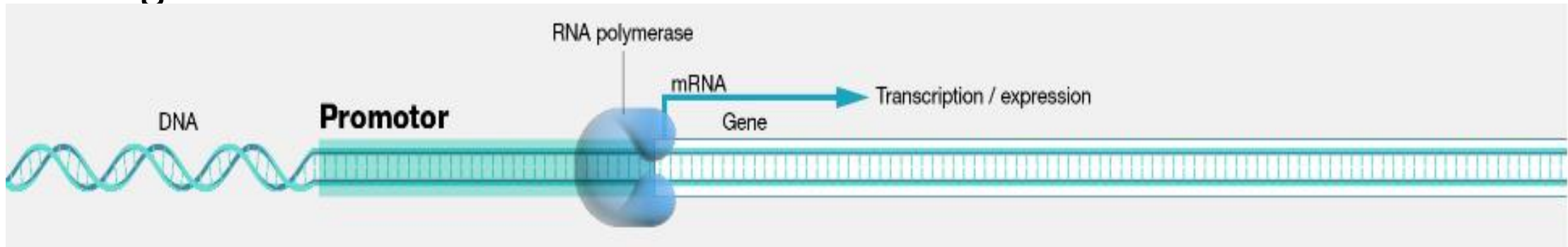
□ It is DNA sequence located **upstream** of a gene.

-**TATAAA BOX:** located 25 bases upstream of starting point of transcription

-**CAAT BOX:** located 70- 80 bases upstream of starting point of transcription



□ It is the site of binding of **RNA polymerase (RNAP)** to initiate transcription of that gene.



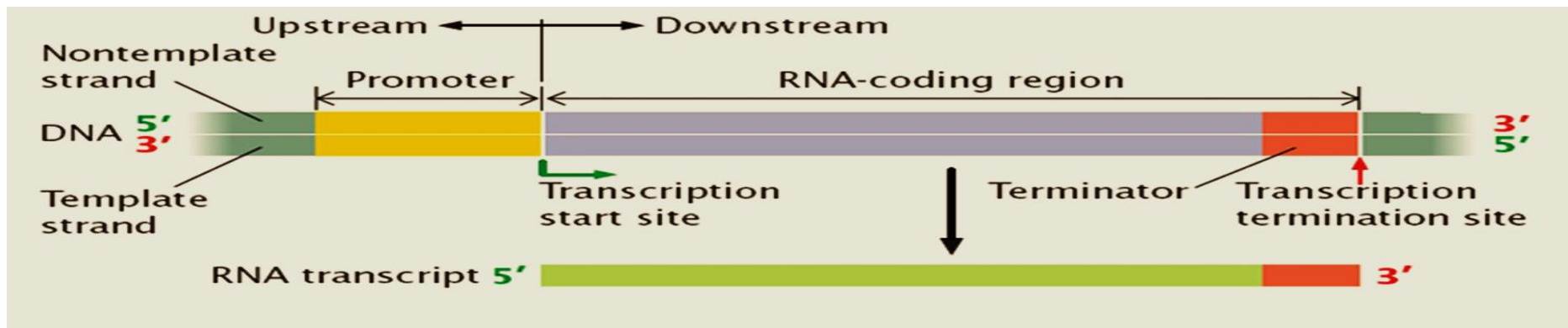
B. Transcription Unit

- ❑ Transcription start site → correspond to 5' end of RNA
- ❑ Transcribed region:

DNA sequence to be transcribed to RNA. It is the region between promoters and terminators. It composed of **exons** interrupted by **introns**.

- ❑ Transcription termination site:

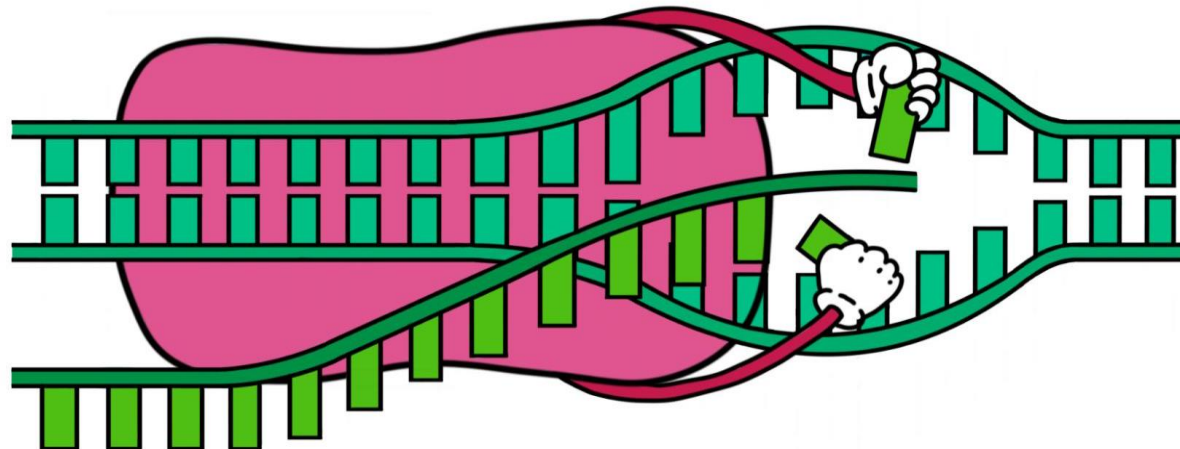
- RNA synthesis continue until a termination signal is reached.
- correspond to 3' end of RNA



RNA polymerase (RNAP):

- RNA polymerase I: transcribes **r**RNA genes
- RNA polymerase II: transcribes **m**RNA
- RNA polymerase III: transcribes **t**RNA

Transcription: Role of the RNA Polymerase



RNA polymerase is the main enzyme involved in transcription. It reads one of the DNA strands and adds complementary nucleotide bases to make an mRNA transcript. The mRNA will later be translated into protein.

