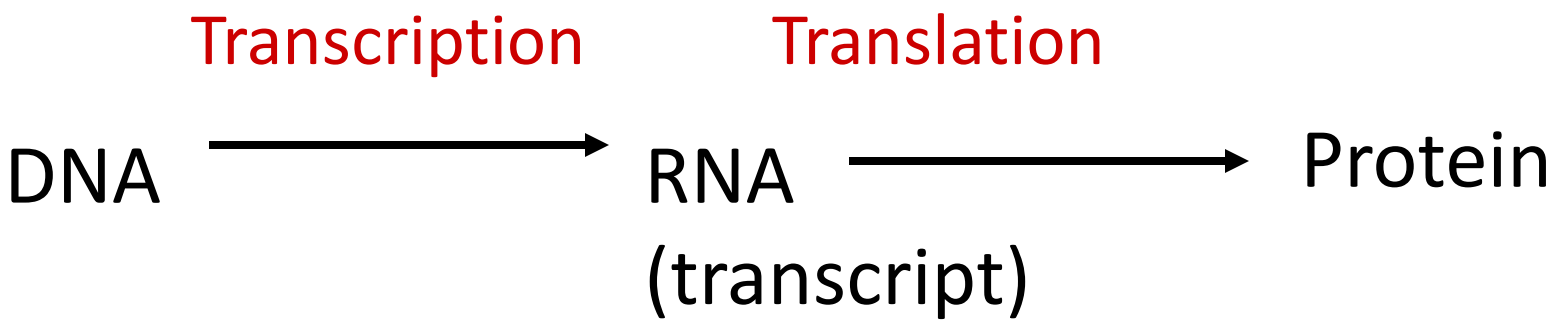
Transcription and gene regulation

Central Dogma of Molecular Biology



The four types of biopolymer molecules “macromolecules”

1. Carbohydrates
2. _____
3. Fats (lipids)
4. _____

DNA Structure

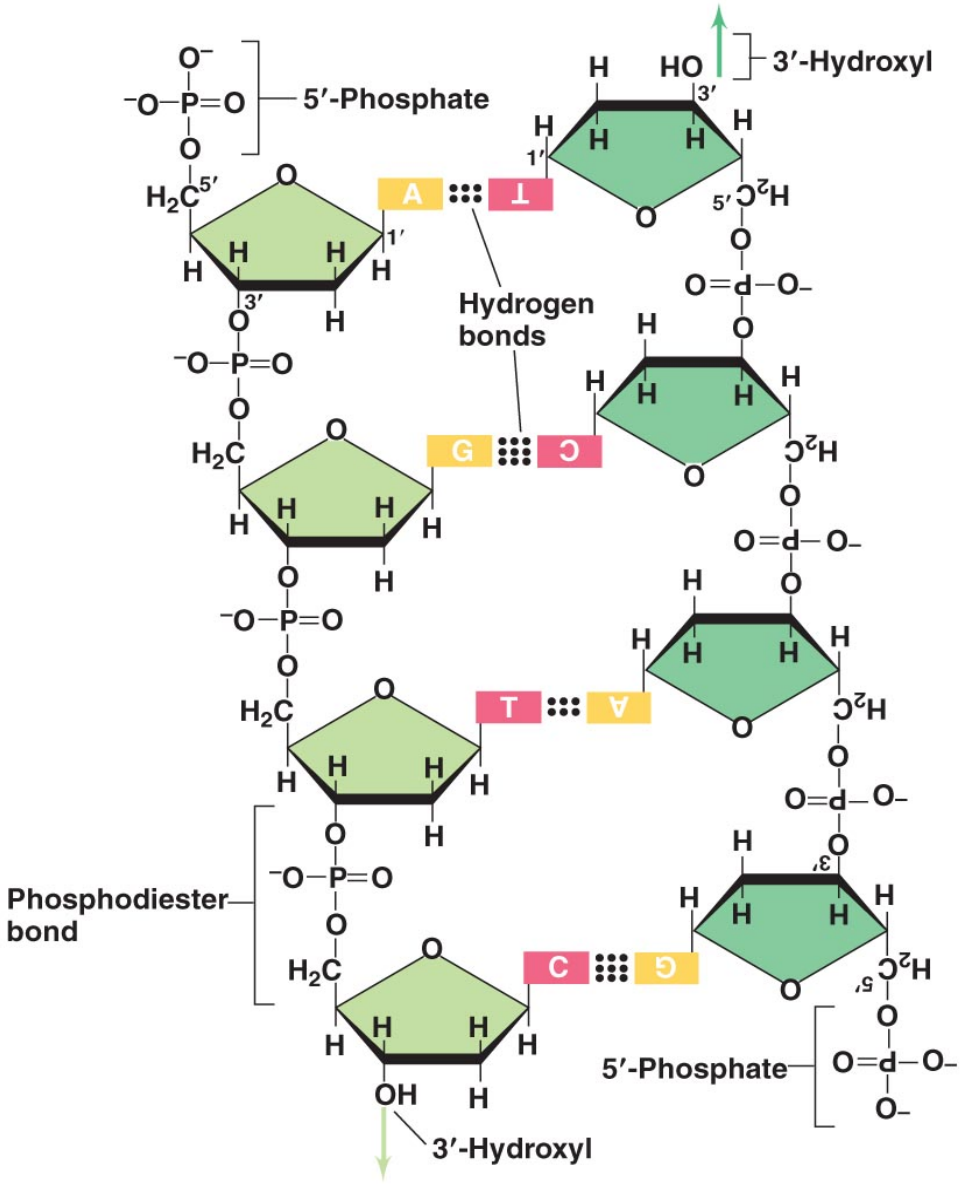
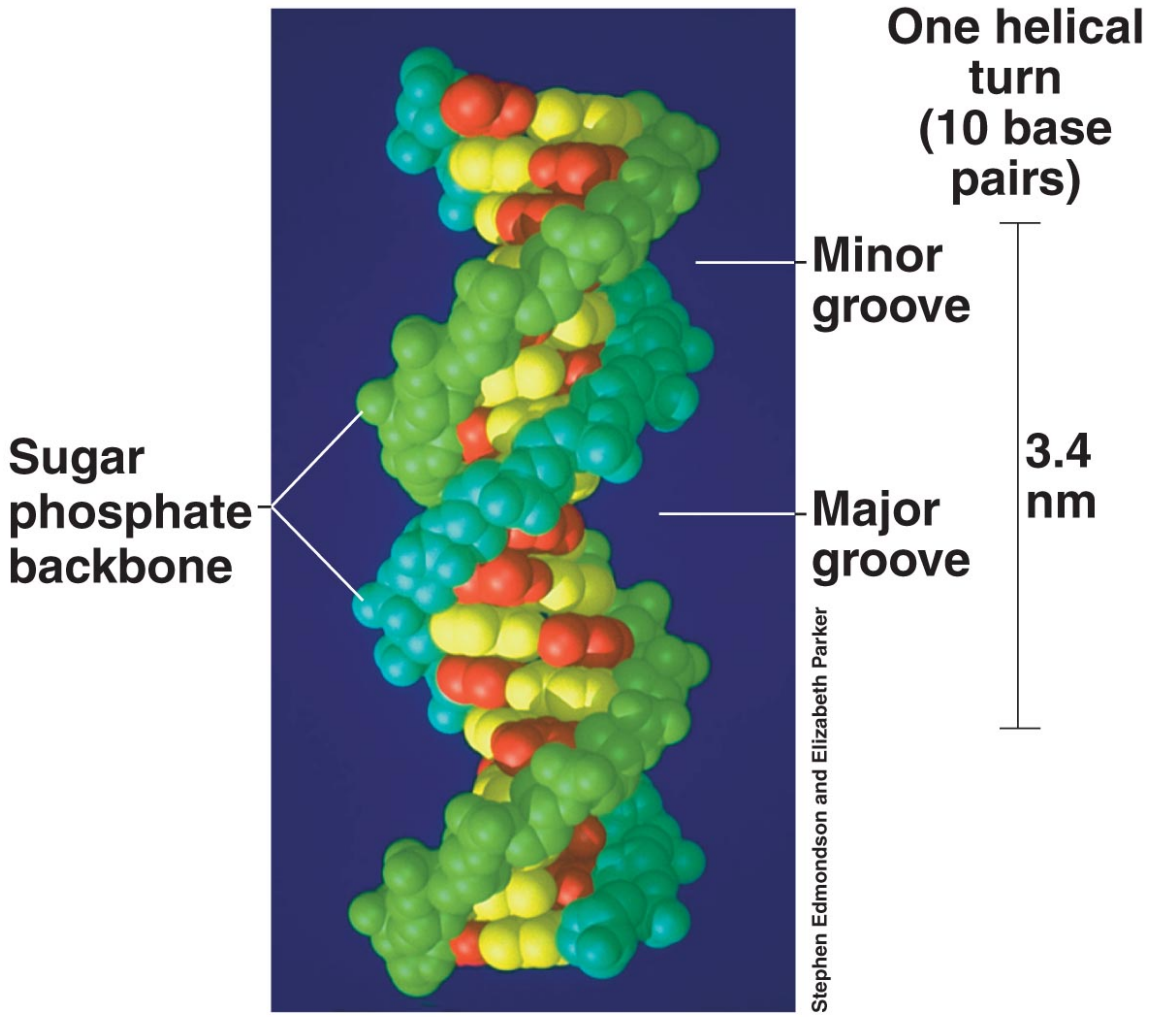


