

RNA Synthesis, Processing and Modification

RNA exists in four major classes

- 1- Ribosomal RNA (rRNA)
 - 2- Messenger RNA (mRNA)
 - 3- Transfer RNA (tRNA)
 - 4- Small nuclear RNA (snRNA)
- 1,2,3, are involved in protein synthesis
4 is involved in mRNA splicing.

RNA is synthesized from a DNA template by an RNA Polymerase

- Similarity to DNA synthesis:

1. The Polarity is 5'→3'
2. Large multicomponent Initiation complexes.
3. Watson-Crick base pairing rules.

- Differences from DNA synthesis:

1. Ribonucleotides are used.
2. U is paired to A not T.
3. No primer is involved.
4. Only a small portion of genom is copied to RNA but the whole genom is Replicated.
5. No proofreading of RNA

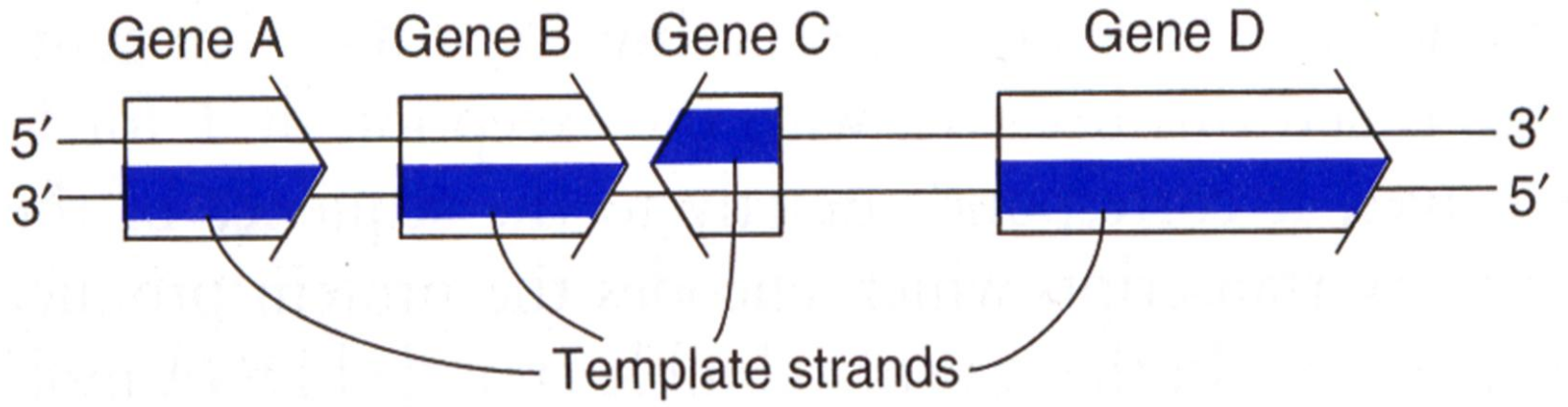
The Template strand of DNA is transcribed

DNA strands:

Coding → 5' —T G G A A T T G T G A G C G G A T A A C A A T T T C A C A C A G C
Template → 3' —A C C T T A A C A C T C G C C T A T T G T T A A A G T G T G T C C

RNA transcript

5' p A U U G U G A G C G G A U A A C A A U U U C A C A C A G C



The PROMOTER

The Enzyme responsible for polymerization of ribonucleotides into a sequence complementary to the template strand of the gene is **DNA-dependent RNA polymerase**. Starts from **Promoter** and ends when reaching **Termination sequence**.

Transcription unit: The region of DNA that includes the signals for Transcription initiation, elongation and termination.

Primary transcript of RNA is capped by 7methylguanosine triphosphate which is necessary for processing to mRNA, for translation of mRNA and for protection of mRNA from exonucleolytic attack.

