

RNA Metabolism

Transcription - process by which DNA (genetic info) gets made into RNA (mRNA, rRNA, or tRNA) by an RNA polymerase

mRNA - messenger RNA

- encodes the amino acid sequence of ≥ 1 protein specified by a gene(s)

rRNA - ribosomal RNA

- constituents of ribosomes (proteins synthesized here)

- catalytic and directly involved in protein synthesis

tRNA - transfer RNA

- reads the information encoded in the mRNA and transfers the appropriate amino acid to a growing polypeptide chain during proteins synthesis

During **DNA replication** usually the entire genome is copied, but during **transcription** there is more selectivity (only particular genes are transcribed, some of DNA genome never transcribed)

RNA Metabolism

Transcription - uses DNA-dependent RNA polymerase

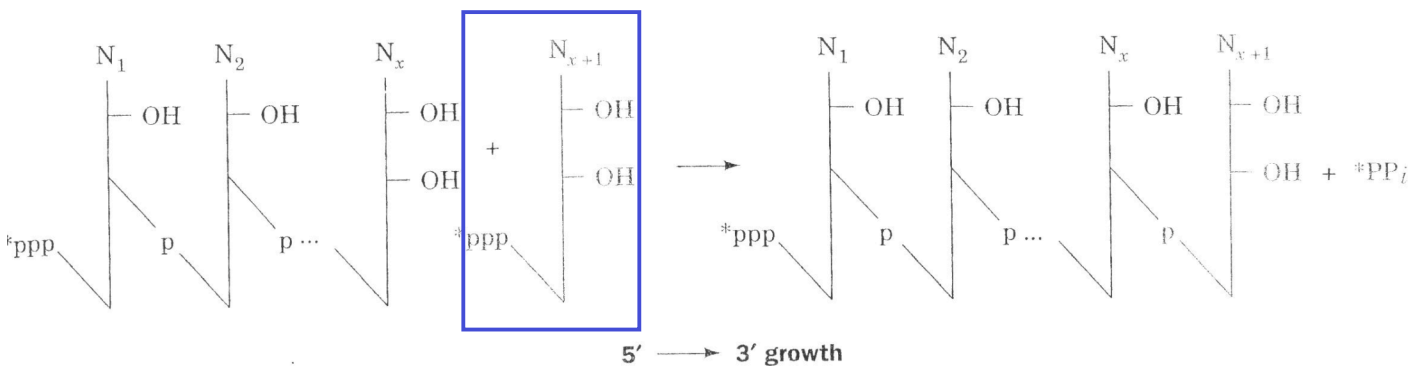
RNA pol requires:

