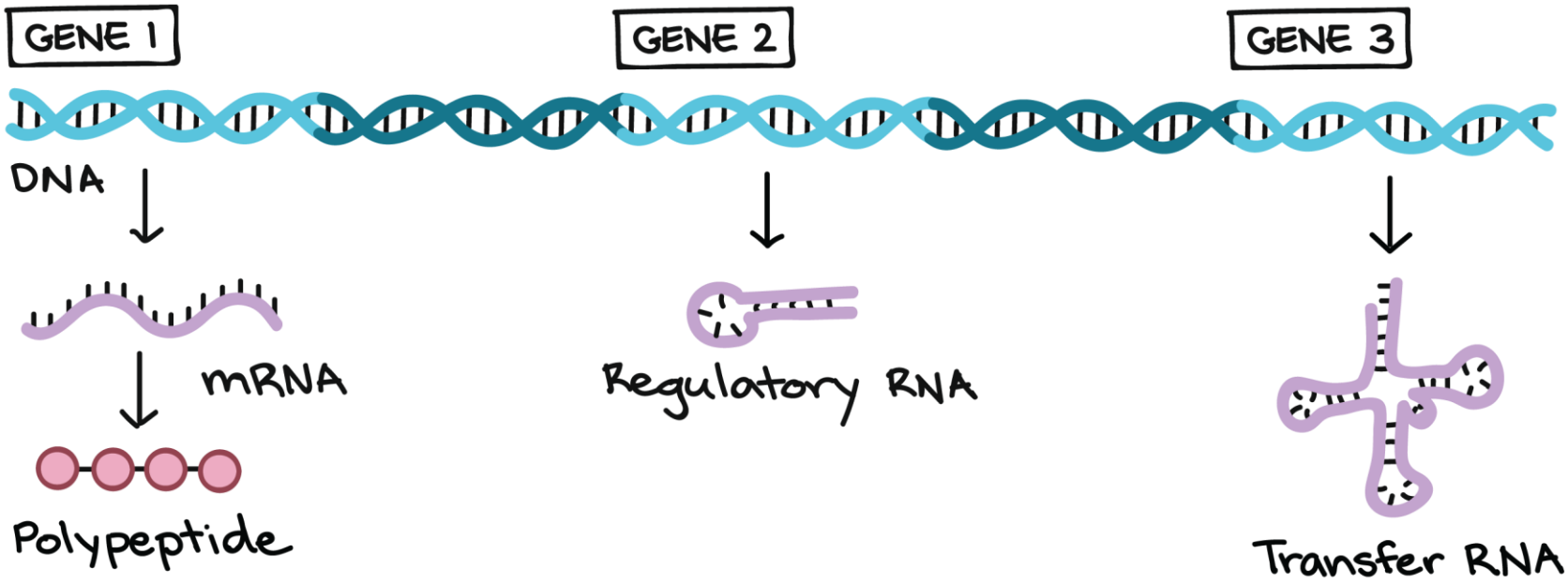
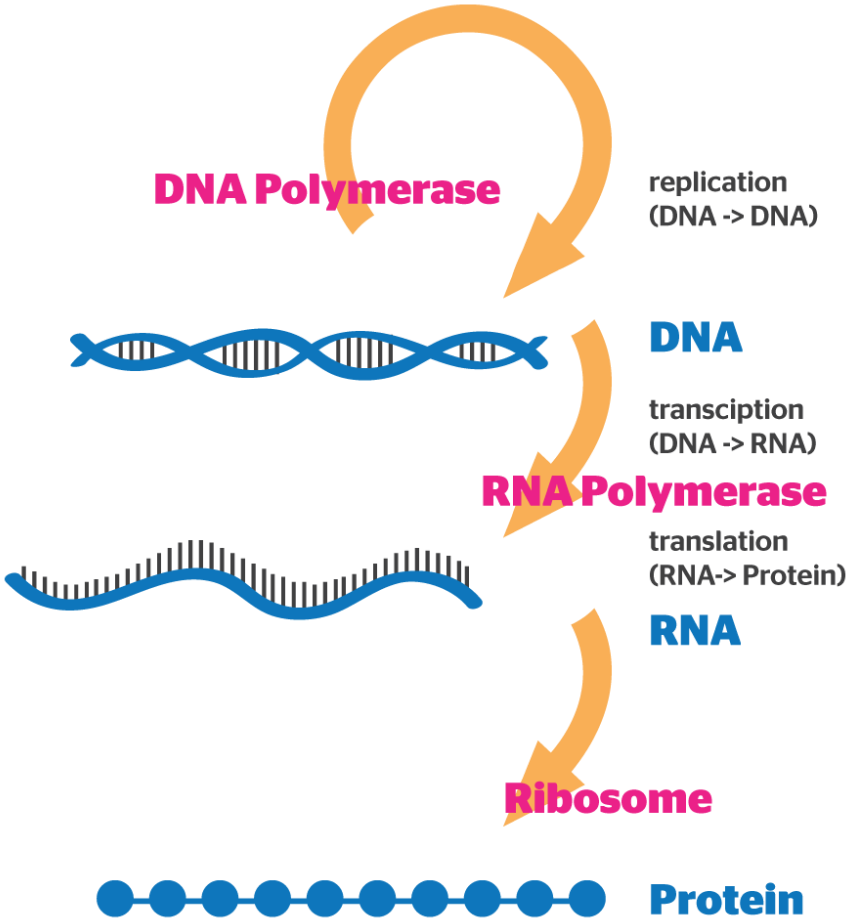
Gene Expression