Bacterial DNA-Dependent RNA Polymerase is a Multisubunit Enzyme

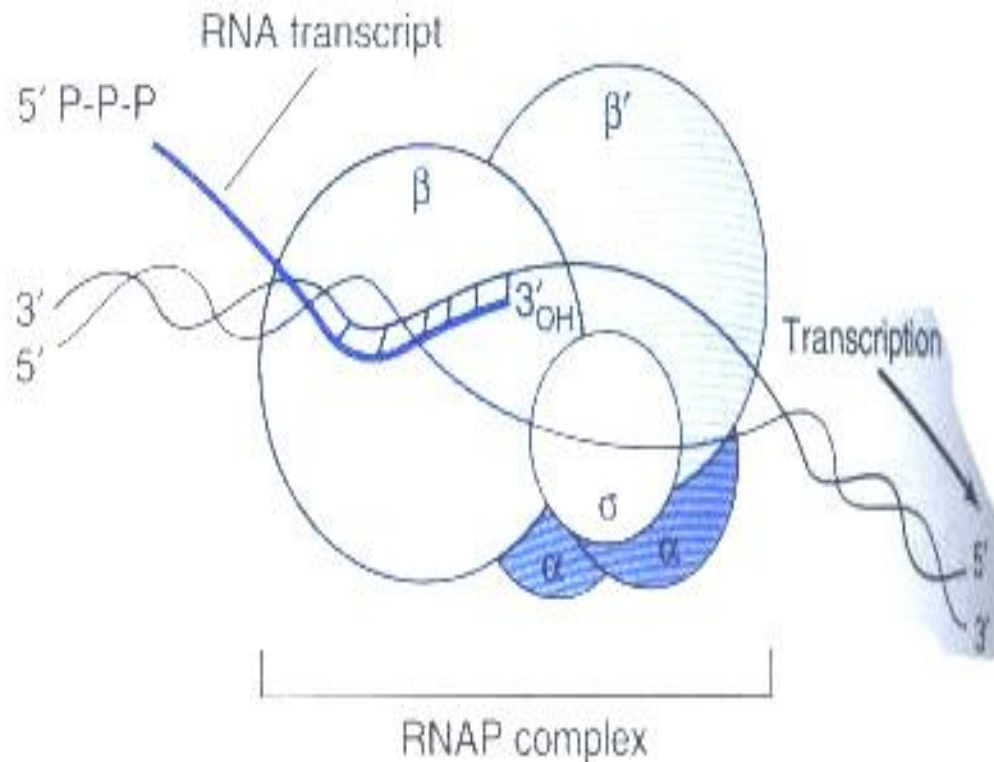
- **RNAP** in E.Coli consists of:

2 α Identical subunits+

2 β Similar (not identical) subunits +
 ω subunit.

The enzyme associates with σ factor (a Protein) which helps RNAP recognize and associate with Promoter sequence on DNA forming the preinitiation complex (**PIC**)