1. DNA template
2. rNTPs (ATP, GTP, UTP, CTP)
3. Mg^{2+}

NO primer needed

3'-OH acts as a nucleophile, attacking the α -phosphate of the next rNTP

RNA pol elongates an RNA in the 5' \rightarrow 3' direction

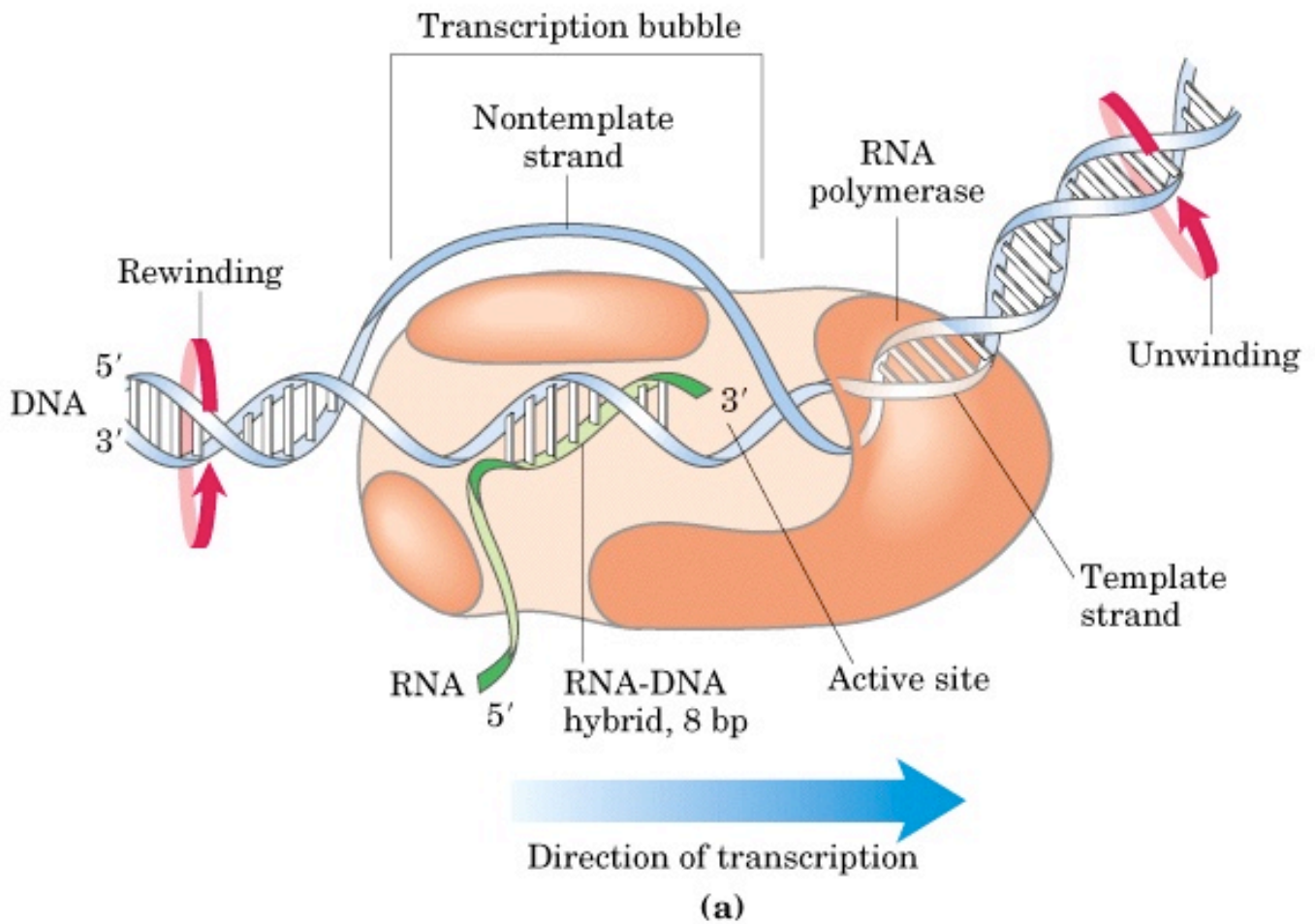


RNA Metabolism

Transcription - uses DNA-dependent RNA polymerase

Polymerization is “asymmetric”