Transcription elements

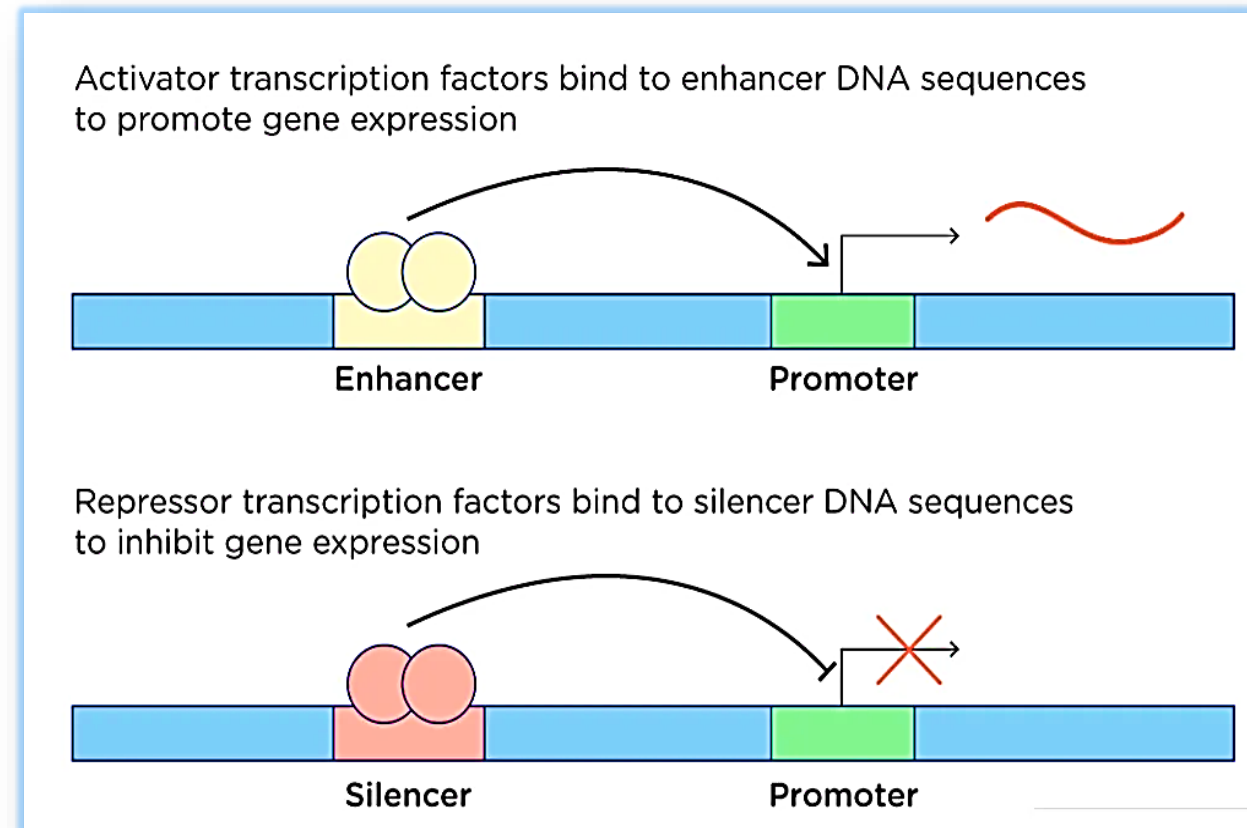
- ❑ They are located either upstream or downstream or within the gene
- ❑ They control the **frequency** of transcription
- ❑ They include:

-Enhancer:

It **increases** the rate of transcription

-Silencer:

It **decreases** the rate of transcription



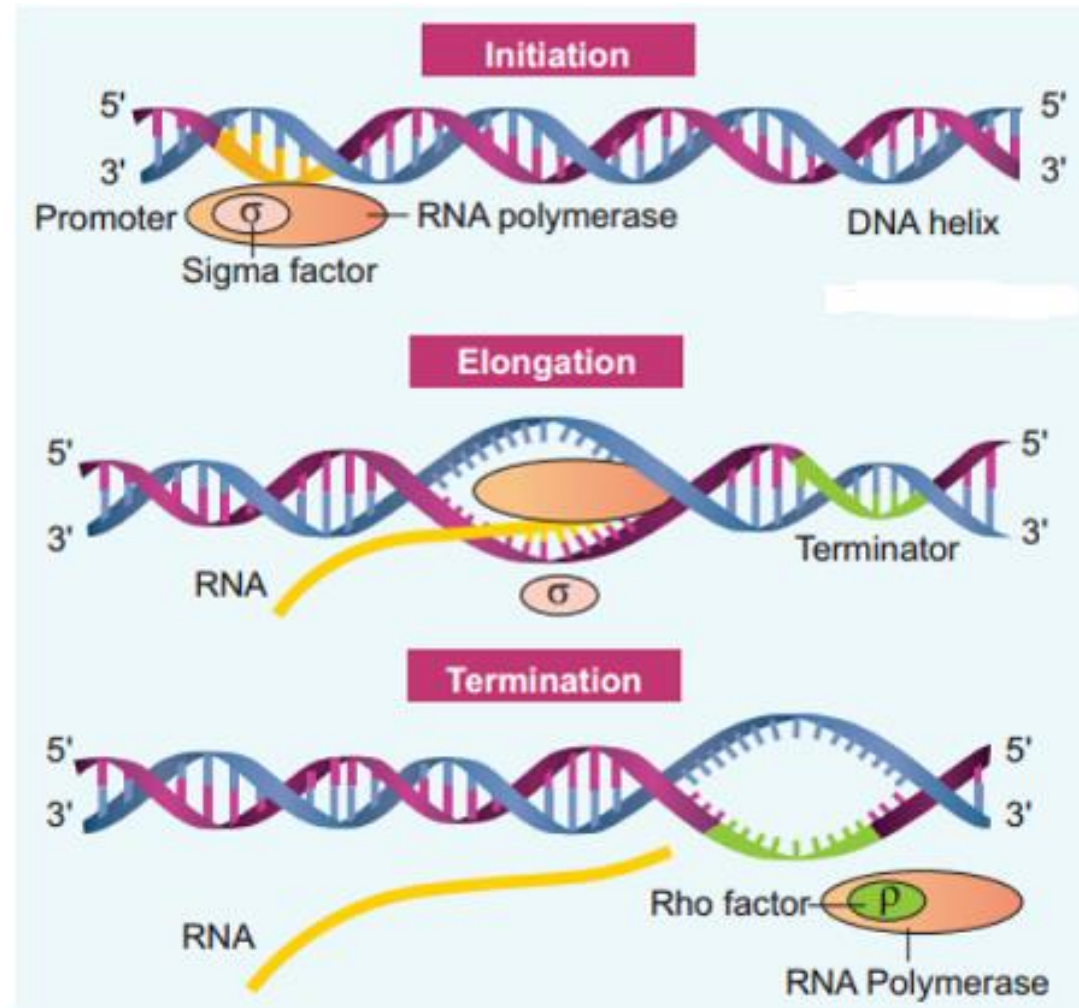
Transcription: Steps

3 Steps:

1. Initiation

2. Elongation

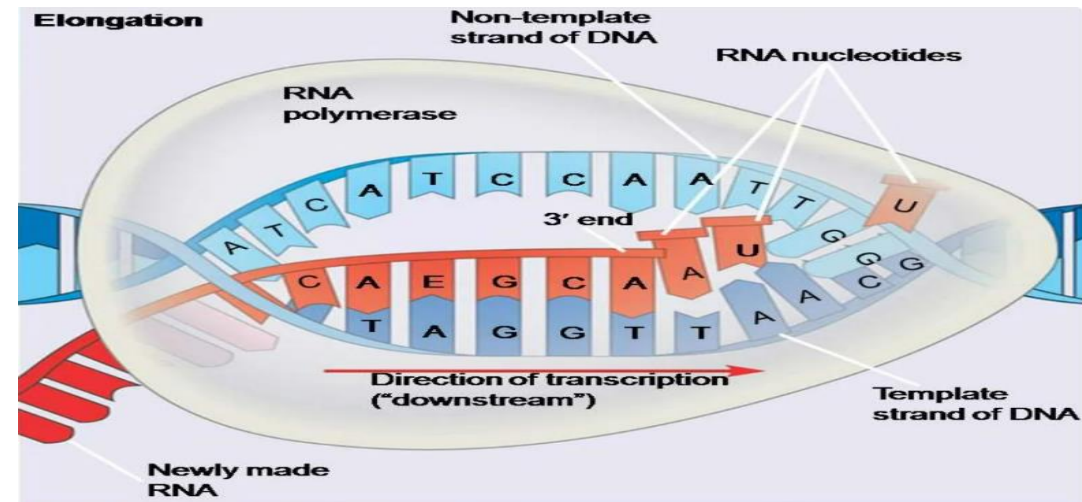
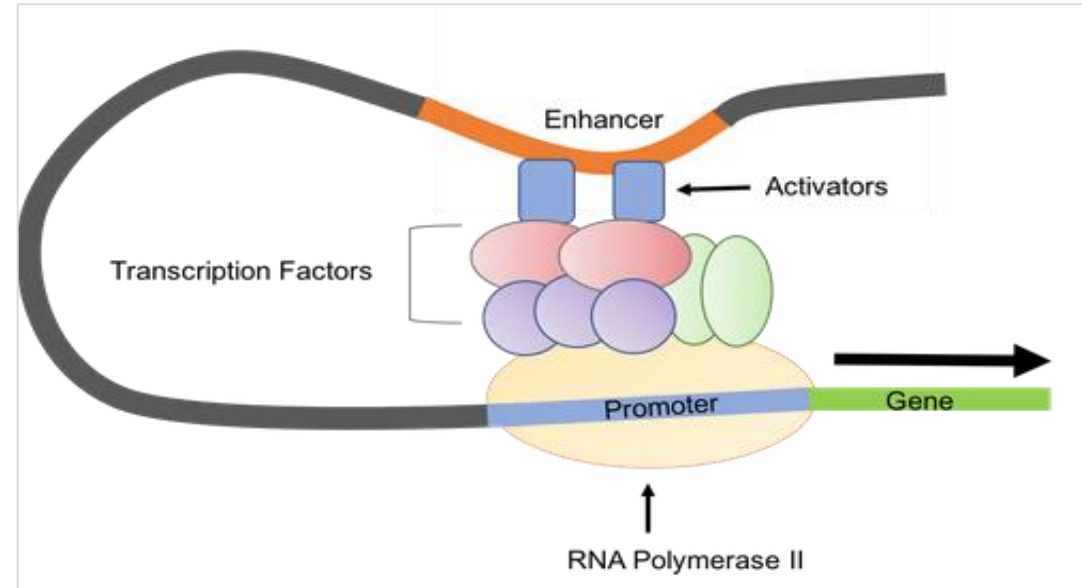
3. Termination



