Gene regulation

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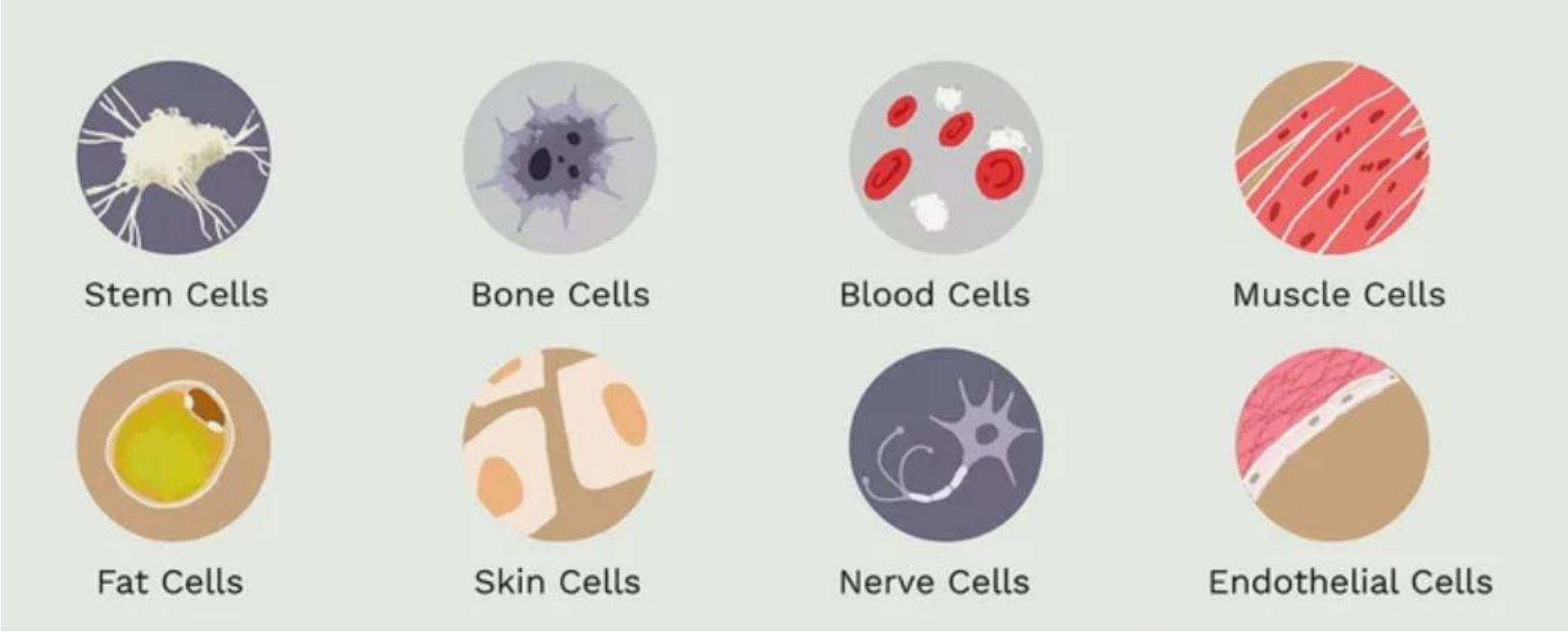
Activities

- 10.00-11.00 Recall Lecture “Gene regulation”
- 11.00-11.20 Group activities
- 11.20-12.00 Discussion