Gene expression is the process by which information from a gene is used in the synthesis of a functional gene product.

Functional gene products



Central dogma of molecular biology

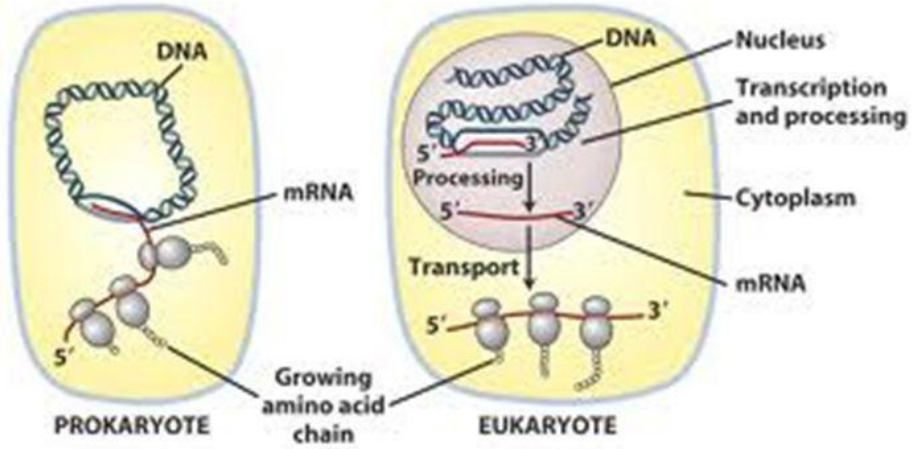


Differences in gene expression between prokaryotes and eukaryotes -1

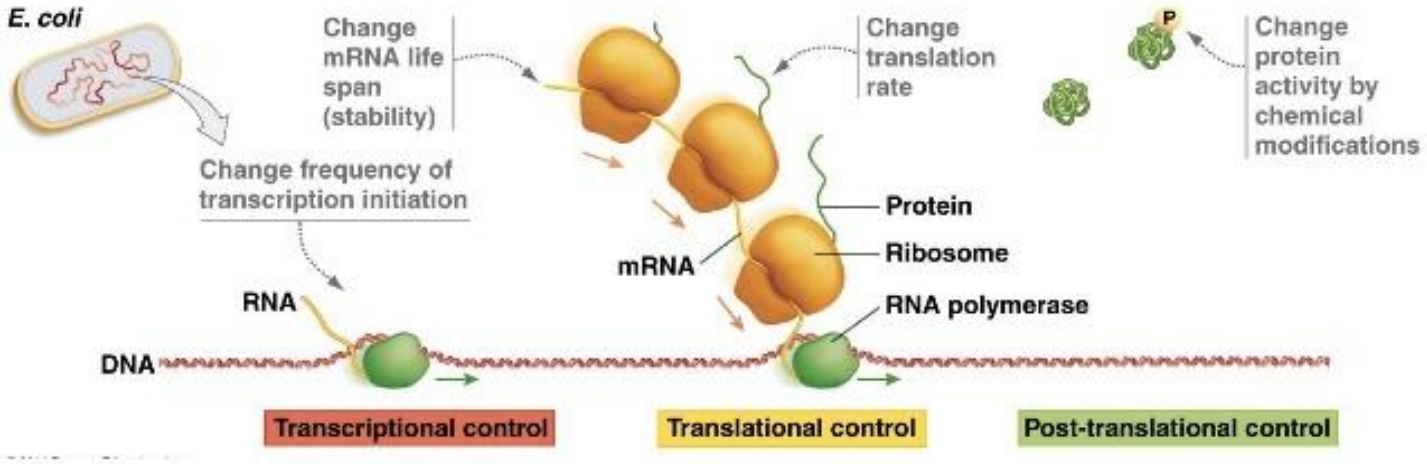
- In prokaryotes transcription and translation often occurs simultaneously and co-localized
- In eukaryotes transcription occurs in nucleus. Messenger RNA is transported outside nucleus where it is translated