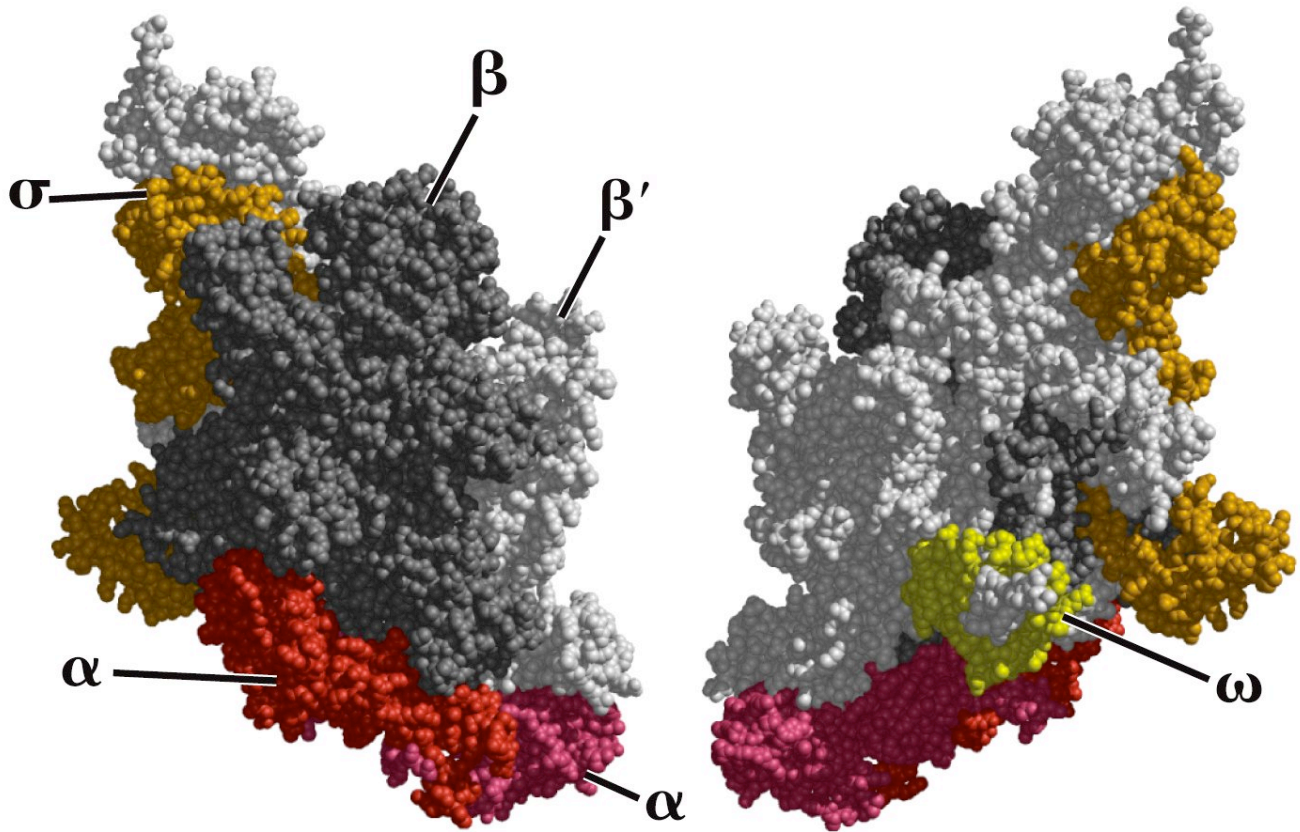
- only one strand of DNA used as template
- new RNA chain is identical in sequence to the nontemplate strand