Transcription: Steps

1- Initiation:

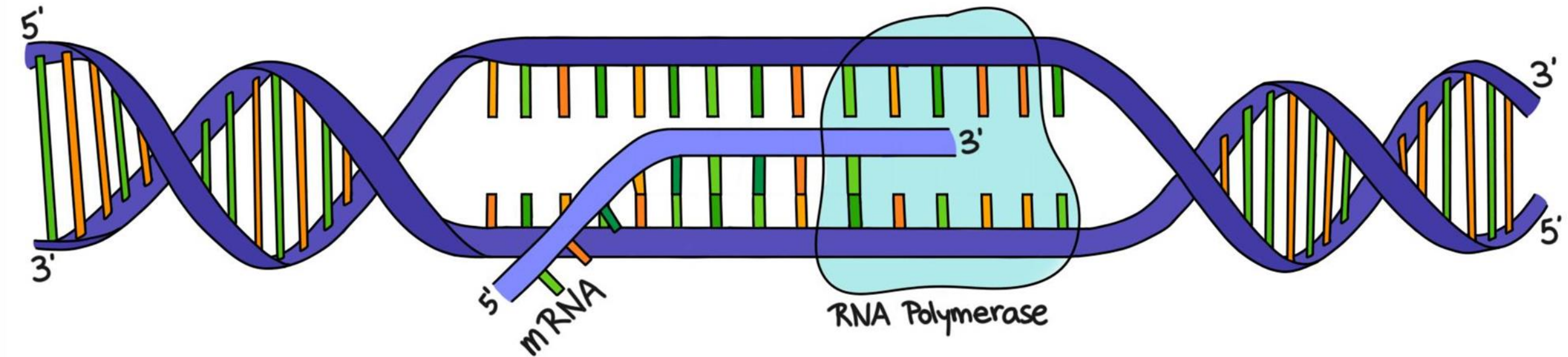
- Binding of **RNA polymerase** to **promoter** region on DNA with the aid of **transcription factor**.
- This causes **unwinding of DNA** double helix into **template & coding strand**.



Transcription: Steps

2- Elongation:

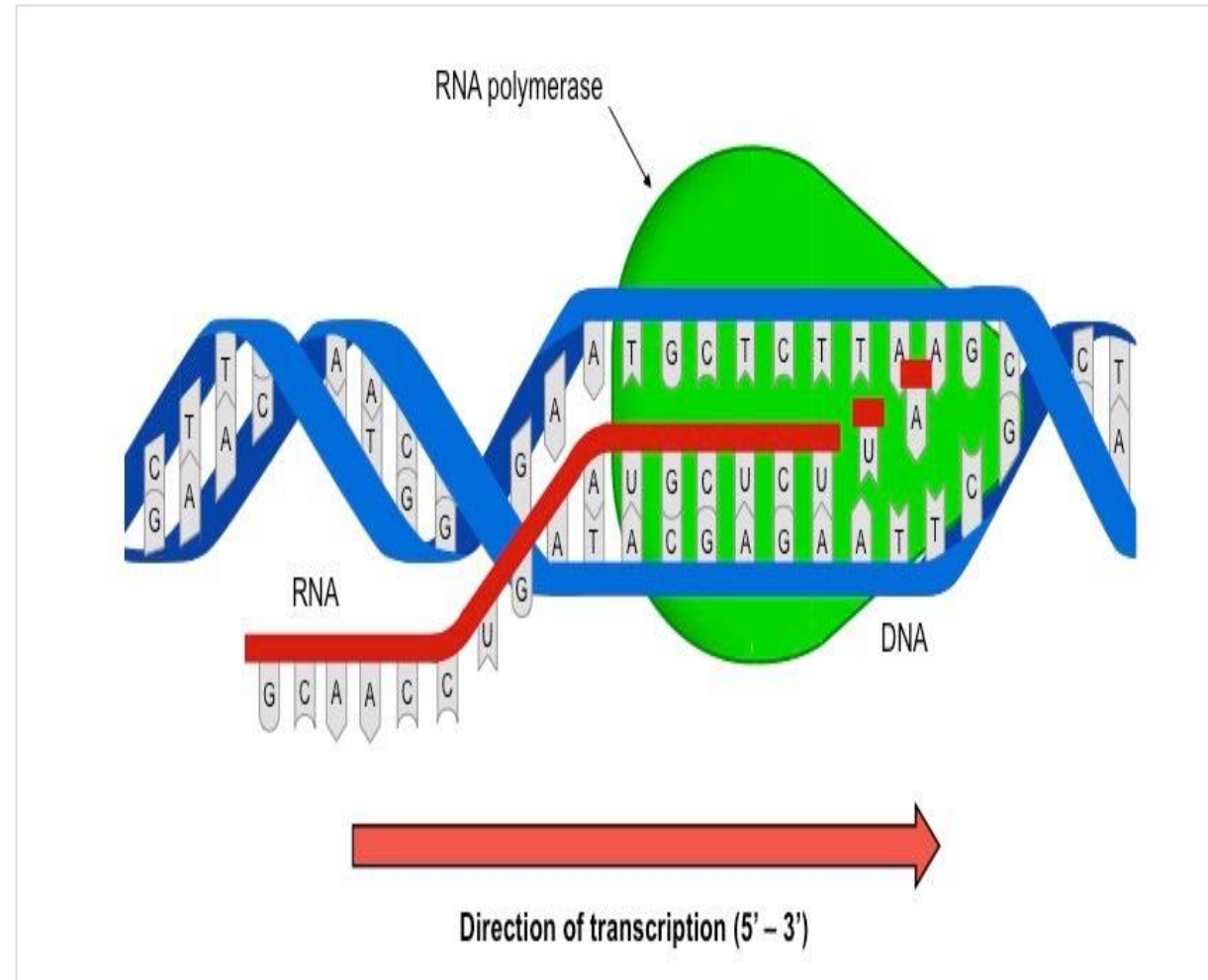
- RNAP starts synthesis of RNA strand complementary to **DNA template strand (3' to 5')**.
- This occur in the **5' to 3' direction**