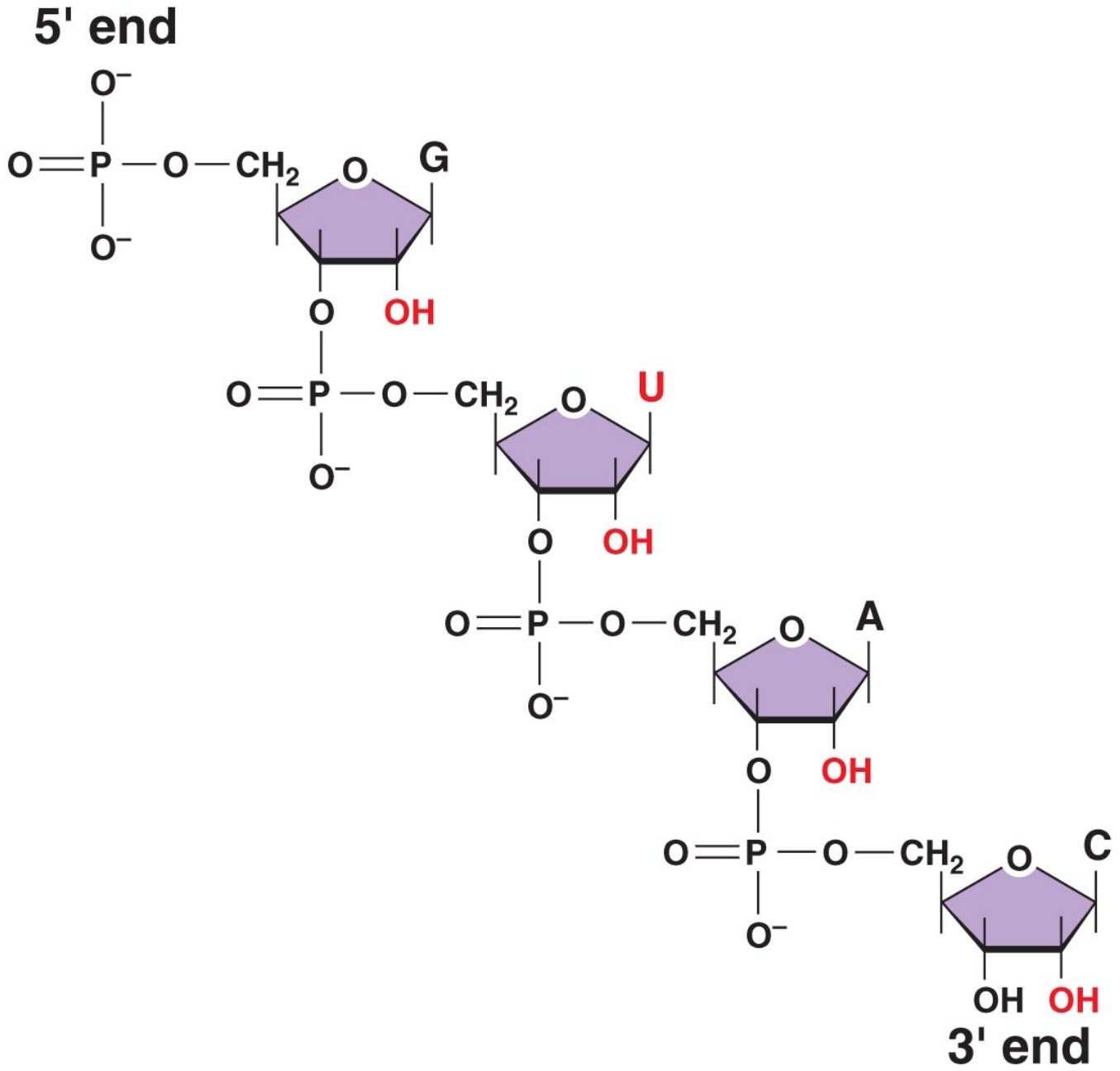
Figure 7.4

DNA structure is a double helix



Features that distinguish RNA from DNA

- RNA is relatively _____. DNA is _____.
- **Multiple copies of _____, while _____is usually single copy.**
- **_____instead of _____in RNA**