RNA Metabolism

Transcription

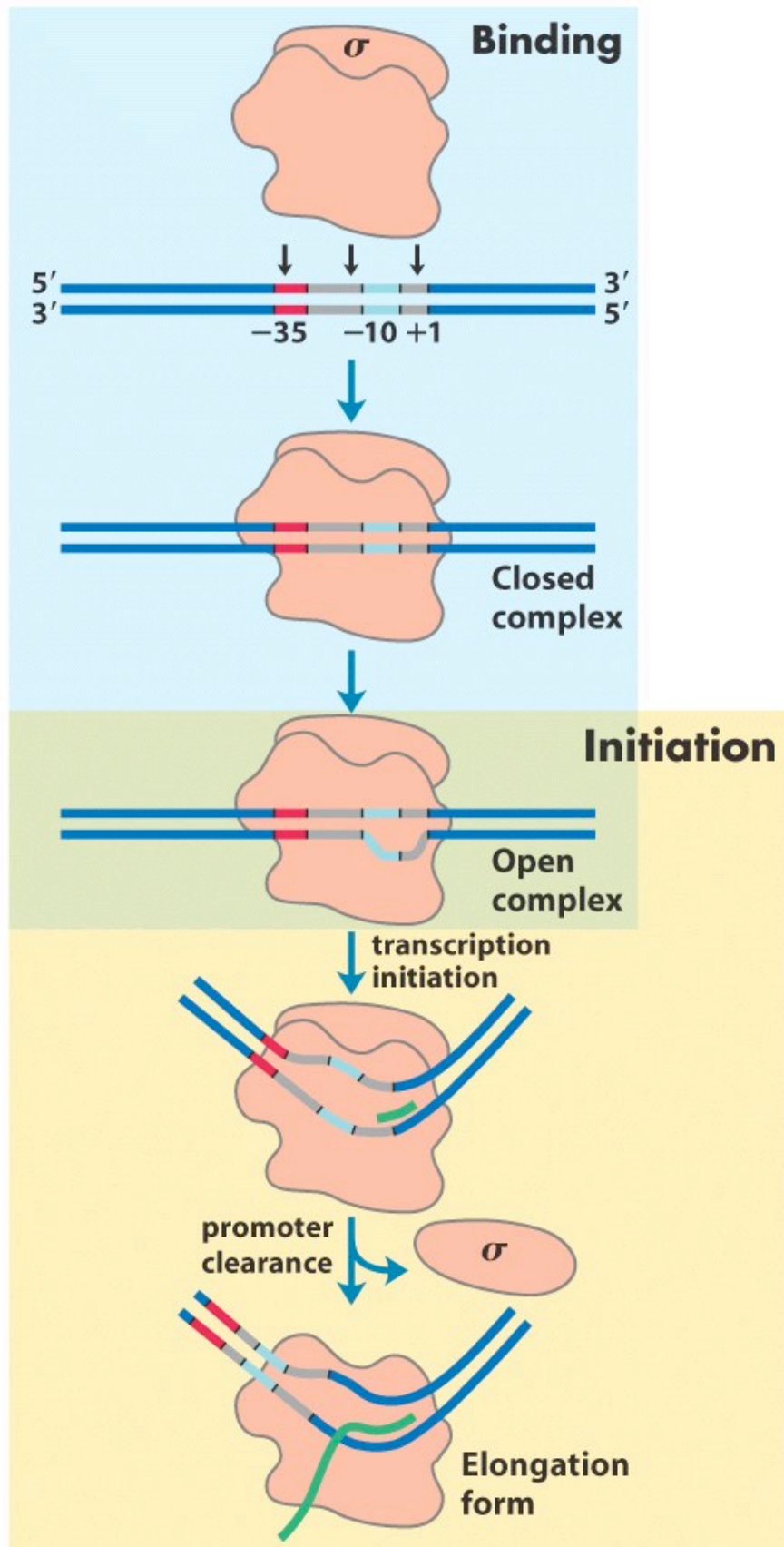
DNA-dependent RNA polymerase from *E.Coli* is large (6 subunits)



| | <u>MW</u> | <u>Number/pol</u> | <u>Function</u> |
|----|-----------|-------------------|---|
| b' | 155 kD | 1 | DNA binding |
| b | 151 kD | 1 | Catalytic site for RNA pol |
| a | 36.5 kD | 2 | Interacts with reg proteins |
| s | 70 kD | 1 | Recognizes promoter Transcription initiation |