Bacteria vs. Eukaryotes

- Both alter their patterns of gene expression in response to changes in environmental conditions
  - This regulation often happens during transcription



Regulation of Gene Expression

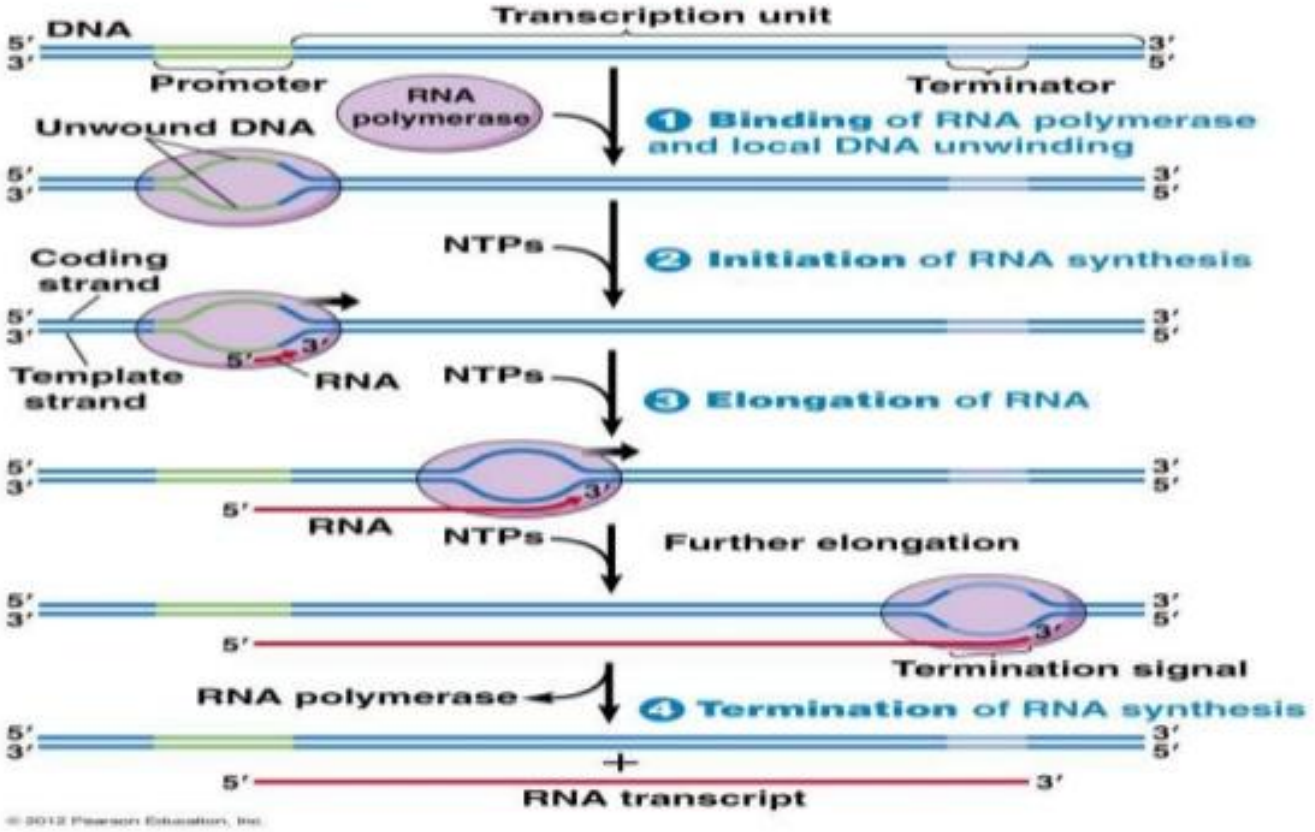


- Gene expression can be regulated:
  - During transcription (transcriptional control).
  - During translation (translational control).
  - After translation (post-translational control).

DNA Transcription in prokaryotes

- There are 3 stages in the transcription process – initiation, elongation and termination.