Synthesis of the Informational Macromolecules

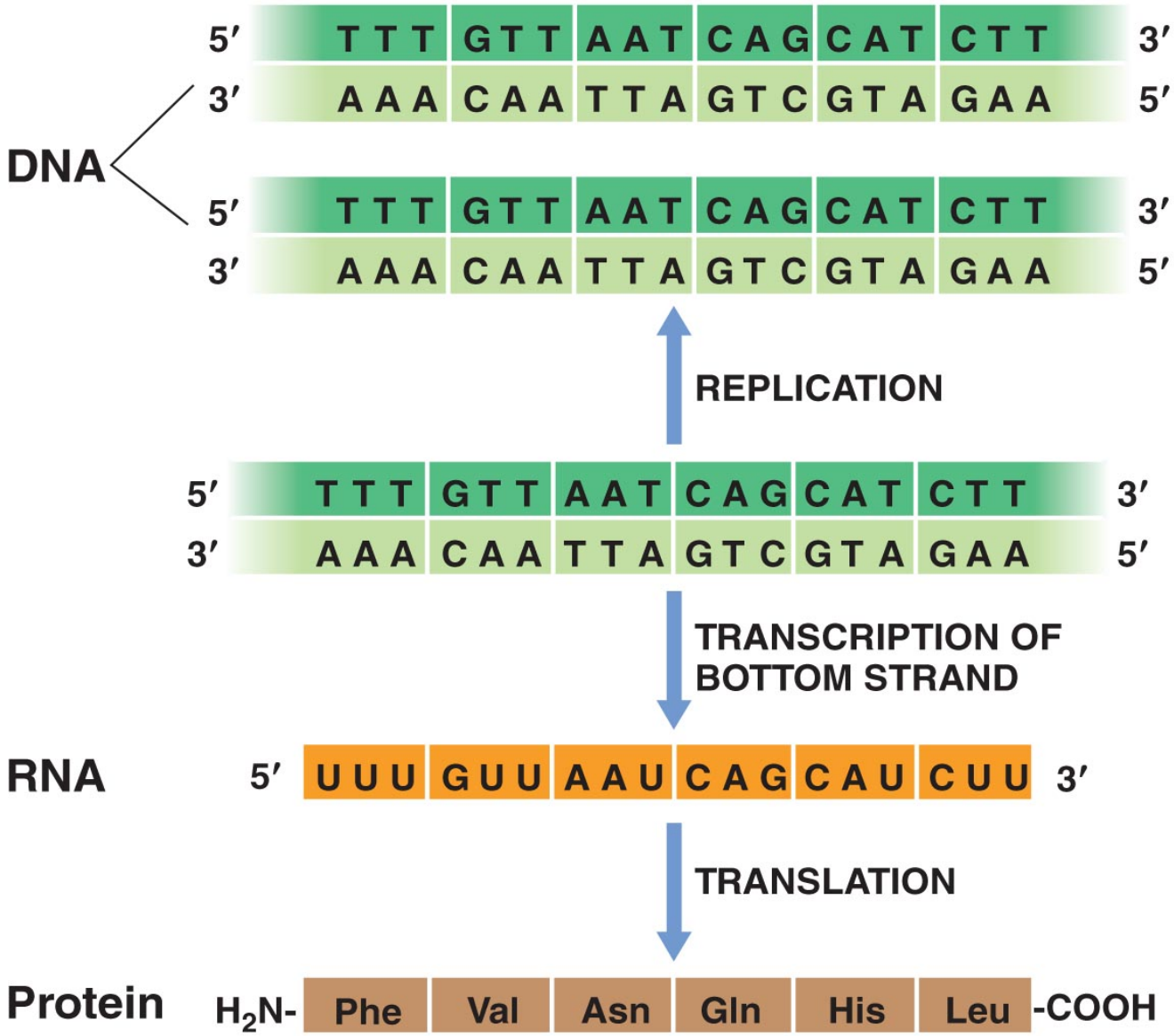


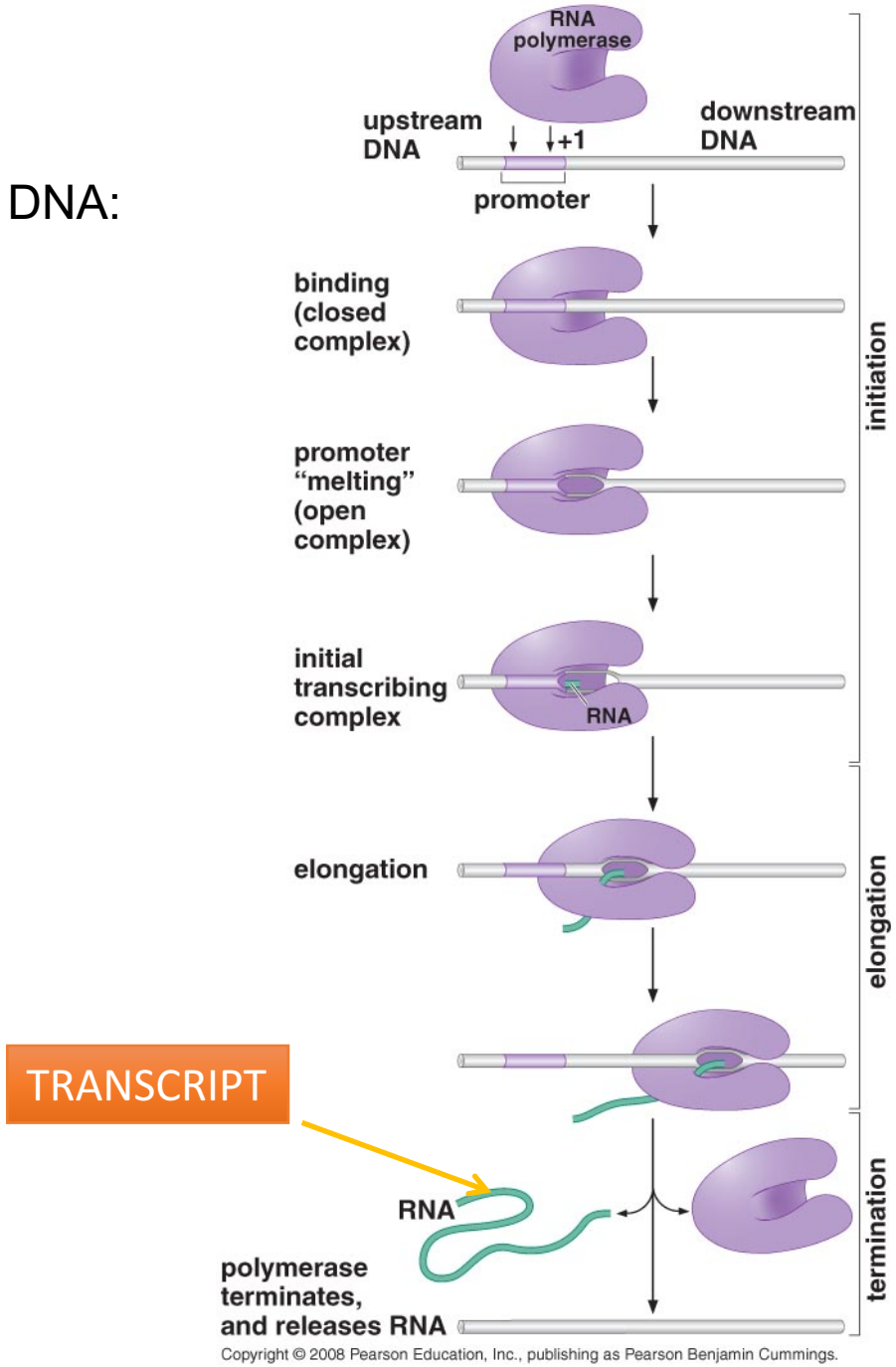
Figure 7.1

Transcription in action: RNA polymerase

- Check out this video for an overview:

https://www.youtube.com/watch?v=SMtWvDbfHLo

Making RNA from DNA:
"Transcription"



Gene expression

- Genes on DNA code for an _____
- When mRNA copy/copies made from DNA, it is said to be “_____”

Basal transcription

- The rate at which transcription initiation and elongation would proceed _____.

Basal Transcription

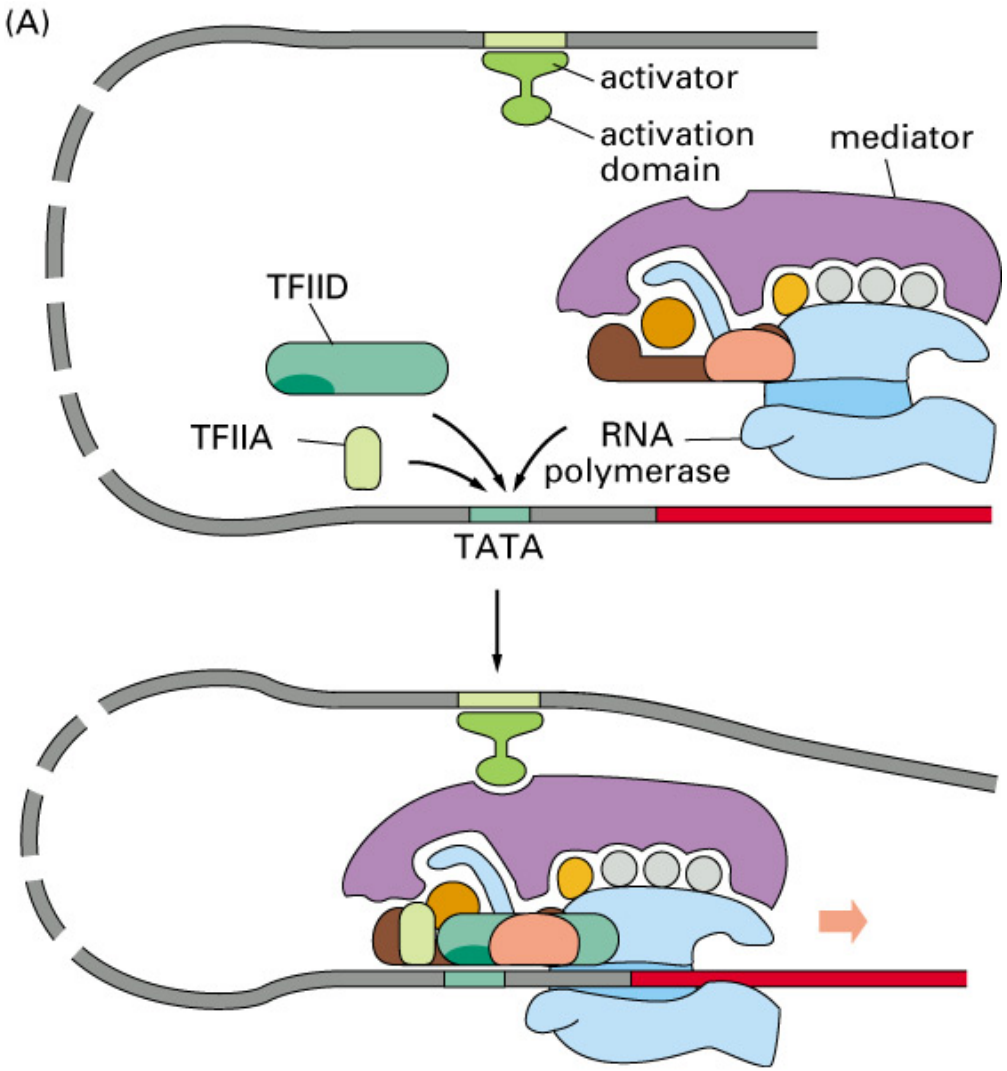
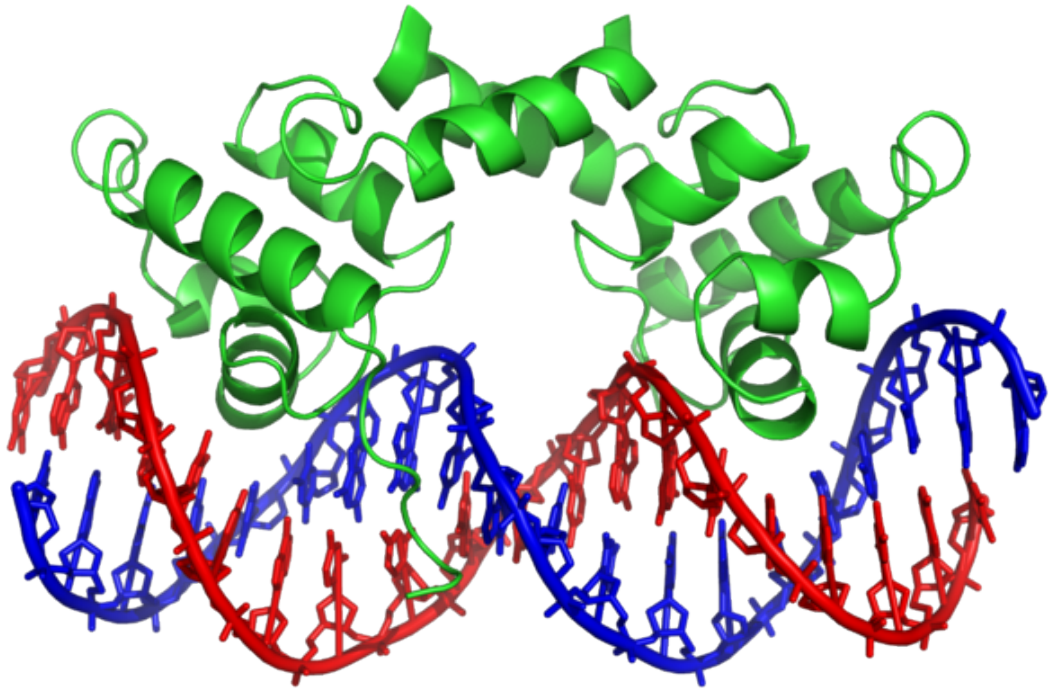
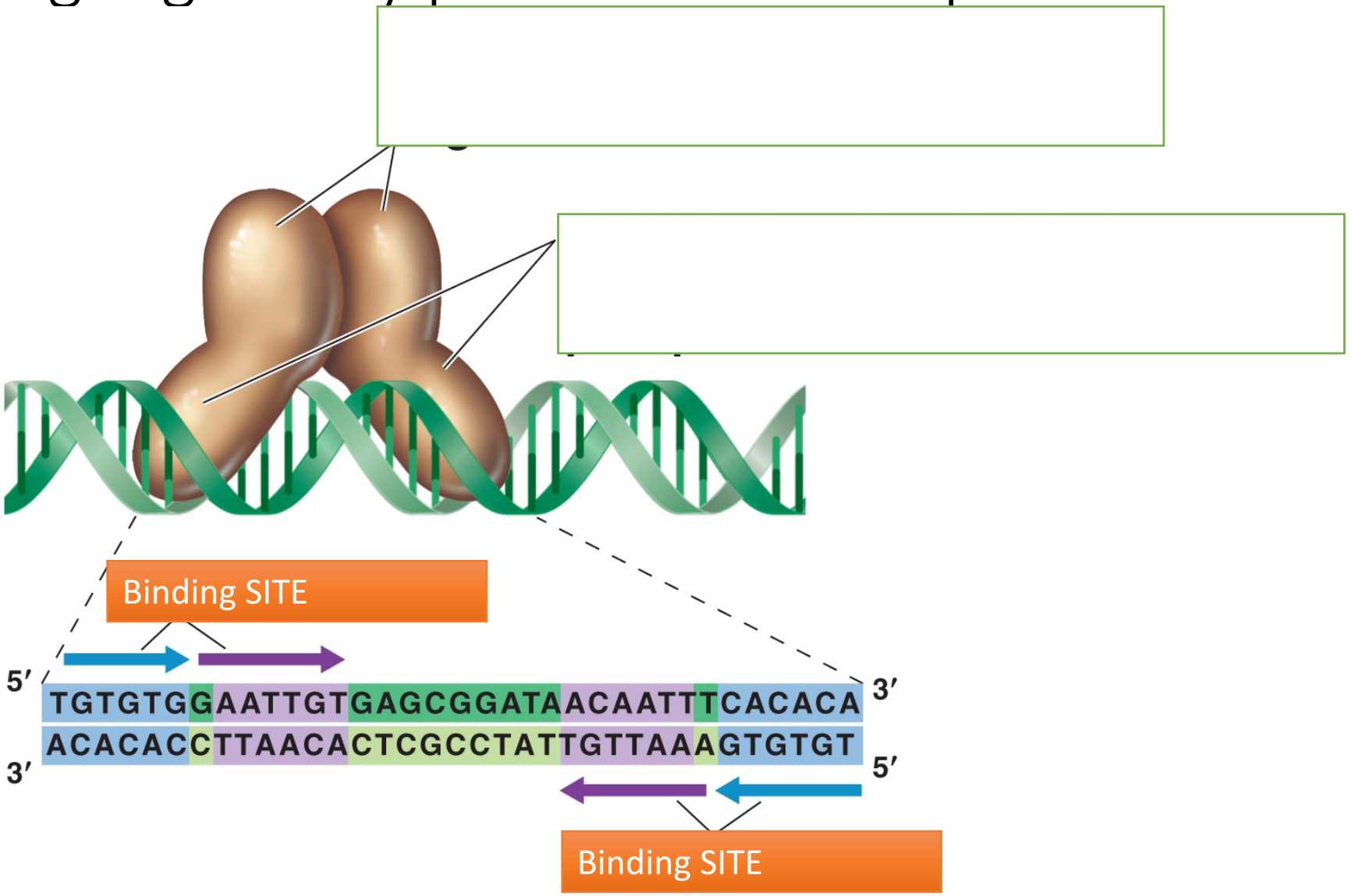