Bacterial DNA-dependent RNA Polymerase is a multisubunit Enzyme



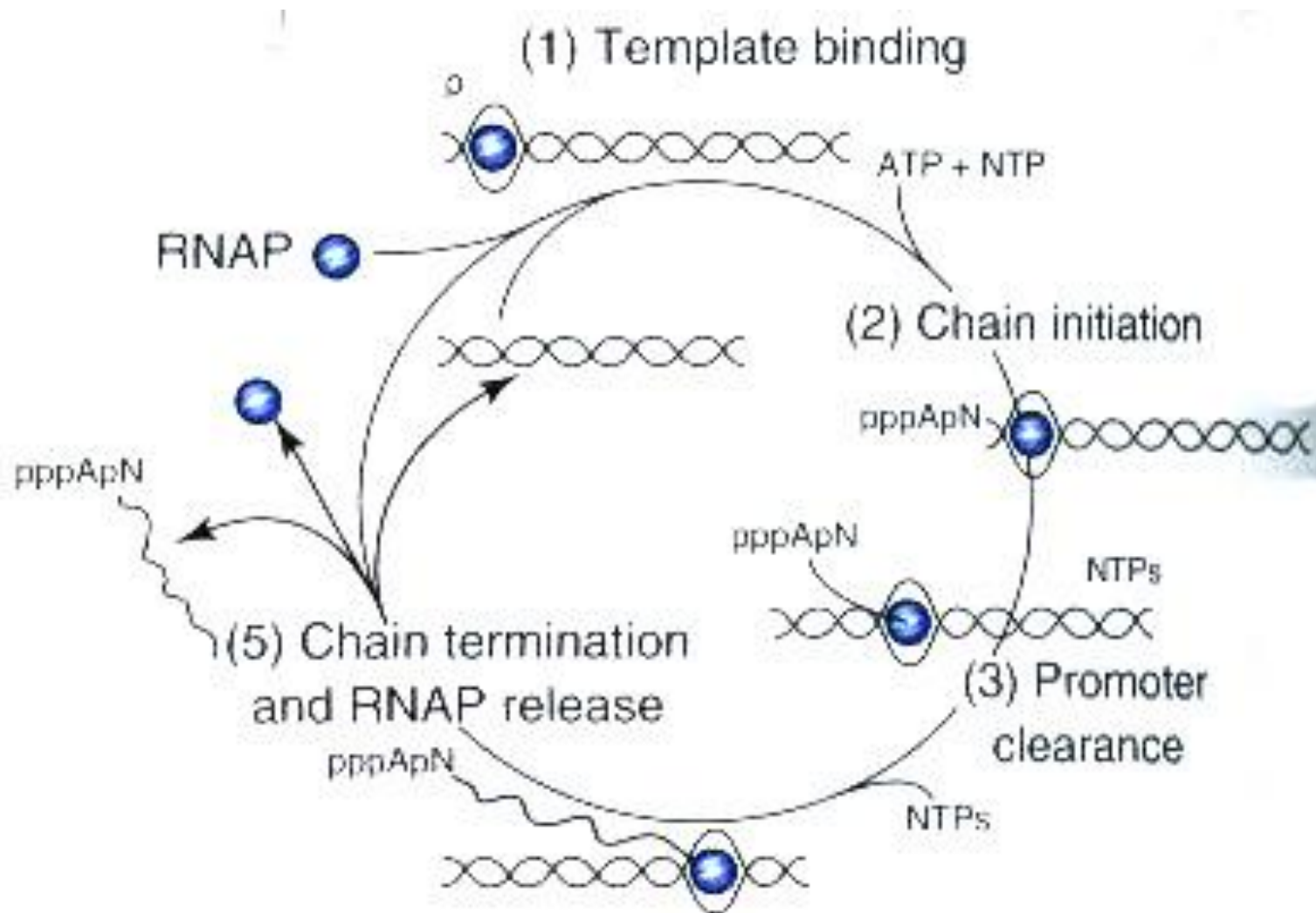
Mammalian Cells Possess Three distinct Nuclear DNA-Dependent RNA Polymerase

- They are much more complex than Prokaryotic RNA Polymerases.
- They consist of two large subunits and as many as 14 smaller subunits.
- A peptide Toxine from mushroom (α Amanitin) is a specific differential inhibitor of eukaryotic DNA-Dependent RNA Polymerase, making it a powerful research tool.

Mammalian cells possess 3 distinct Nuclear DNA-Dependent RNA Polymerase

Form of RNA Polymerase	Sensitivity to α Amanitin	Major products
I (A)	Insensitive	rRNA
II(2)	High sensitivity	mRNA
III(3)	Intermediate sensitivity	tRNA/5S rRNA

RNA synthesis is a cyclical process & involves Initiation, Elongation & Termination



- Initiation:

Binding of RNA Polymerase to Promoter with the aid of the factor σ (sigma).