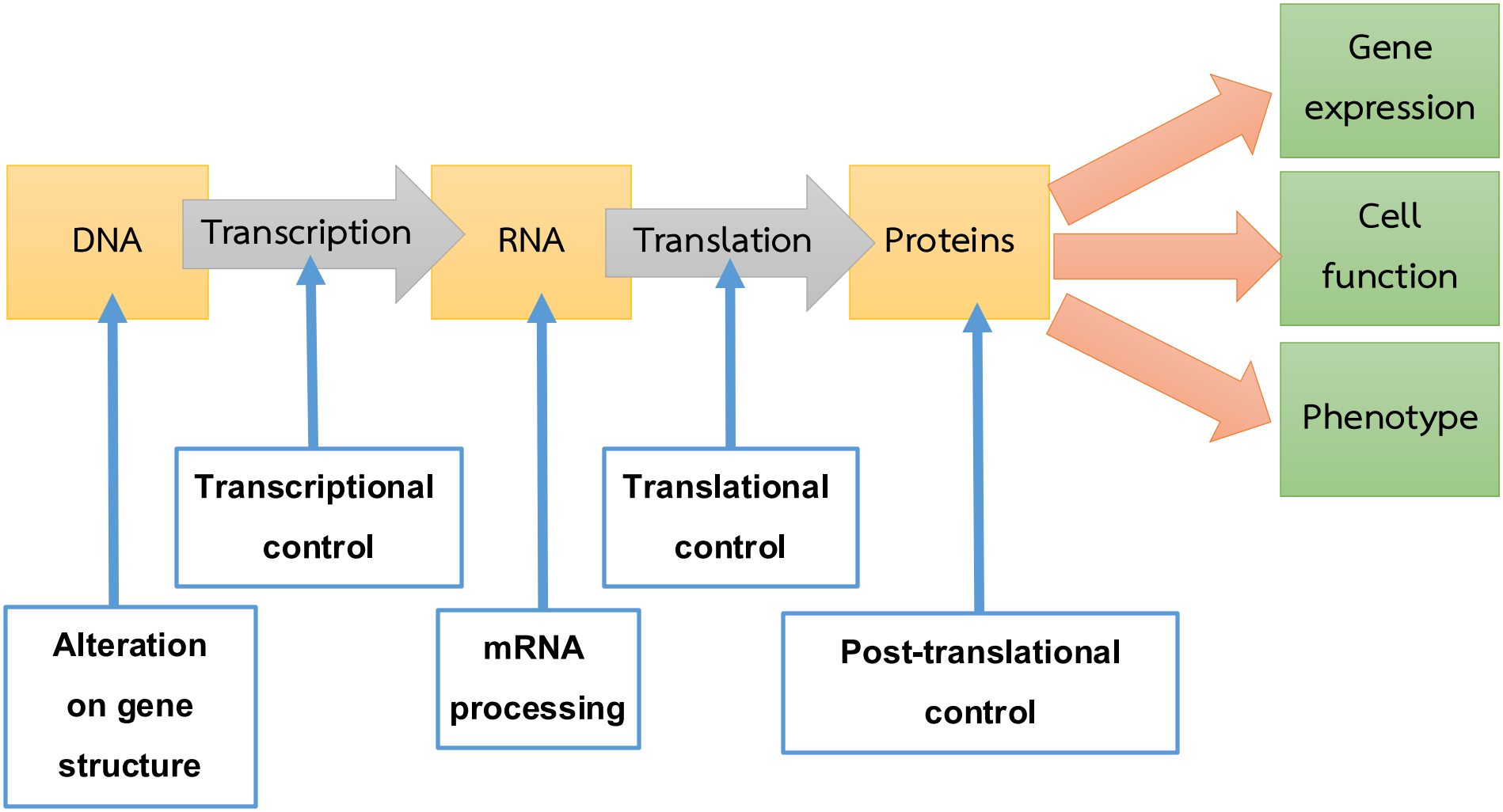
Objectives

- Regulation of gene expression in prokaryotes
- Regulation of gene expression in Eukaryotes

Why is gene regulation necessary?