Figure 7–43 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

Transcription factors are proteins that bind DNA



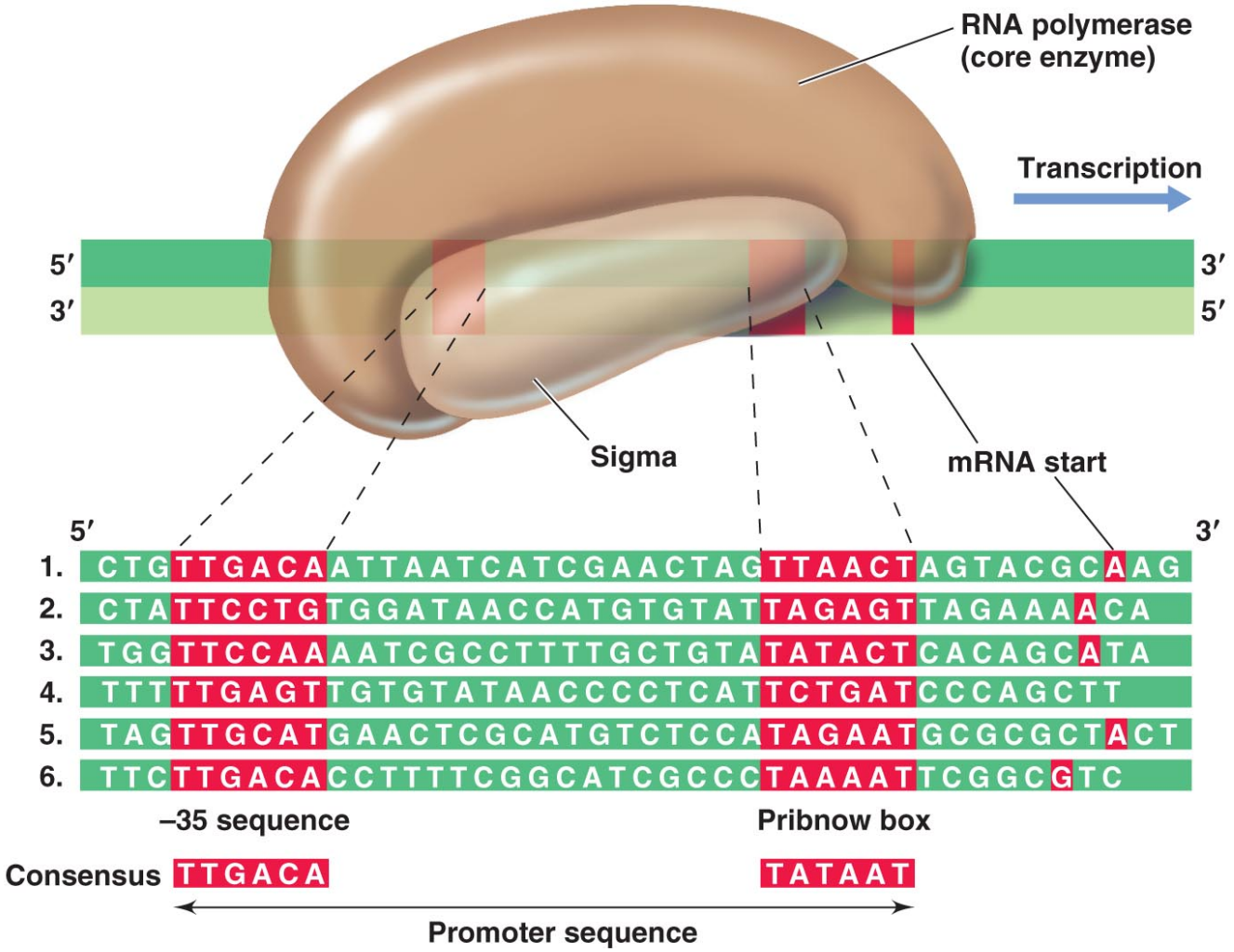
DNA binding regulatory proteins: Transcription factors



TFs bind to specific non-coding DNA sequences

- These sequences are also called _____.
- They can be found throughout _____and, although the motifs for a given TF follow a certain _____, they are not exactly the same.
- The motif therefore has a "_____"
- The more a motif resembles a "_____", the more likely _____.

Example: TFs bind to specific non-coding DNA sequences



Regulatory TFs change the basal transcription rate in response to stimuli

- Activators = _____the rate of transcription
  - Attract/recruit _____
  - Stabilize _____
- Repressors = _____or block rate of transcription
  - Block _____*
  - Block _____
  - Destabilize _____
  - Etc.
- Video of regulated transcription: https://www.youtube.com/watch?v=vi-zWoobt_Q

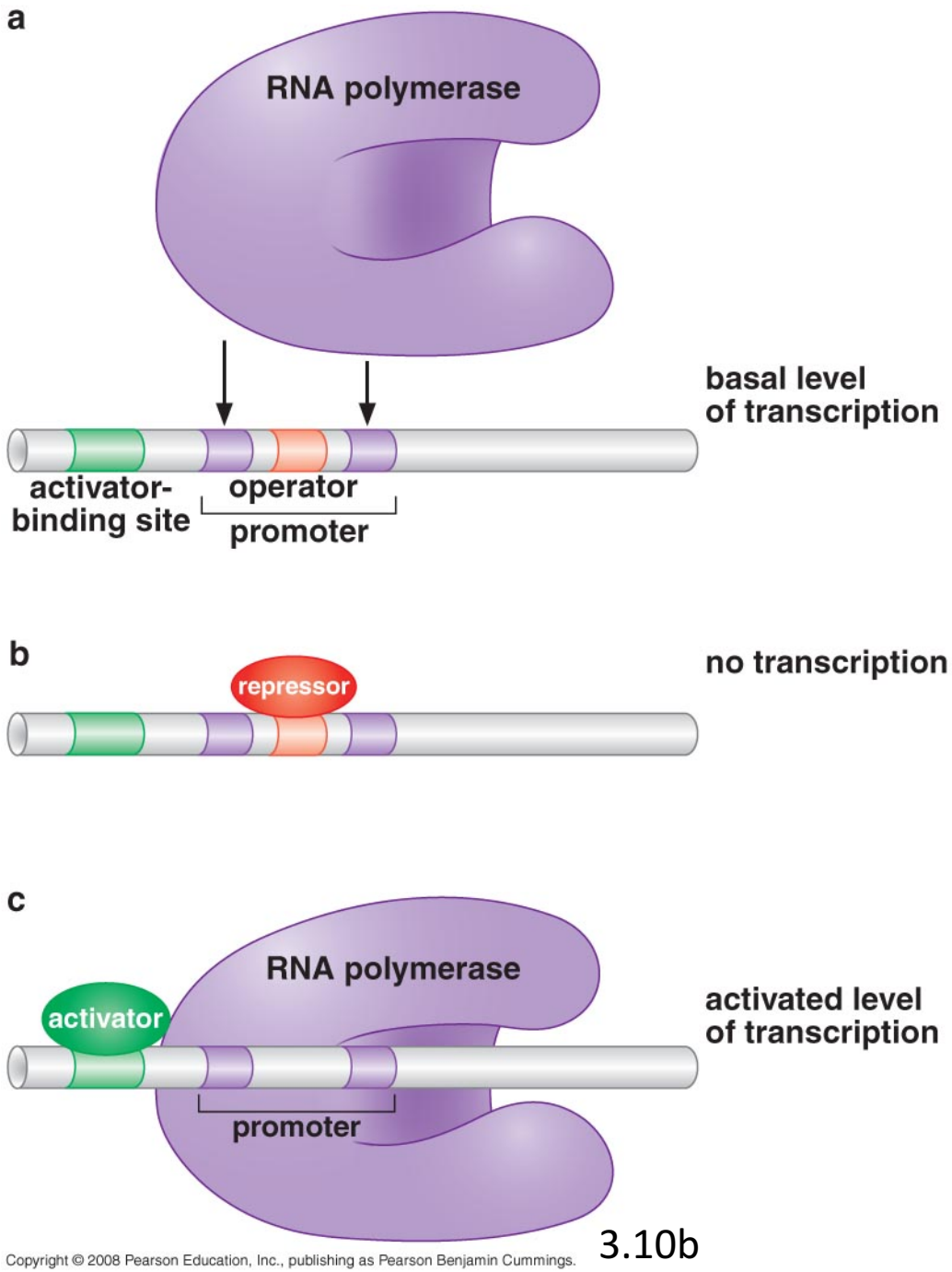
Reminder: Signals from outside the cell are relayed by signal transduction cascades that culminate in changing the levels of transcription

- Genes are expressed at different _____in response to different _____.
- Different genes are expressed in different _____
- Genes are expressed within the _____of eukaryotic cells, where the _____is located.