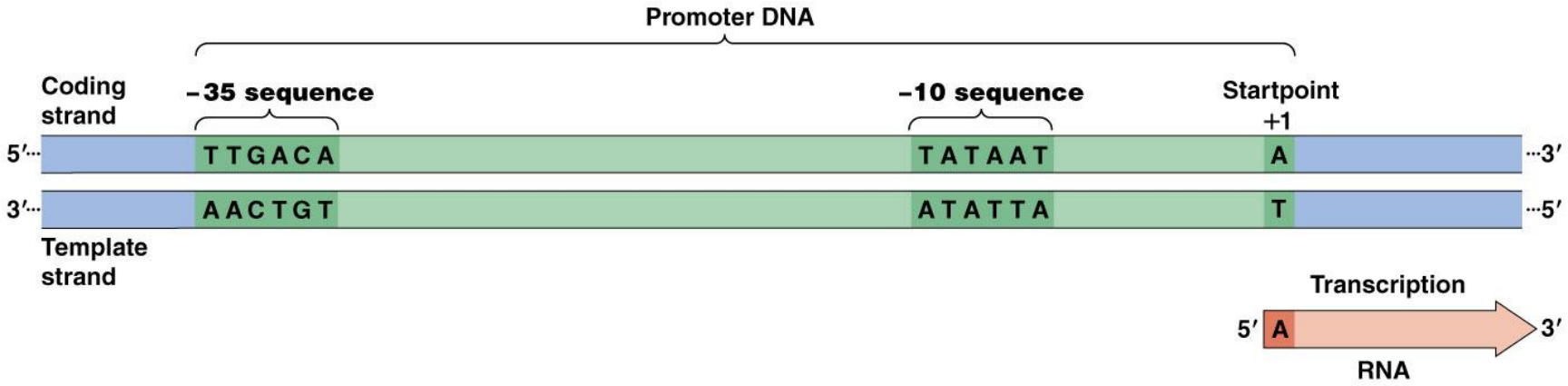
Overview of Prokaryotic DNA Transcription

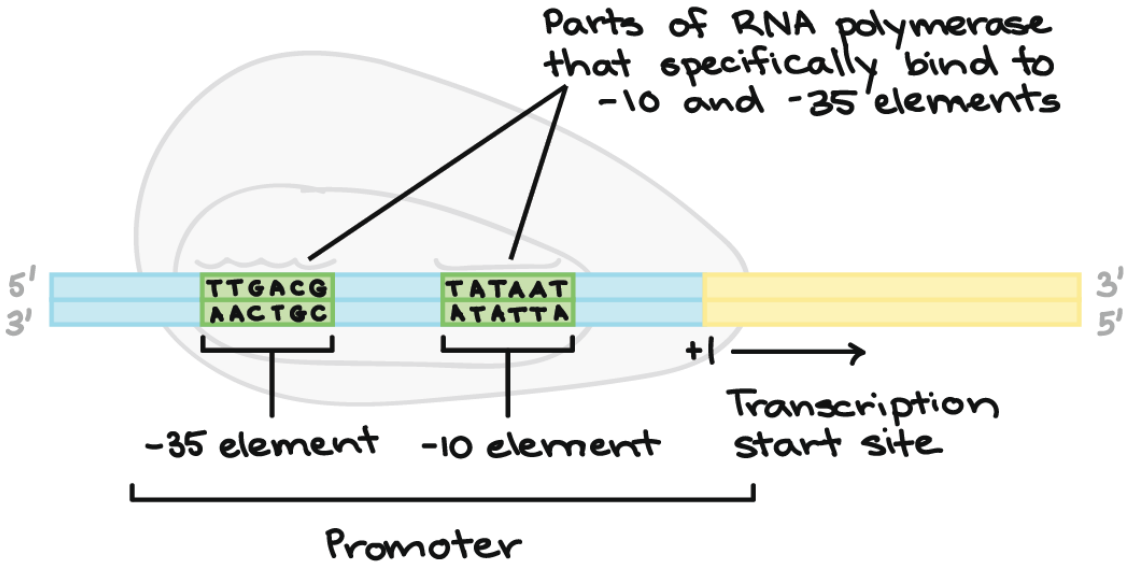


- In bacteria transcriptional control is facilitated mostly through changes in frequency of initiation of transcription