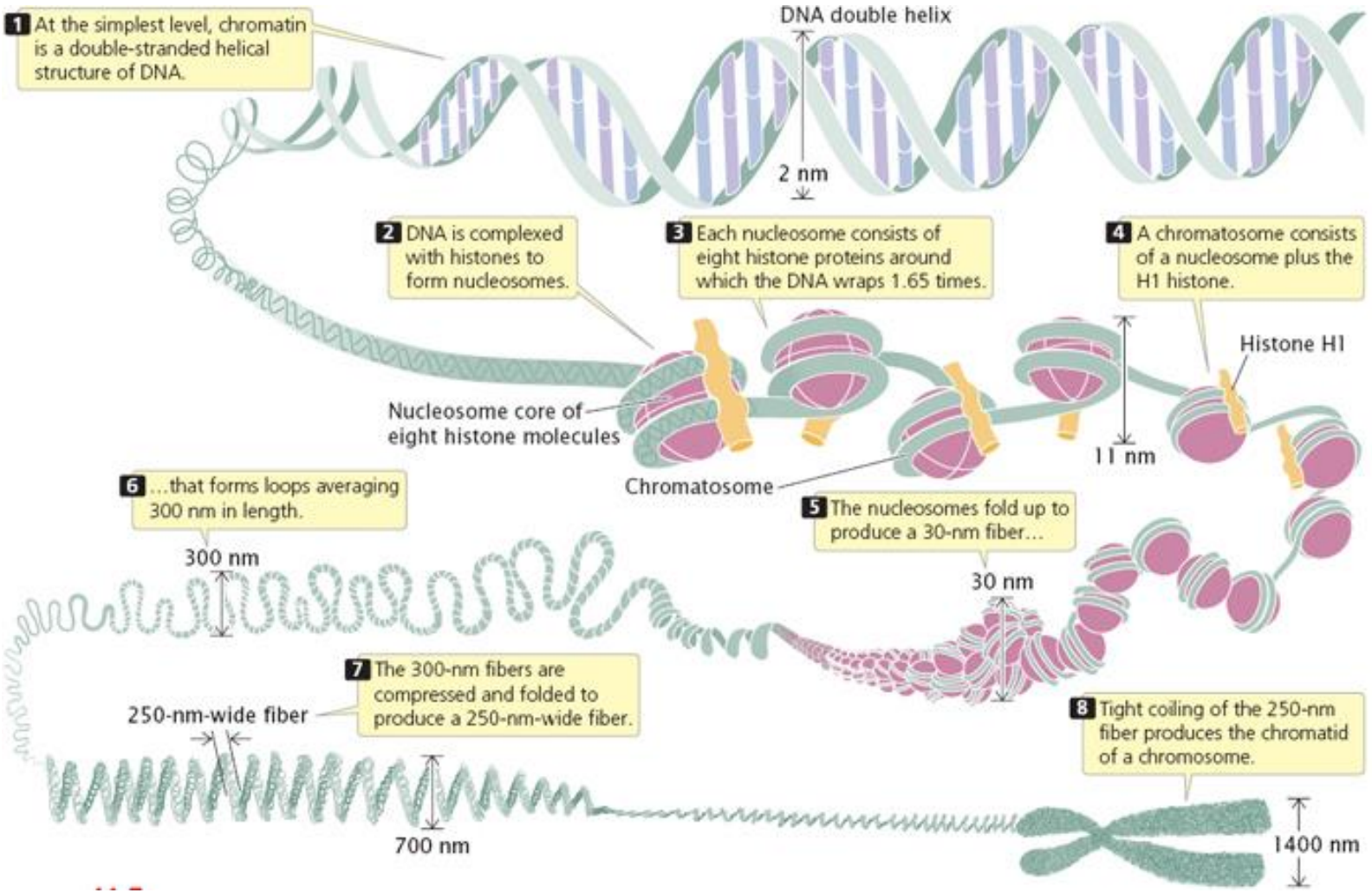


Gene expression : Eukaryote



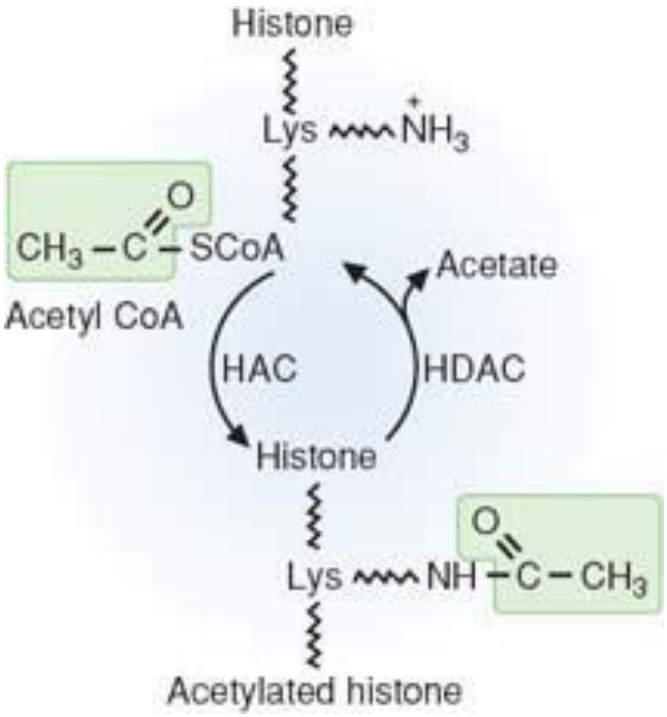
Alteration on gene structure

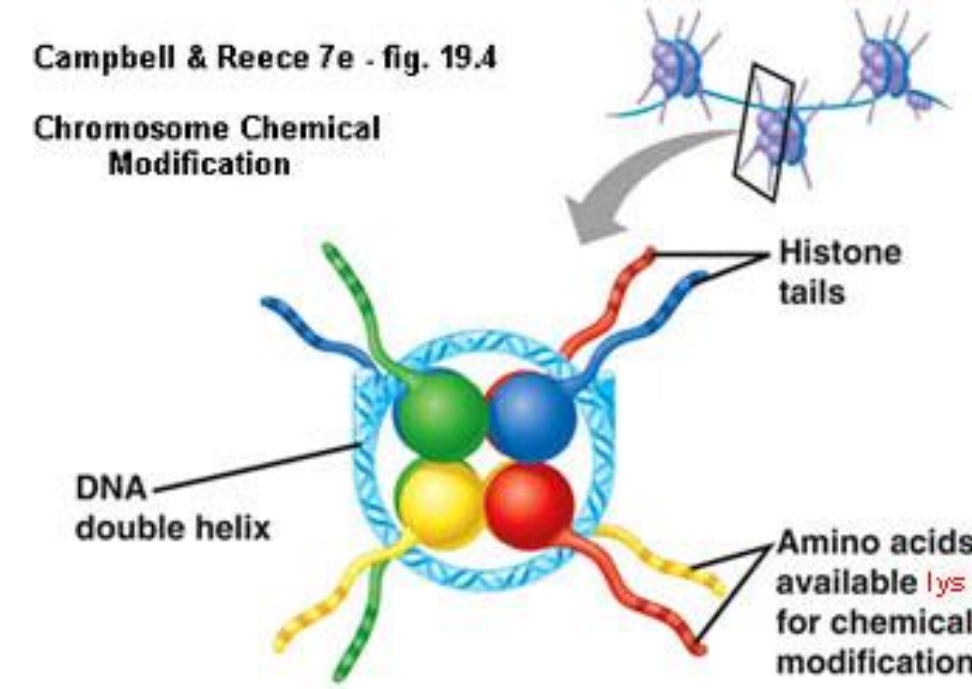
- **Chromatin rearrangement**



