Mechanism of Transcription in Prokaryotes

Transcription in prokaryotes

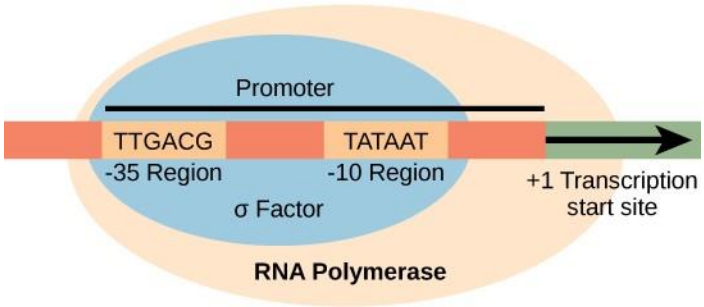
- The process of synthesis of RNA by copying the template strand of DNA is called transcription.
- During replication entire genome is copied but in transcription only the selected portion of genome is copied.
- The enzyme involved in transcription is RNA polymerase. Unlike DNA polymerase it can initiate transcription by itself, it does not require primase. More exactly it is a DNA dependent RNA polymerase.

The steps of transcription

The mechanism of transcription completes in three major steps
1. Initiation:
2. Elongation
3. Termination:

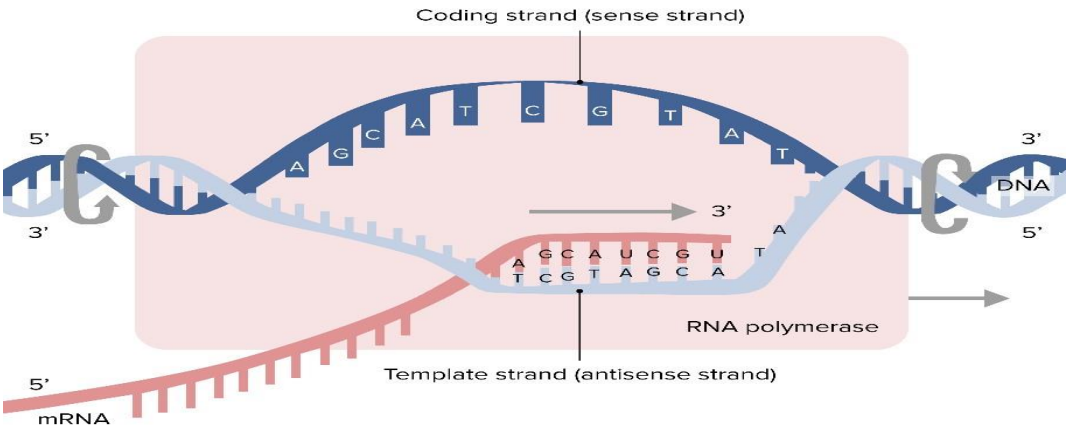
1. Initiation:

- The transcription is initiated by RNA polymerase holoenzyme from a specific point called promotor region.
- Only one RNA polymerase is involve in prokaryotic transcription is called core polymerase it consists of α, β, β' and ω sub units. The core polymerase along with σ-factor is called RNA polymerase holoenzyme.
- In case of e. coli, promotor consists of two conserved sequences the -35 element and -10 element. These sequence are upstream to the site from which transcription begins. RNA polymerase recognizes and binds directly to these sequences.
- Binding of RNA polymerase to the promotor sequence form closed complex.
- After formation of closed complex, the RNA polymerase holoenzyme separates 10 -14 bases from -11 to +3 is called melting. And form open complex.
- If the enzyme synthesizes short RNA molecules of less than 10 bp, it does not further elongates which is called abortive initiation When the RNA polymerase escape from abortive initiation and synthesize RNA more than 10 bp long. This is the formation of tertiary complex.



2.Elongation:

- After synthesis of RNA more than 10 bp long, the σ-factor is ejected and the RNA polymerase move along 5'-3' direction continuously synthesizing RNA.
- The synthesized RNA exit from RNA exit channel.



3. Termination:

There are two mechanism of termination.

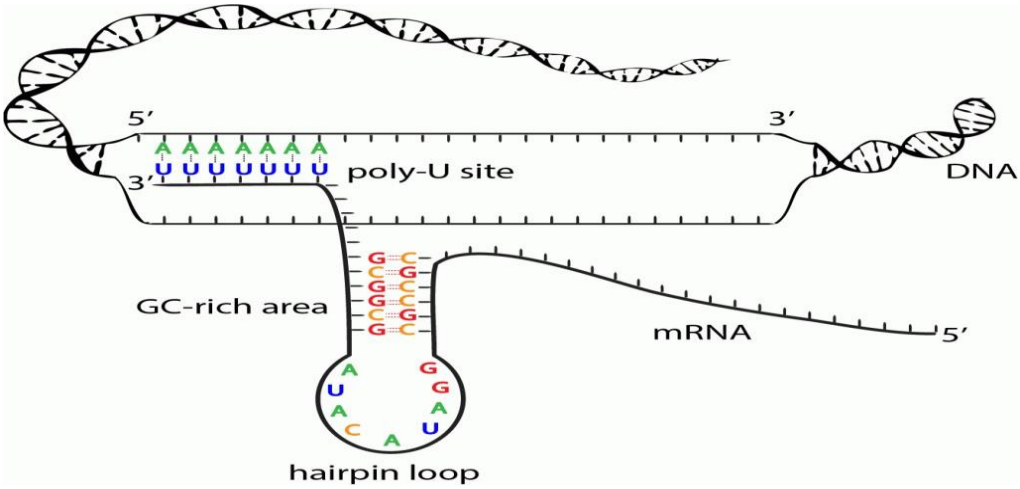
I. Rho Independent:

- In this mechanism, transcription is terminated due to specific sequence in terminator DNA.

- The terminator DNA contains GC rich sequence when RNA polymerase transcribe this sequence RNA get GC rich sequence which is complementary this cause RNA transcript to form hair pin like structure

- The GC sequence is followed by larger number of AAAAAAA on template DNA. When RNA polymerase transcribes this sequence, the uracil appear in RNA.

- The load of hair pin structure is not tolerated by A=U base pair so the RNA gets separated from RNA-DNA hybrid



II. Rho Dependent:

- In this mechanism, transcription is terminated by rho (ρ) protein, It is ring shaped protein.
- The rho protein binds the single stranded RNA and starts "climbing" up the transcript towards RNA polymerase.
- When it reaches the transcription bubble, Rho pulls the RNA transcript and the template DNA strand apart, releasing the RNA molecule and ending transcription.