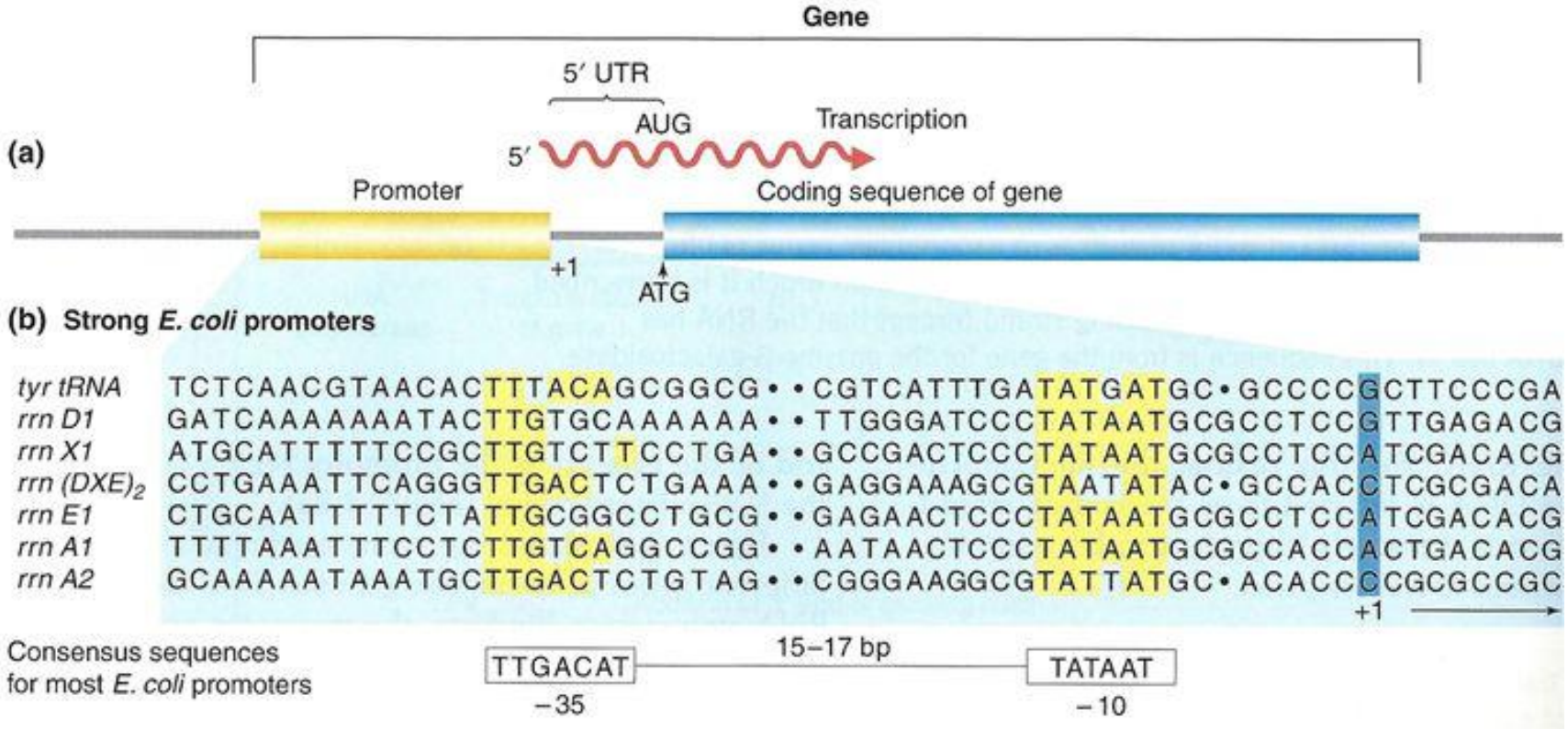
Bacterial promoter

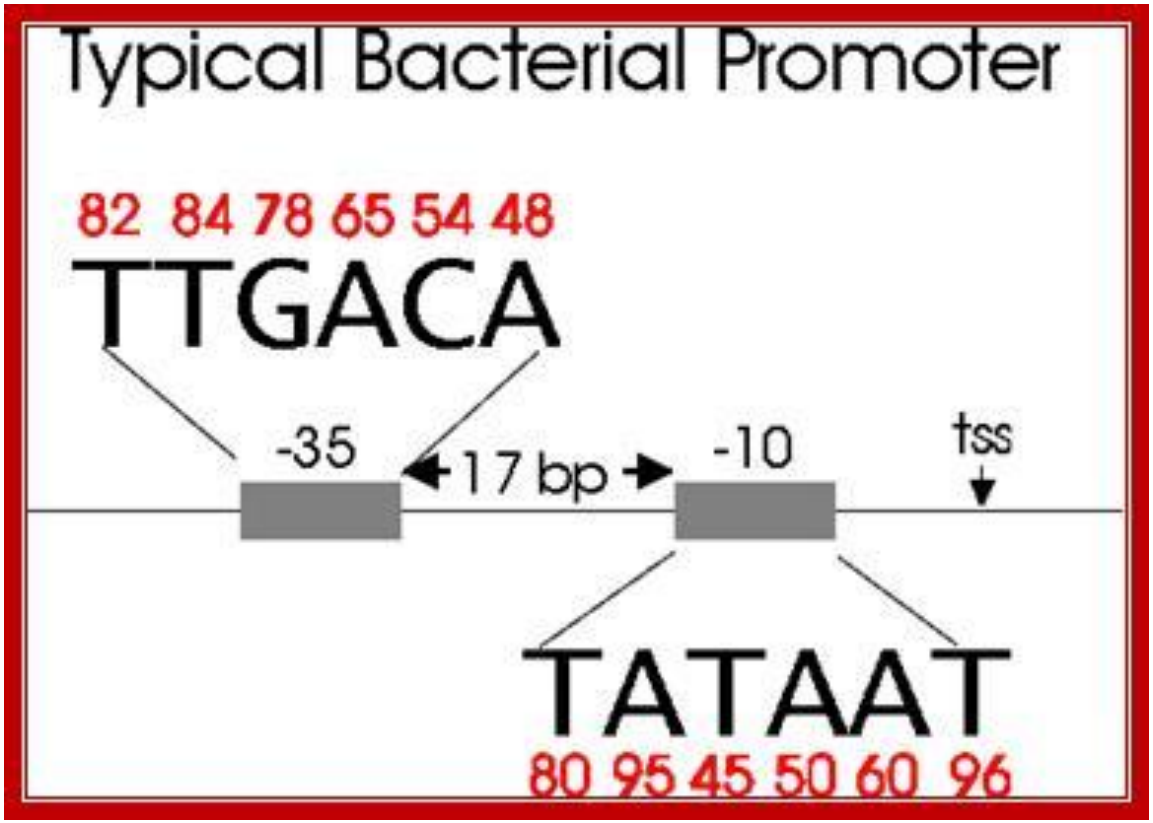
- In genetics, a *promoter* is a region of DNA that initiates transcription of a particular gene.
- In bacteria, the promoter contains two short sequence elements approximately 10 (Pribnow Box) and 35 nucleotides