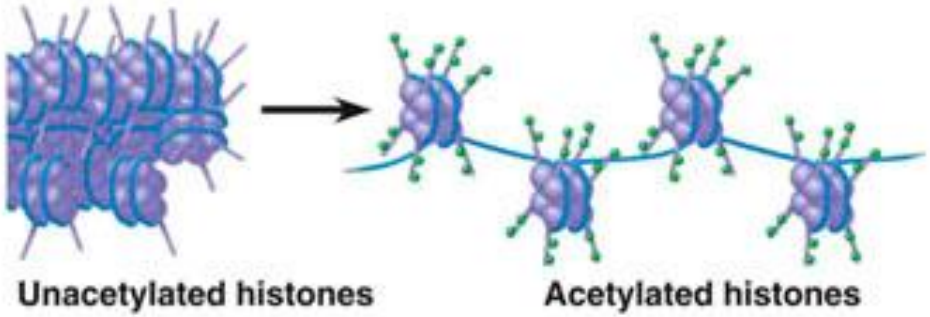
Alteration on gene structure

- Histone modification
- HAC = Histone acetylase
- HDAC = Histone deacetylase





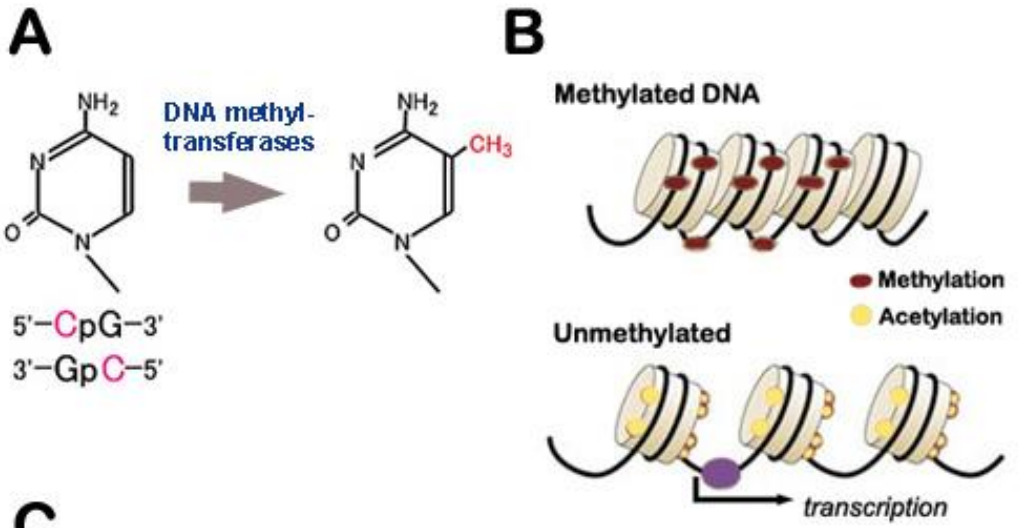
(a) Histone tails protrude outward from a nucleosome