Transcription: Steps

2- Elongation (Cont.):

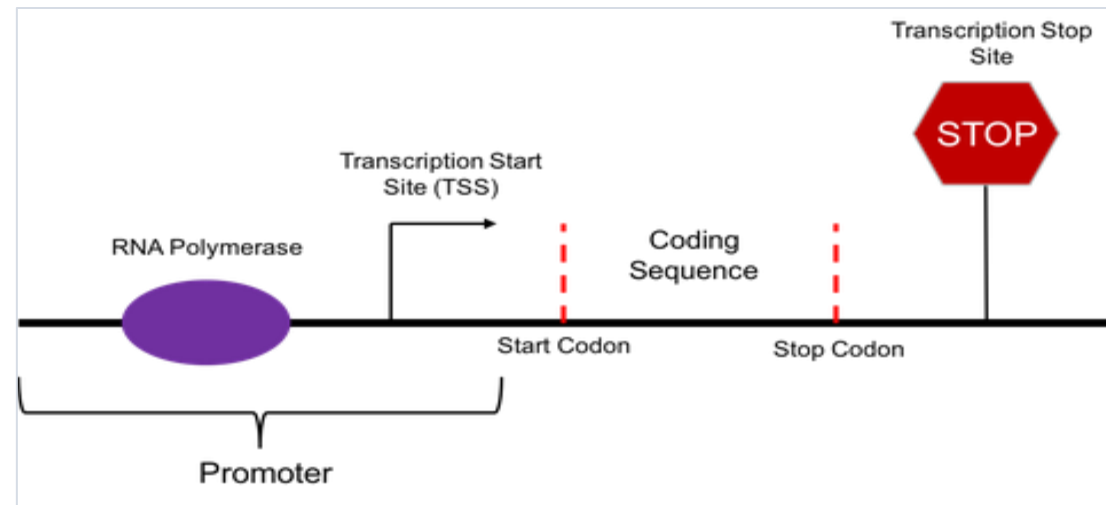
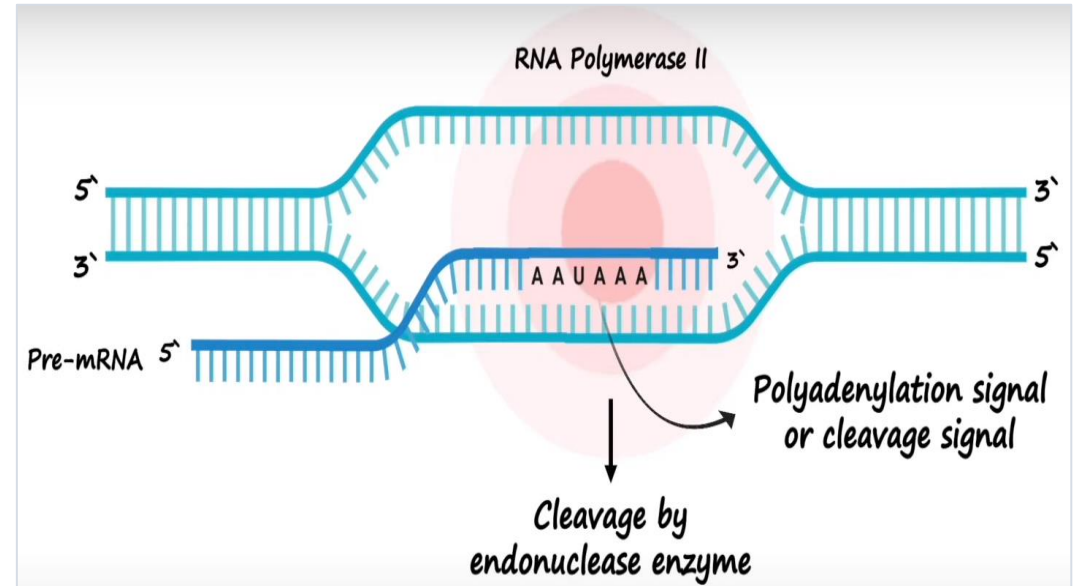
- RNAP add nucleotides to the **3'** end of the growing RNA chain.
- Using **ribonucleoside triphosphate** (ATP, GTP, CTP, UTP)
- Elongation of RNA occurs **till termination sequence** is reached.