upstream from the transcription start site.




Parts of RNA polymerase that specifically bind to -10 and -35 elements
5'
3'
TTGACG
AACTGC
TATAAT
ATATTA
3'
5'
+1
Transcription start site
-35 element
-10 element
Promoter

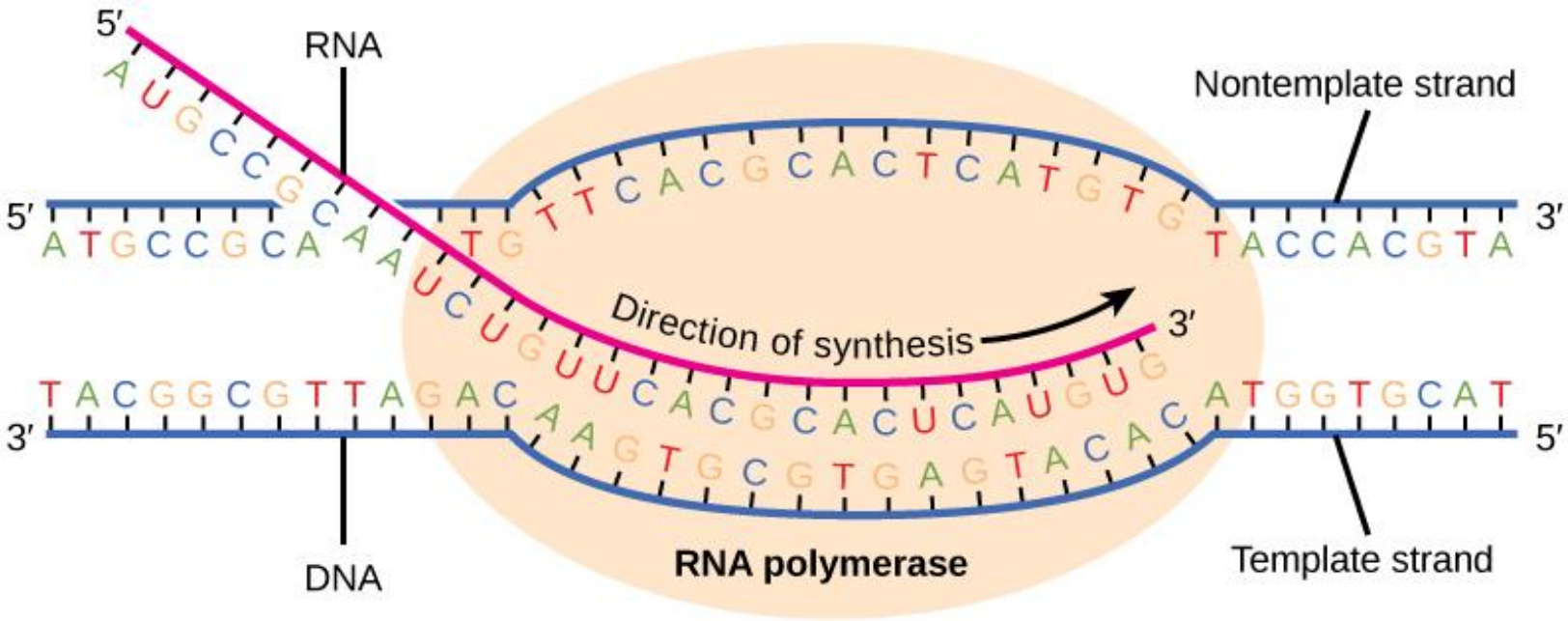
Promoters may differ from the consensus sequence