RNA Metabolism

Transcription

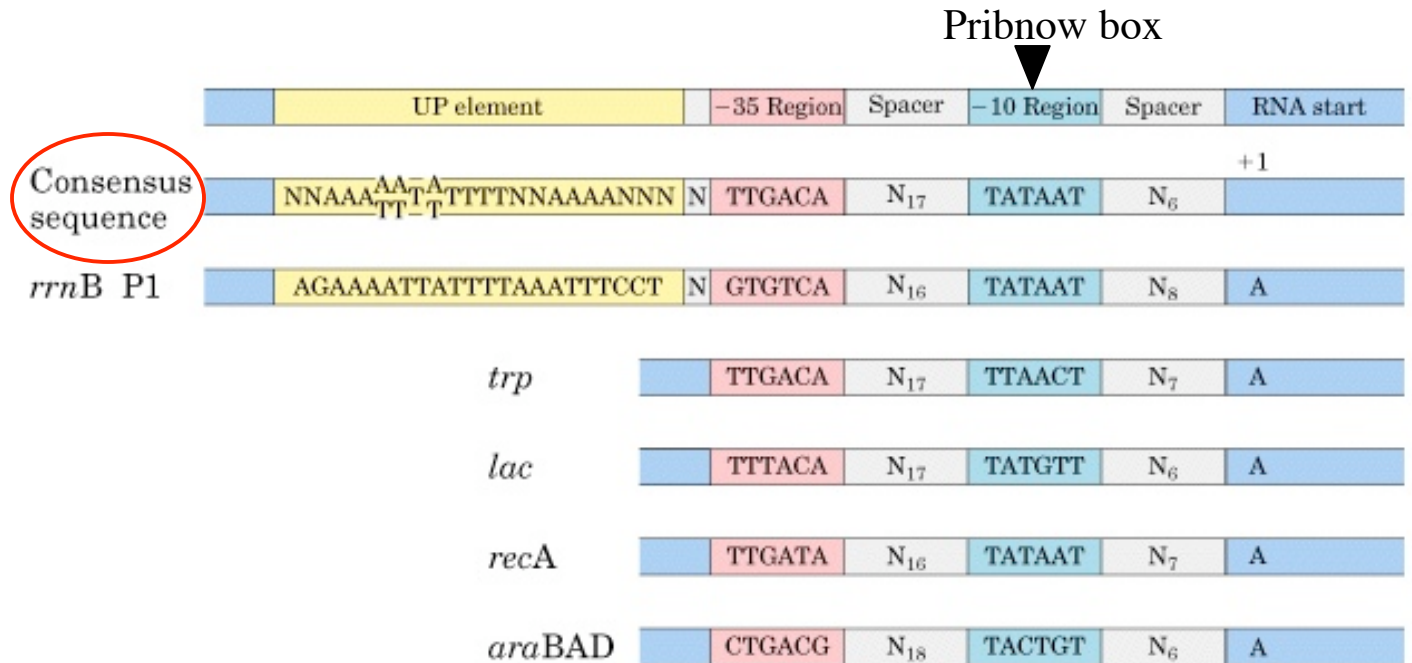


RNA Metabolism

Transcription

RNA synthesis initiated at promoters (specific DNA sequence)

Typical *E.Coli* promoters:



EUKARYOTES:

-75
CAAT box

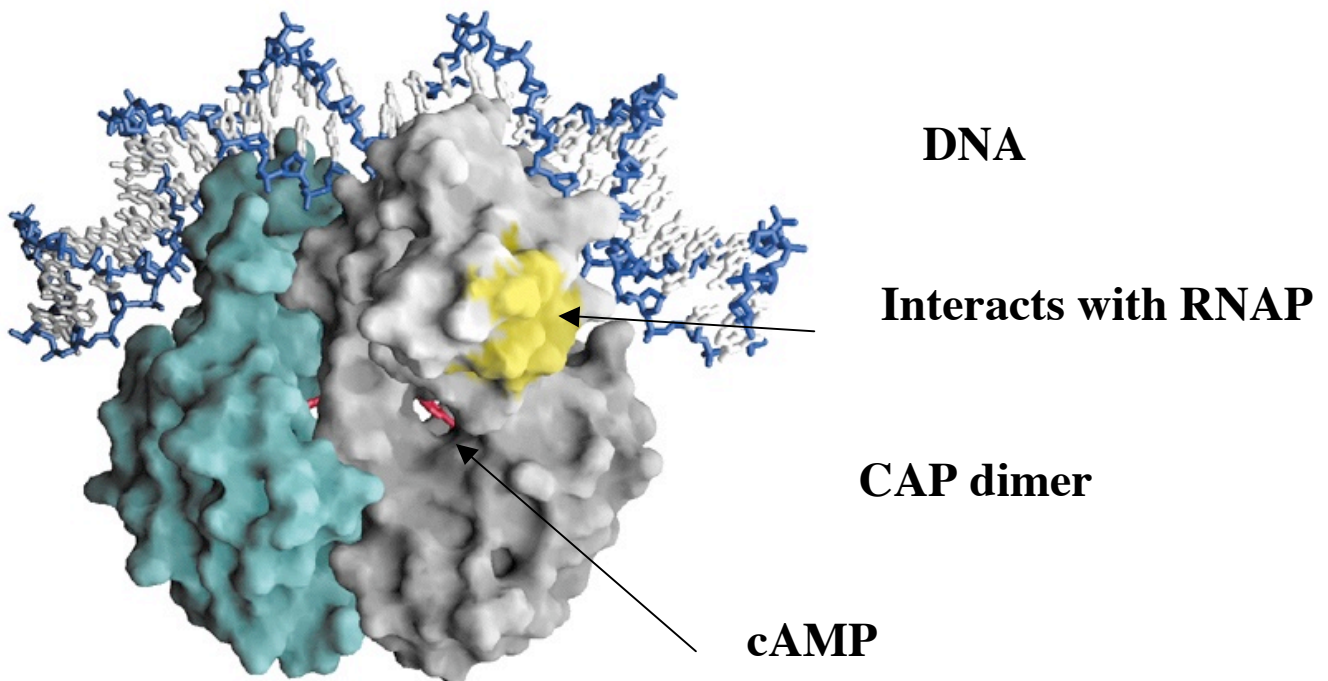
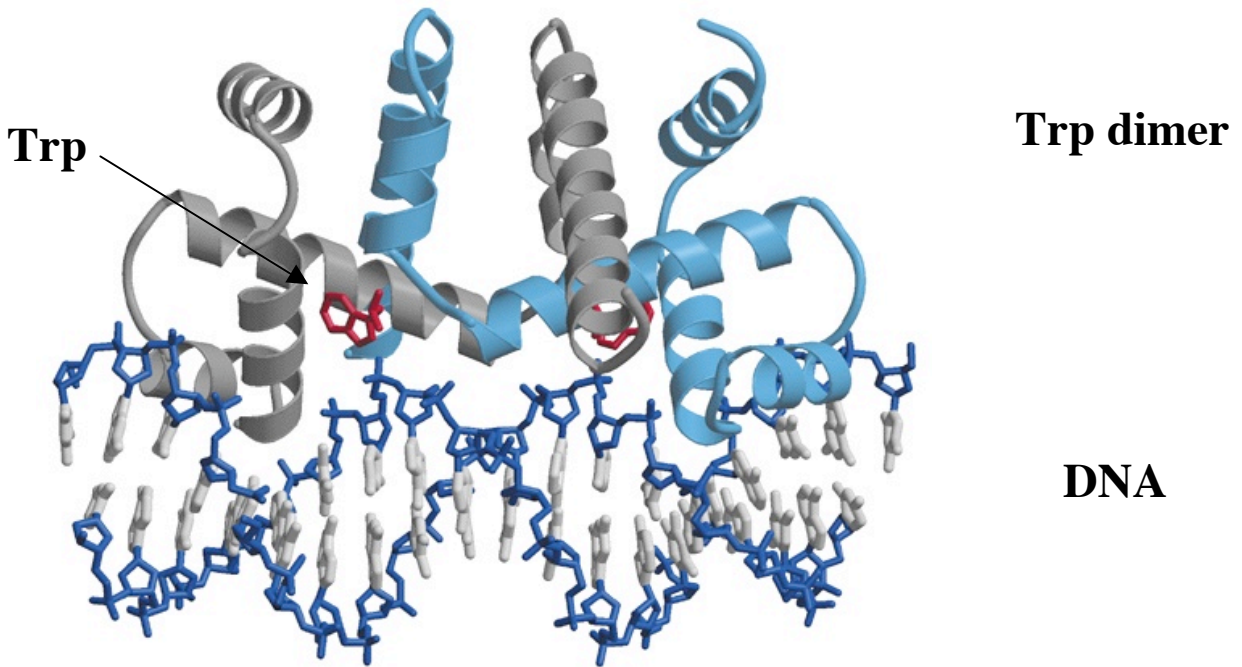
-25
TATA box (TATAAA)

RNA Metabolism

Transcription - frequency of transcription regulated by inhibitors (repressors) and activators of RNA Polymerase

Repressor = trp repressor

Activator = CAP (catabolite activator protein)