Transcription: Steps

3- Termination:

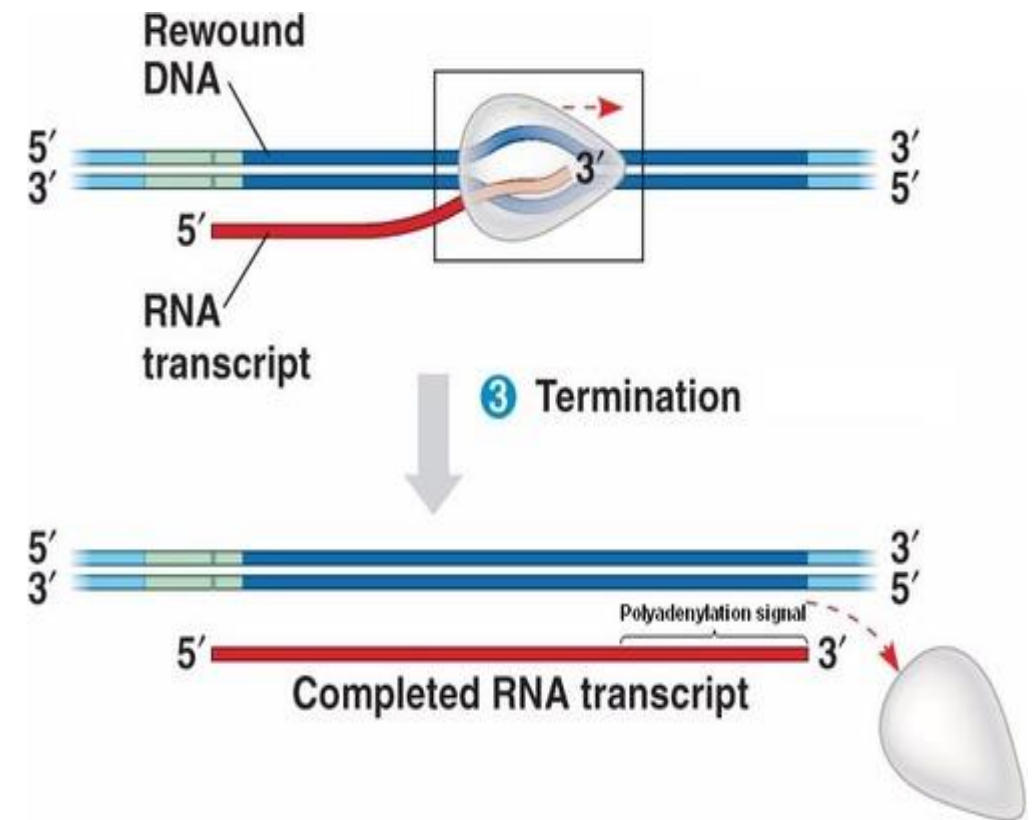
- When a sequence on mRNA (**AAUAAA**) is transcribed, it acts as a **signal for termination of transcription**.
- This **termination signal** is telling RNA polymerase where to **stop** and **transcription ends** at that point.



Transcription: Steps

After termination:

- **RNA polymerase:** detaches from DNA may move to another gene and begin transcription once again.
- **The RNA molecule:** is released & become free for processing.
- **DNA** completely rewinds into a double helix



Transcription: Steps



Posttranscription modification (RNA Processing)

- ❑ Nascent RNA (**Primary transcript**), known as **the pre-mRNA**, needs to be modified to become **mature (functional) mRNA**.
- ❑ This includes:
 - 1) **Capping at 5' end**
 - 2) **Splicing**
 - 3) **Polyadenylation at 3' end**



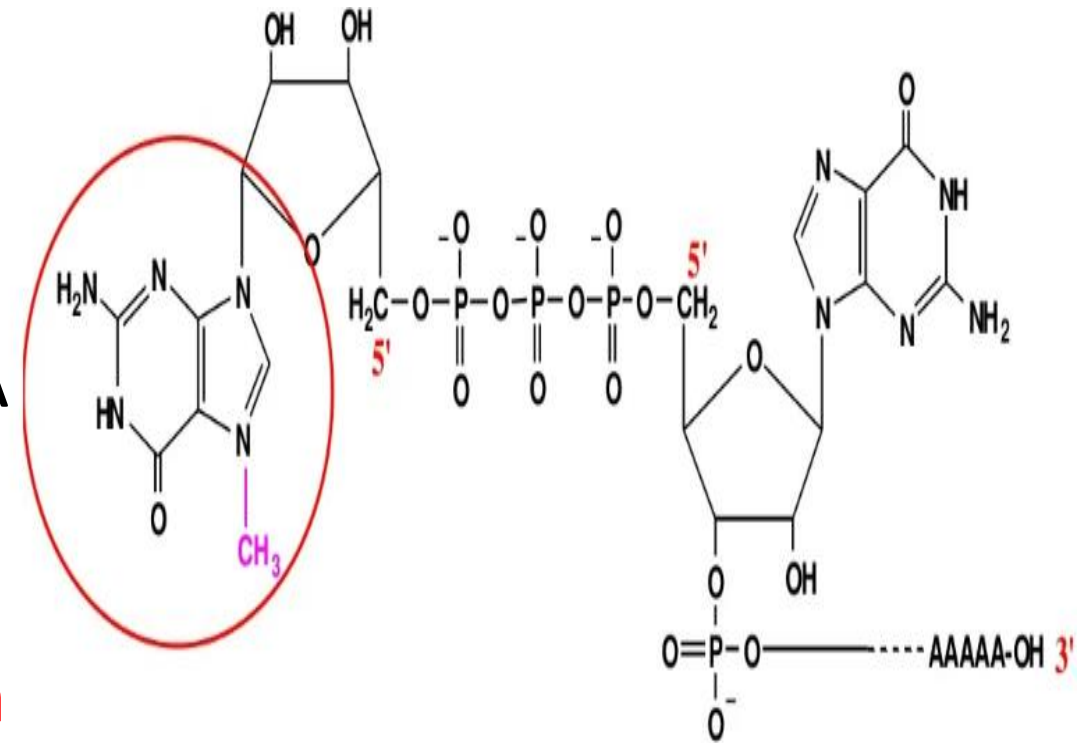
Capping

It involves the addition of a Methylguanosine triphosphate group to the 5'-end of the transcribed RNA

Functions of capping:

1- **Protect the 5' end** of mRNA against degradation by exonucleases.