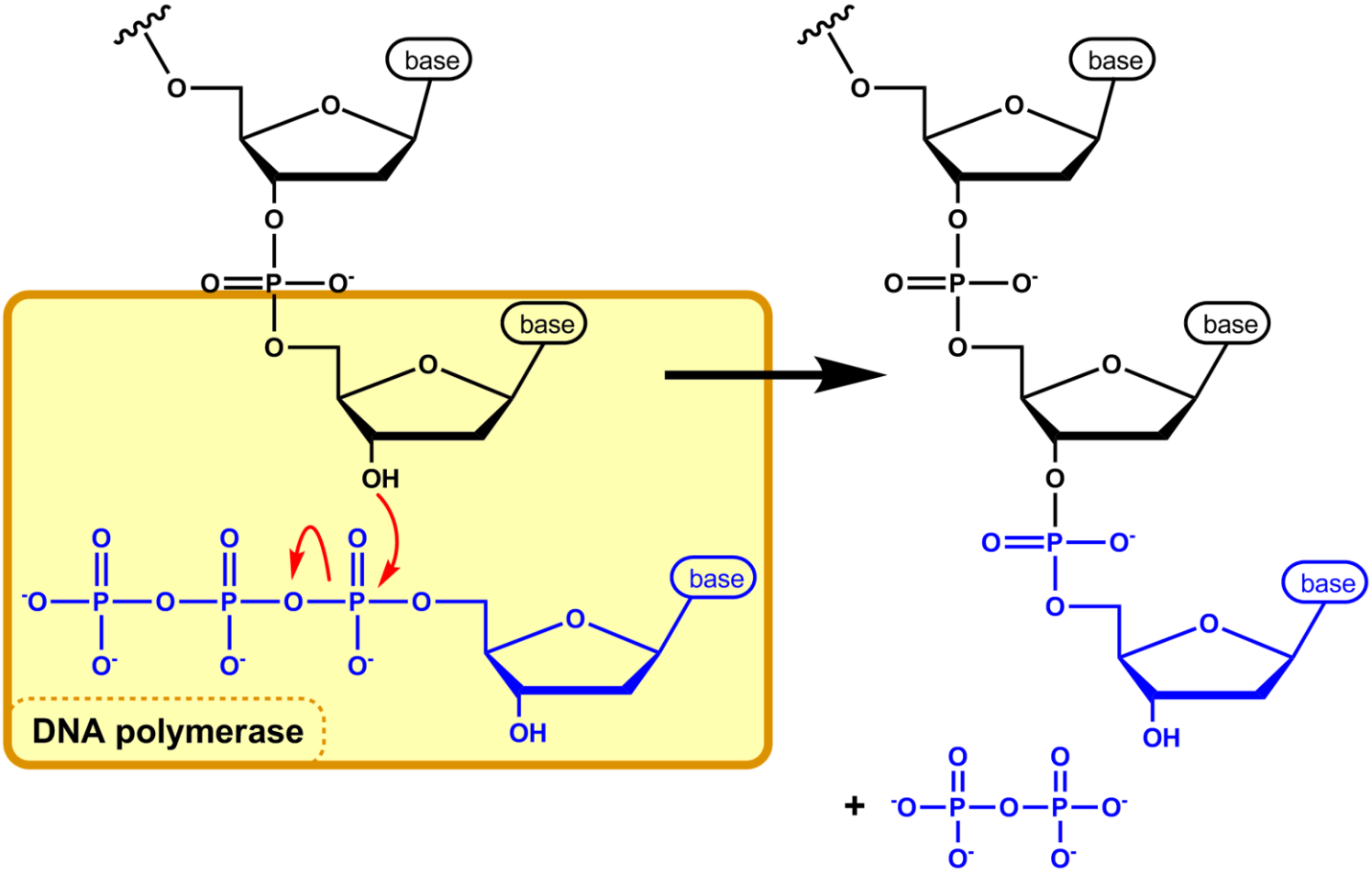

Typical Bacterial Promoter
82 84 78 65 54 48
TTGACA
-35
17 bp
-10
tss
TATAAT
80 95 45 50 60 96

- -35 and -10 sequences determine the rate of a bacterial gene transcription – "*strength of the promoter*"
- Cell might need some proteins all the time. These proteins are synthesized continuously at the same rate. This is called *constitutive* gene expression.