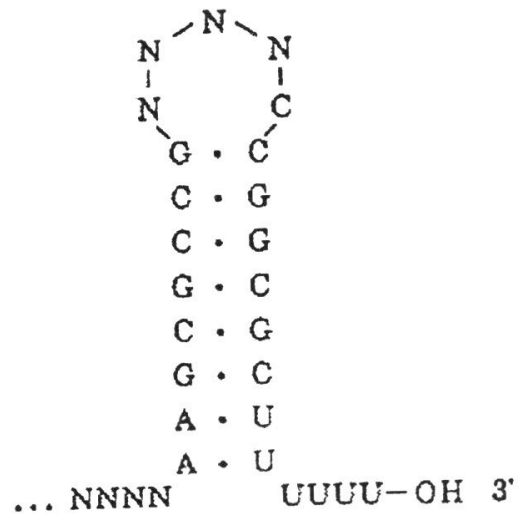
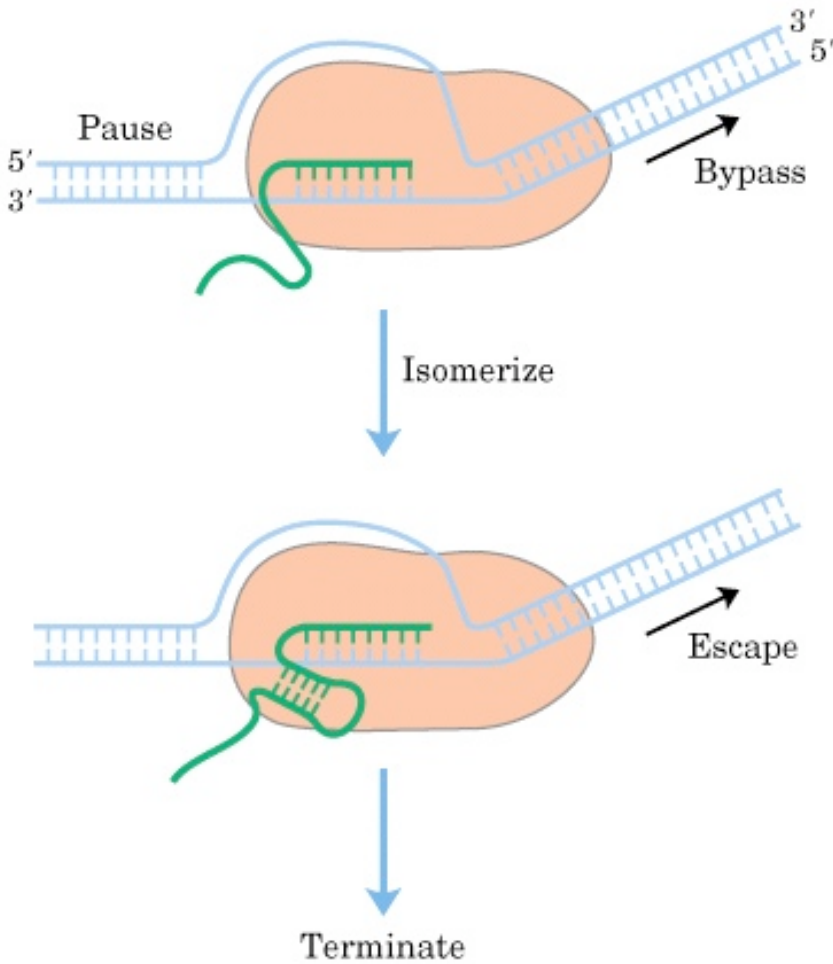


RNA Metabolism

Transcription - termination

Termination sites have a GC-rich region followed by 4-10 A:T bp
 Stem-loop structure in RNA being synthesized induces pausing of RNA
 Polymerase