2- It is important for **initiation of translation**



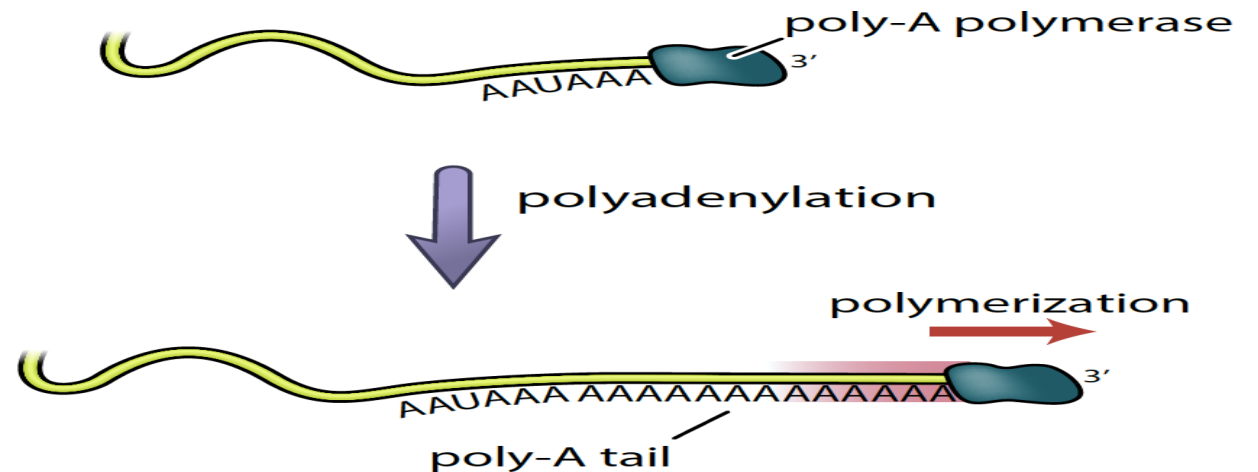
Polyadenylation

□ Polyadenylation is the **addition of a long chain of adenine nucleotides (a poly-A tail)** to the **3'-end** of the transcript

□ Function of poly-A tail

1- **Protect the 3' end** of mRNA against degradation by exonucleases.

2- Stabilizes mRNA



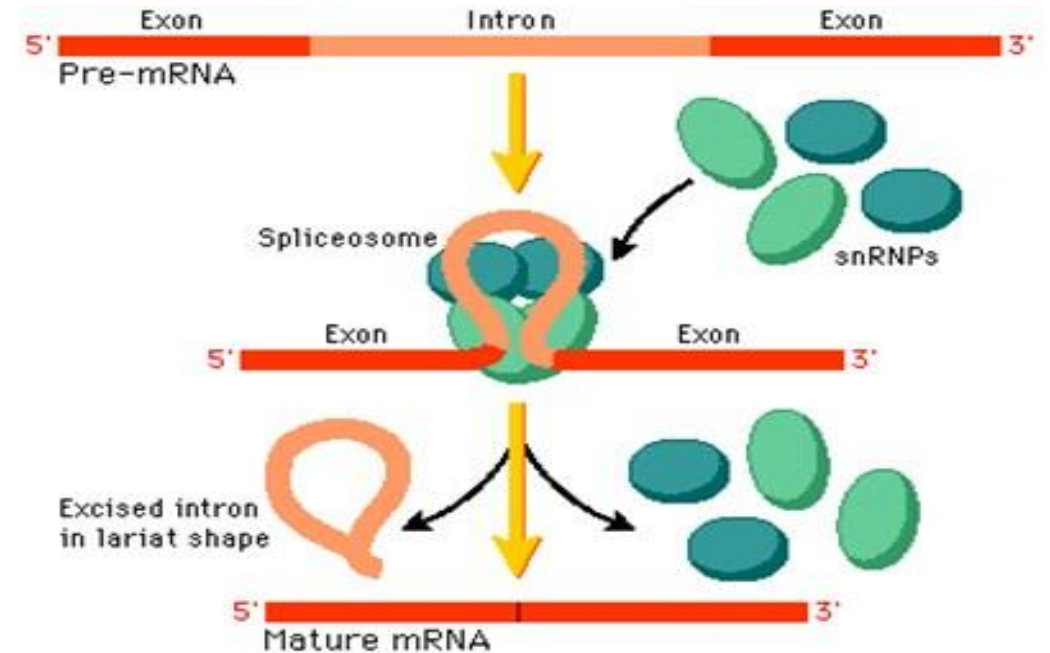
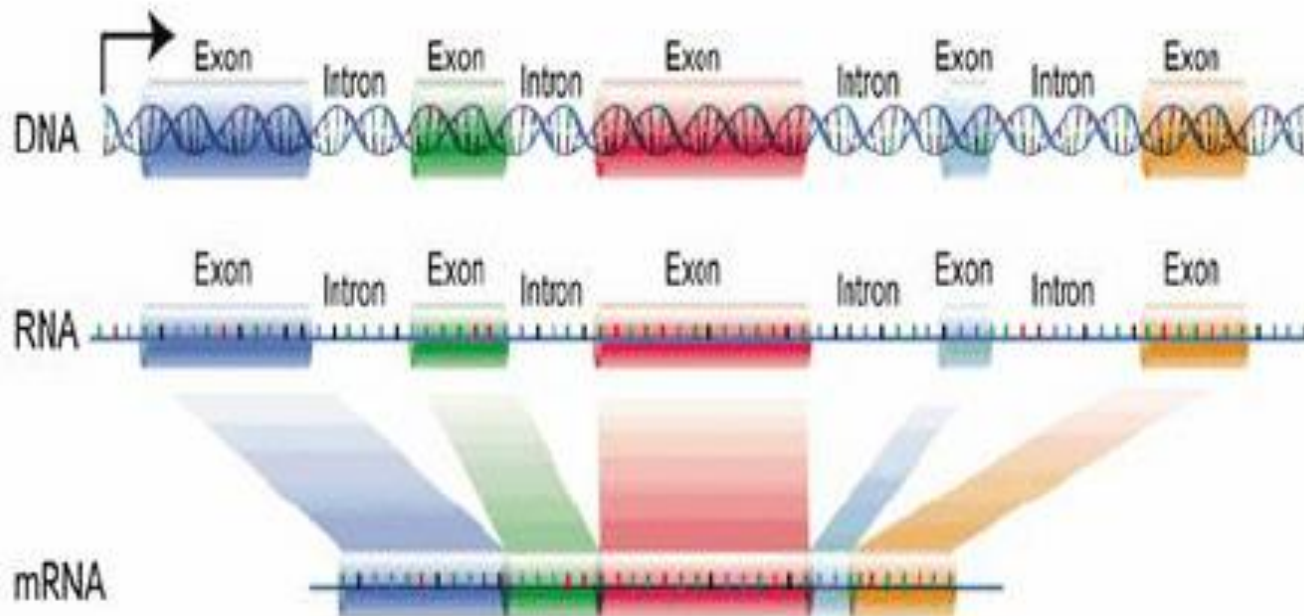
Splicing