- Elongation:

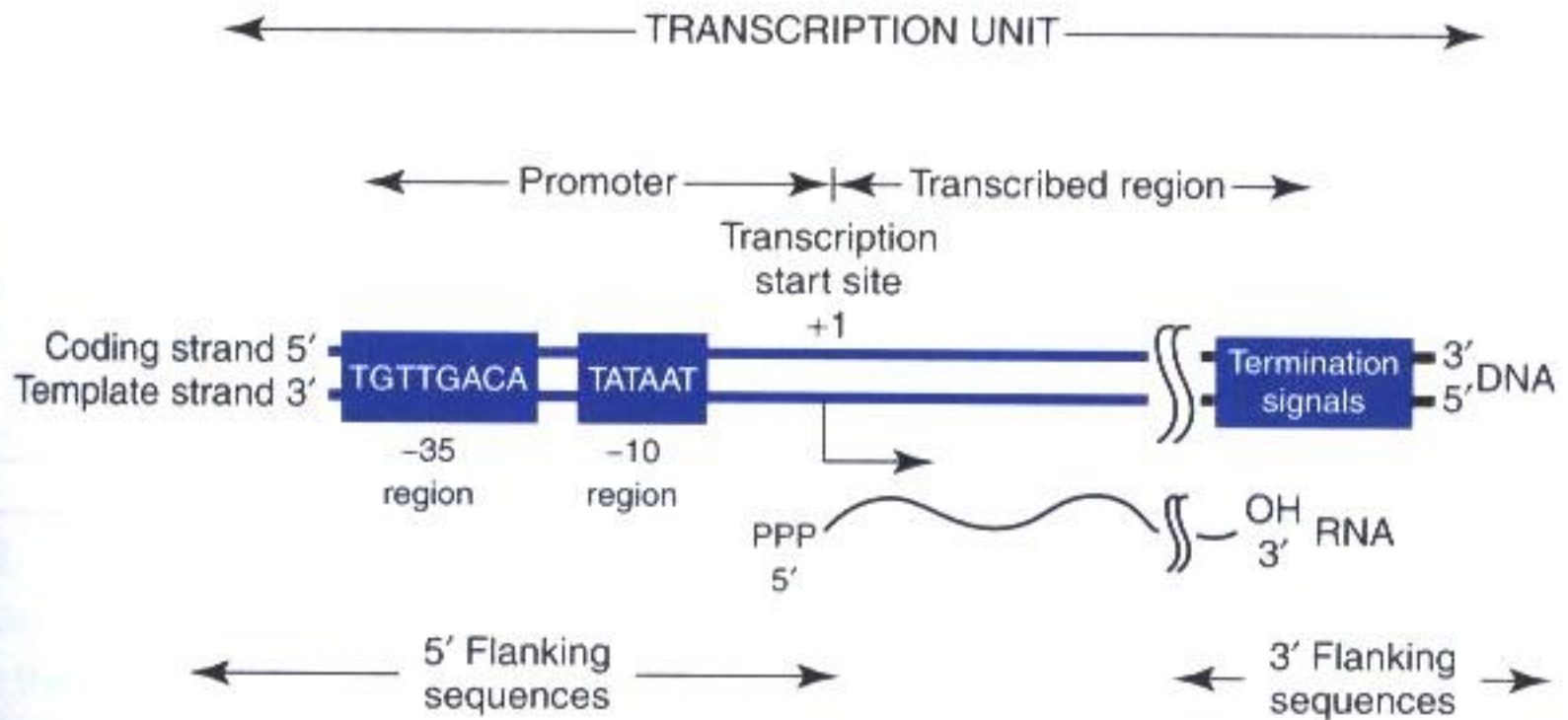
As Elongation factor progresses DNA unwinding must occur, Topoisomerase precedes and follows RNA polymerase (RNAP).

- Termination:

By a termination sequence in DNA template, recognized by Rho factor (ρ) a helicase that disrupts RNA-DNA complex. After termination RNAP dissociates from DNA template and releases σ .

Bacterial promoters

Closed complex, Open complex



Eukaryotic promoters are More Complex

Signals Define:

- 1-Where transcription is to commence.
- 2-How frequently it occurs.

Termination signals