Weak U:A bp cause a conformational change in RNA Polymerase



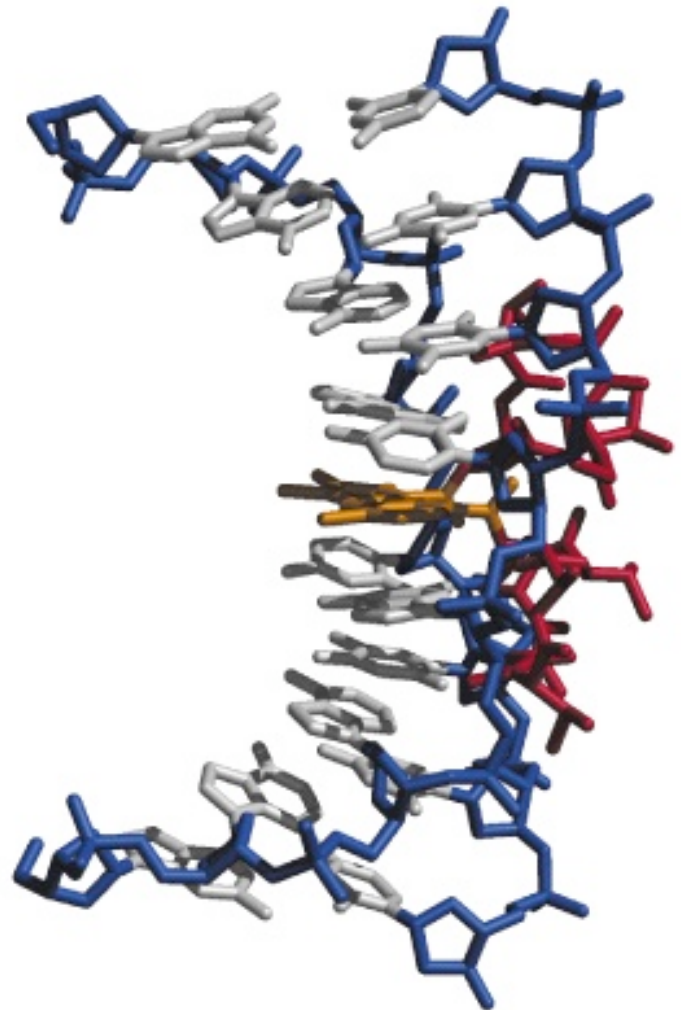
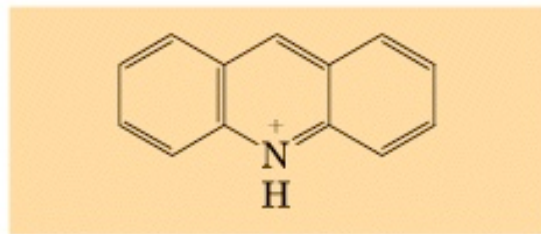
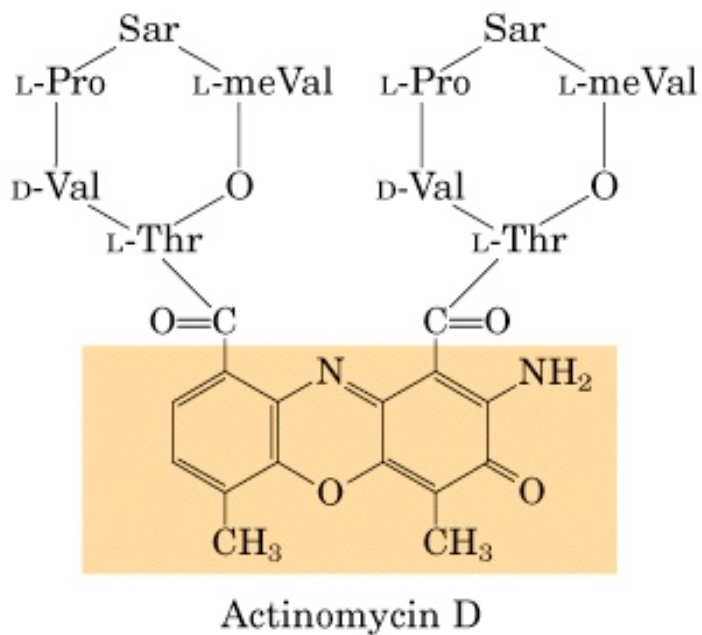
RNA Metabolism

Transcription -

Inhibitors of RNAP

Rifampicin - blocks initiation by binding to β subunit

Actinomycin, acridine - intercalates into DNA, prevents RNAP moving



(a)

(b)