Done by spliceosome

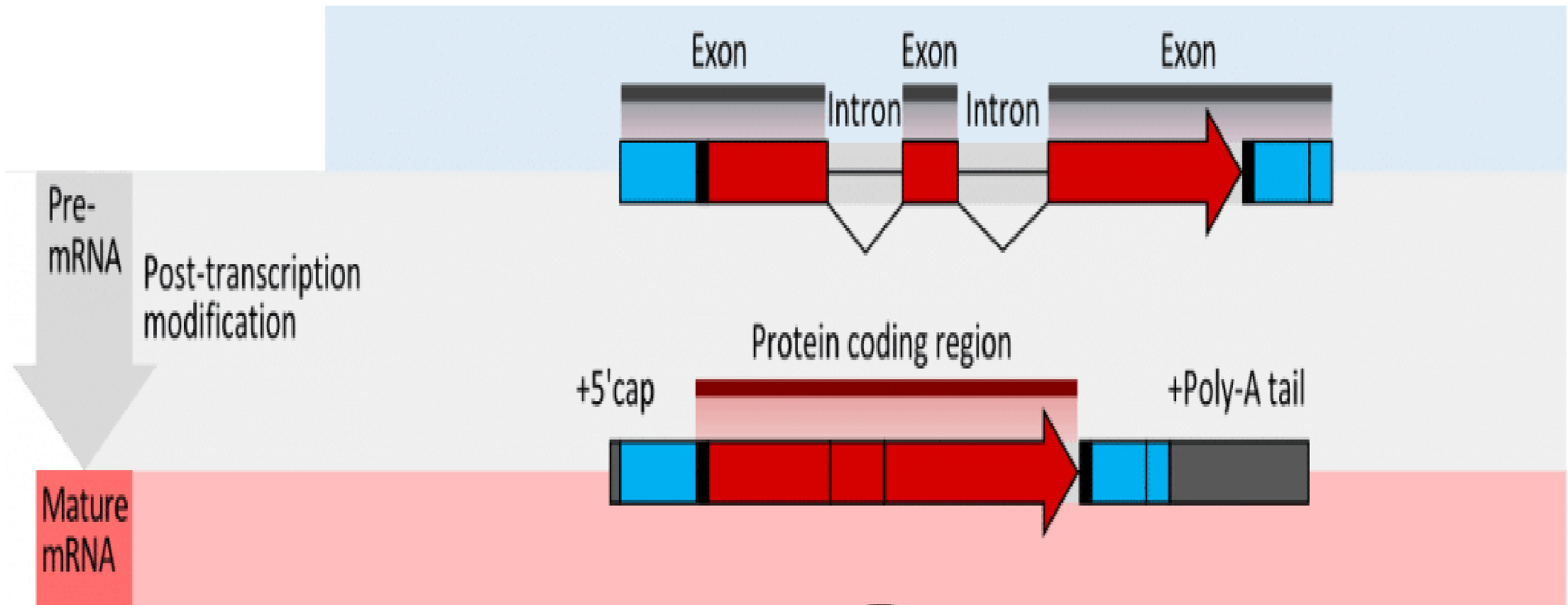
□ The pre-mRNA contains:

- **Coding regions** called **exons** (expressed sequences)
- **Noncoding regions** called **introns** (intervening sequences)

□ **Splicing:** Removal of introns from the pre-mRNA, and linking the exons to form the **mature mRNA (continuous sequence)**, using spliceosome



Posttranscription modification (RNA Processing)



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instructions to make proteins are contained in our DNA. DNA contains genes. A gene is a continuous string of

A photograph of a 'Thank you' card, a pen, and wrapped gifts on a marble surface. The card is white with the words 'Thank you' written in a purple cursive font. A black pen with a white grip is lying horizontally to the right of the card. In the background, there are two wrapped gifts: one with a red and white striped ribbon and another with a white and red patterned ribbon. To the left of the card, there is a bouquet of small purple flowers with green foliage. The entire scene is set on a light-colored, veined marble surface.

Thank
you