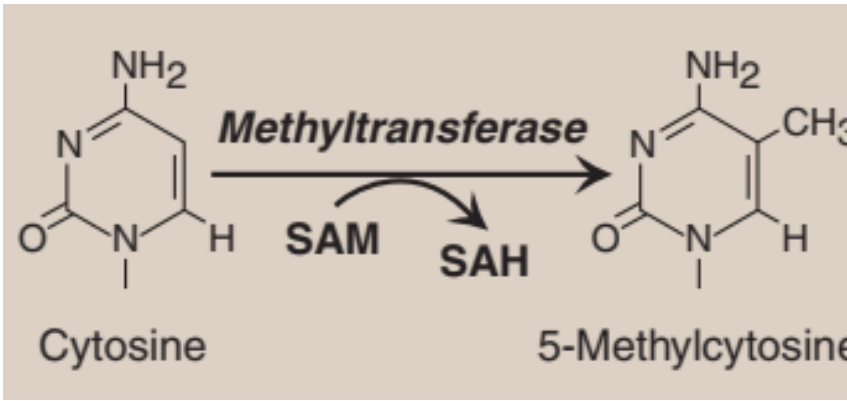


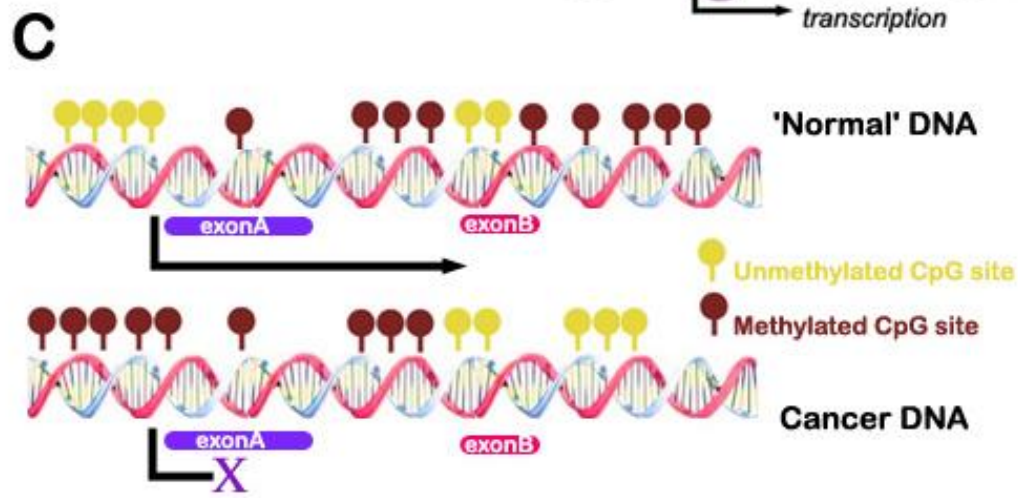
(b) Acetylation of histone tails promotes loose chromatin structure that permits transcription