TFs can regulate transcription when they bind DNA next to RNA polymerase

Operator:

Activator binding site:



3.10b

Transcription factors can also regulate transcription at a distance

Enhancer:

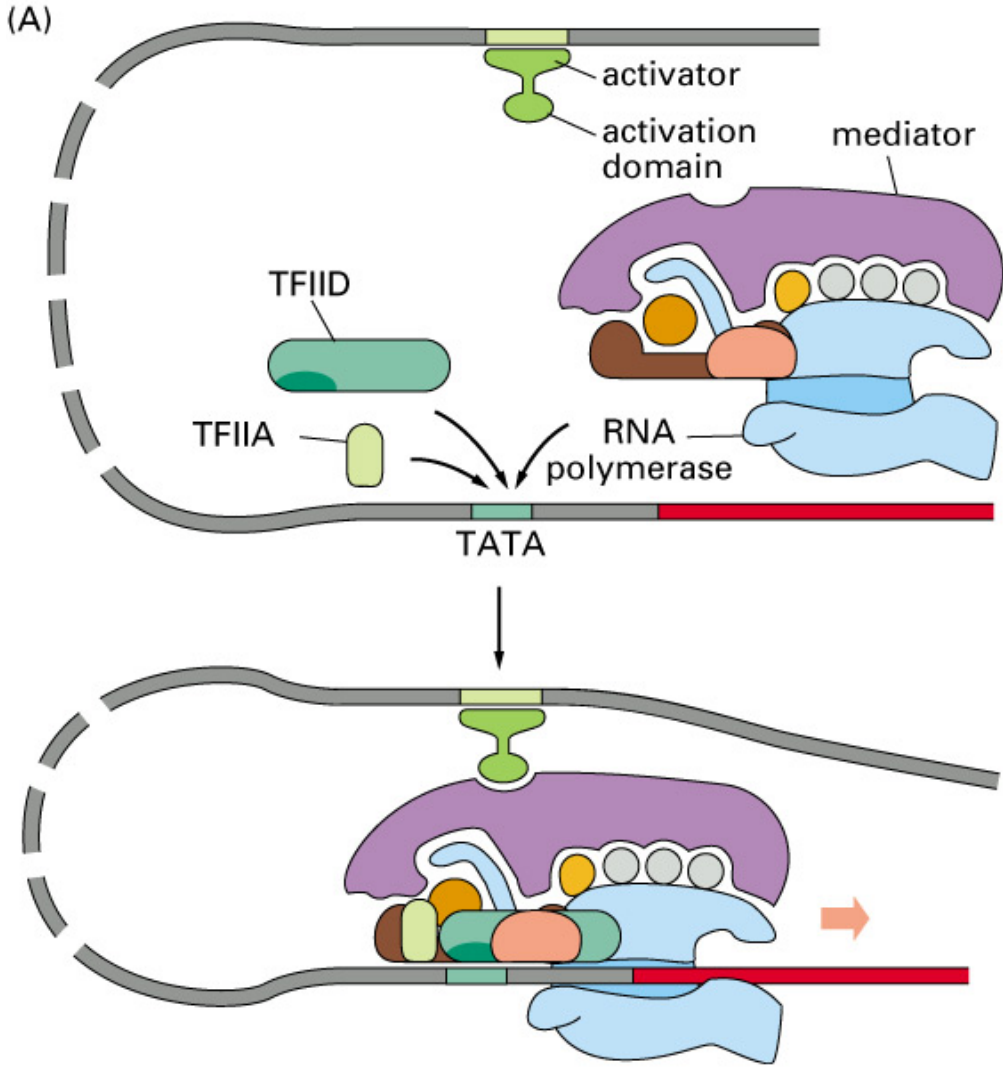


Figure 7–43 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

How are TFs themselves regulated?

- By phosphorylation (the end of a signal transduction cascade). Phosphorylation usually induces a _____that allows the TF to bind DNA
- By binding a small molecule directly (_____). Again, _____change and binding. Binding can occur in the presence or absence of the signal, also called a _____.
- By increase or decrease in their _____(i.e. some TFs regulate the transcription of genes encoding _____). Some TFs regulate the expression of their own gene.

Combinatorial complexity of gene regulation

- Heterodimerization – when two different TFs make a _____together. Formation of this complex is required to _____.
- A few different transcription factors can bind to different _____ DNA locations to regulate the same gene

