Transcription Overview

The mechanism for transcription, the creation of an mRNA template from DNA, begins with initiation in which sigma factors and promoters bind to the genes that need to be transcribed. Once the correct sequence is promoted, RNA polymerase binds to the promoter which is typically located just prior to the transcription start site. The DNA opens up by helicase enzymes that create a transcription bubble. Elongation stretches out the bubble as RNA polymerase zips down the DNA, continuing to read the DNA nucleotide sequence and synthesize a complementary RNA strand. It reads in the 3' to 5' direction, like DNA polymerase, so that the new mRNA is synthesized in the 5' to 3' direction. This means that nucleotides are added to the 3' end. Once the desired gene is transcribed, termination occurs and the RNA polymerase is kicked off the DNA. This happens when a hairpin loop, or stem loop, forms and forces RNA polymerase off the DNA. It puts mechanical stress on the RNA-DNA temporary bond. The other method is a series of Rho proteins that push RNA polymerase off, which results in breaking up of the transcription complex.



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Initiation
Initializing-screen
Initiation of transcription occurs when DNA is opened and promoters and sigma factors bind to the promoter regions of genes that need to be transcribed.

RNA Polymerase Binds Promoter
RNA Polly-mirror Binding to Promoter
RNA polymerase binds the promoter region which is slightly upstream of the gene site. Its binding is facilitated by the promoters and sigma factors.

Elongation
Long-johns
Elongation is the extension of that bubble while RNA polymerase is zipping along the DNA, coding an RNA complementary strand of the desired genes.

DNA Opens by Helicase
DNA Opened by Helicopter-briefcase
The DNA opens via helicase enzymes which create a transcription bubble.

RNA Polymerase Reads 3' to 5'
Poly-Mirror Reading from (3) Tree to (5) Hand
RNA polymerase reads DNA in the 3' to 5' direction, such that the new strand is synthesized in the 5' to 3' direction, just like DNA replication.

Nucleotides Added to 3' End
Nuclear-toad at (3) Tree
Nucleotides are added to the 3' end of the growing mRNA molecule, such that the 3' end is being extended while the 5' end is fixed.

Termination
Terminator
Termination of transcription occurs once the gene is finished and can happen in multiple ways.

Stem Loop Formation
Stem Loop
A stem loop is important to the structure of RNA and DNA. It consists of a stem, a double helix, and a loop which links the stem. To stop transcription, a stem loop forms and forces RNA polymerase off the DNA. It does this by putting mechanical stress on the DNA RNA temporary bond, which can pull the strands apart and release RNA polymerase.

Rho Protein Factor
Rowboat Protein
Rho proteins can also directly bump RNA polymerase off the DNA strand, allowing the RNA strand to be read for translation and the DNA strand to recoil.

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