- Other proteins could be synthesized in response to an external stimulus, e.g. certain nutrient present in the growth medium.

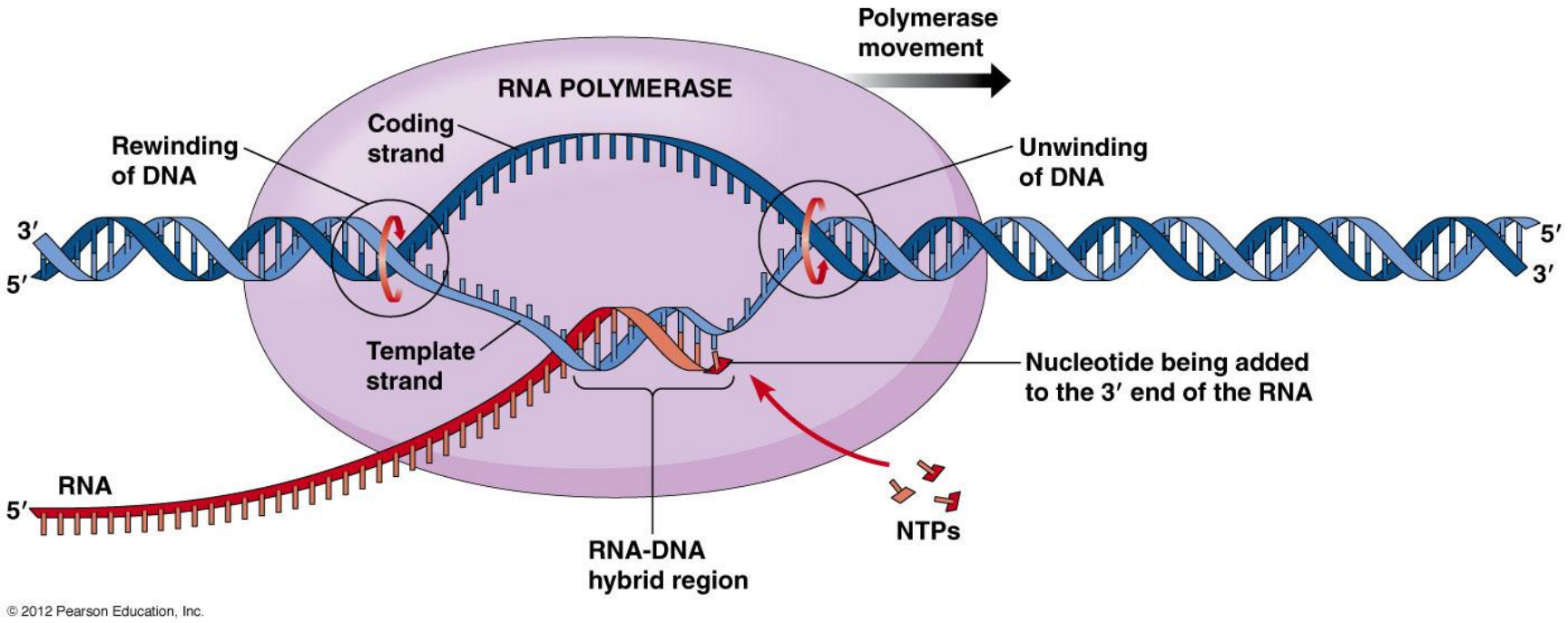
Transcription. Elongation.



Addition of new monomer to the growing RNA (RNA) strand



Transcription. Elongation.



Termination of transcription in prokaryotes