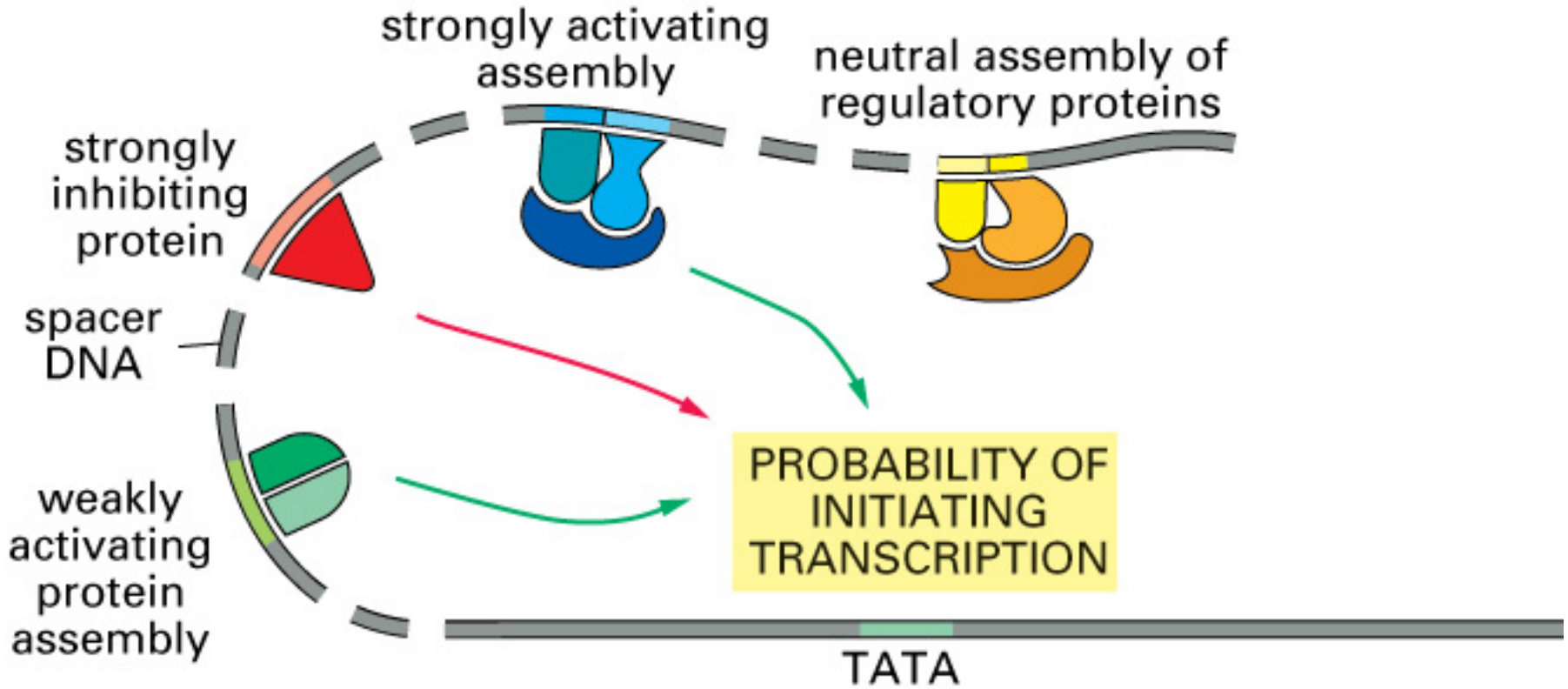
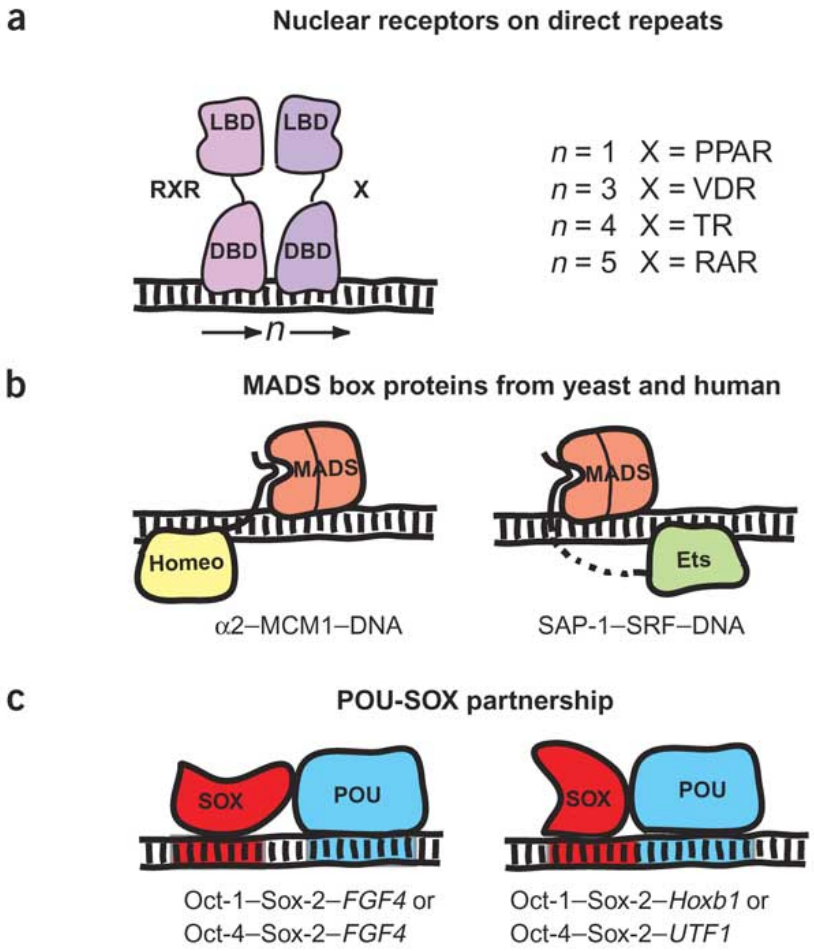


Figure 7–57. Molecular Biology of the Cell, 4th Edition.

Combinatorial control, specific examples



Attila Reményi, Hans R Schöler & Matthias Wilmanns Nature Structural & Molecular Biology 11, 812 - 815 (2004)

Inter-TF gene regulatory network of yeast

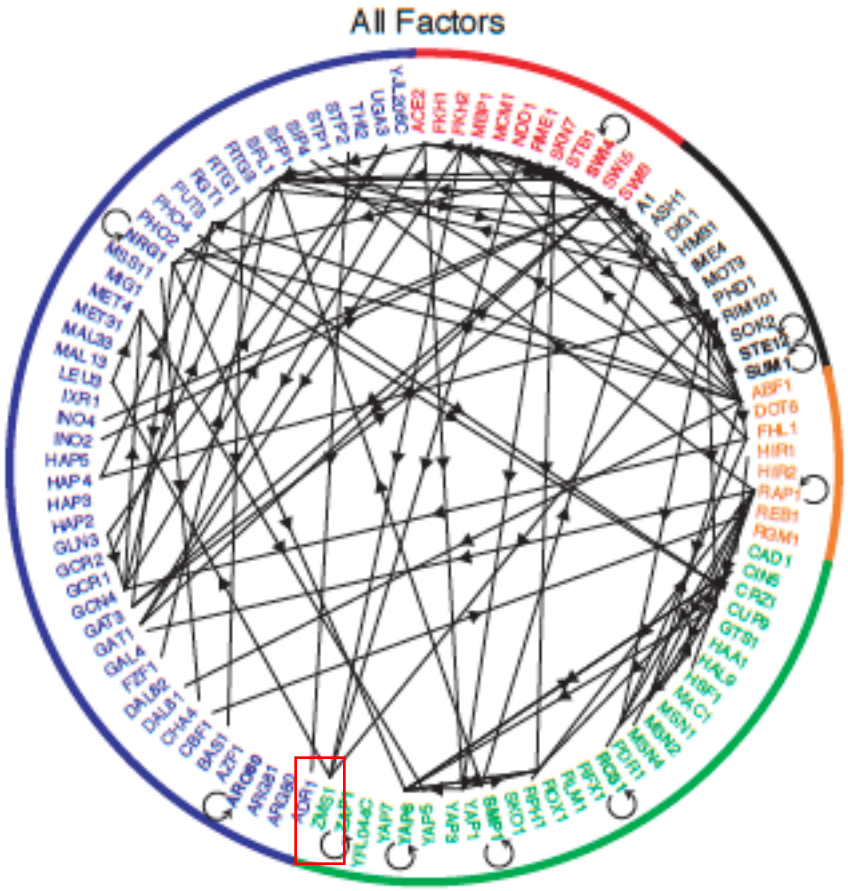


Figure 5, Lee et al., 2002