Alteration on gene structure

- **DNA methylation (CpG islands)**



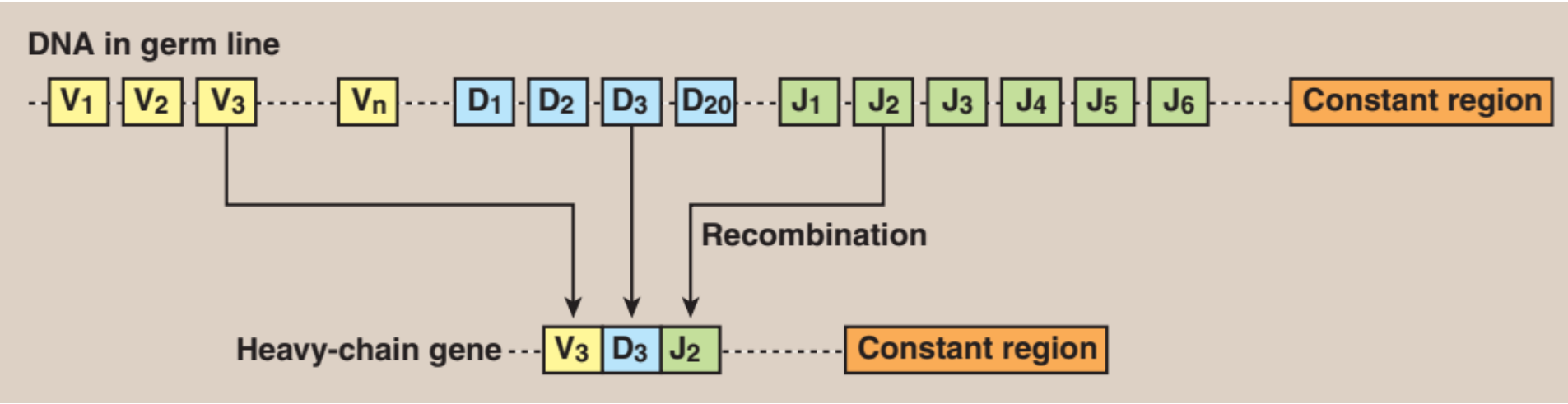




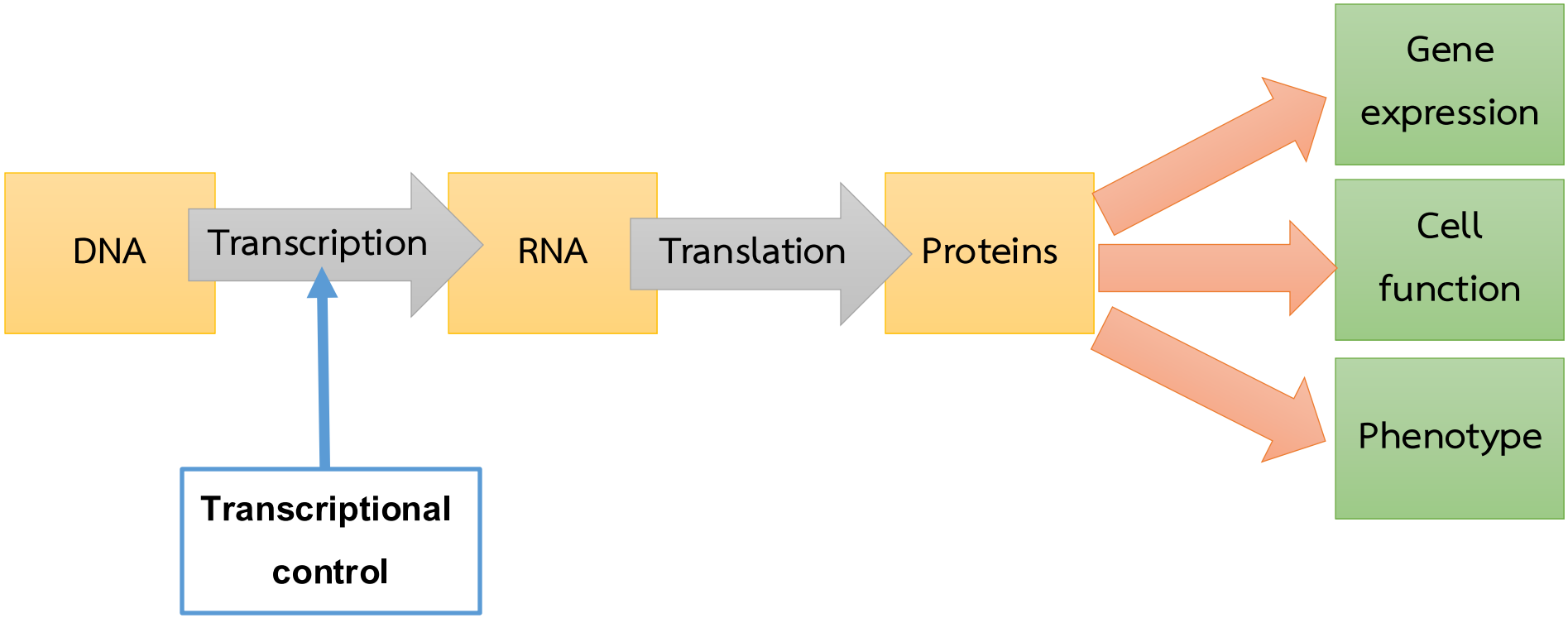
http://www.cellscience.com/reviews7/Taylor1.jpg

Gene rearrangement

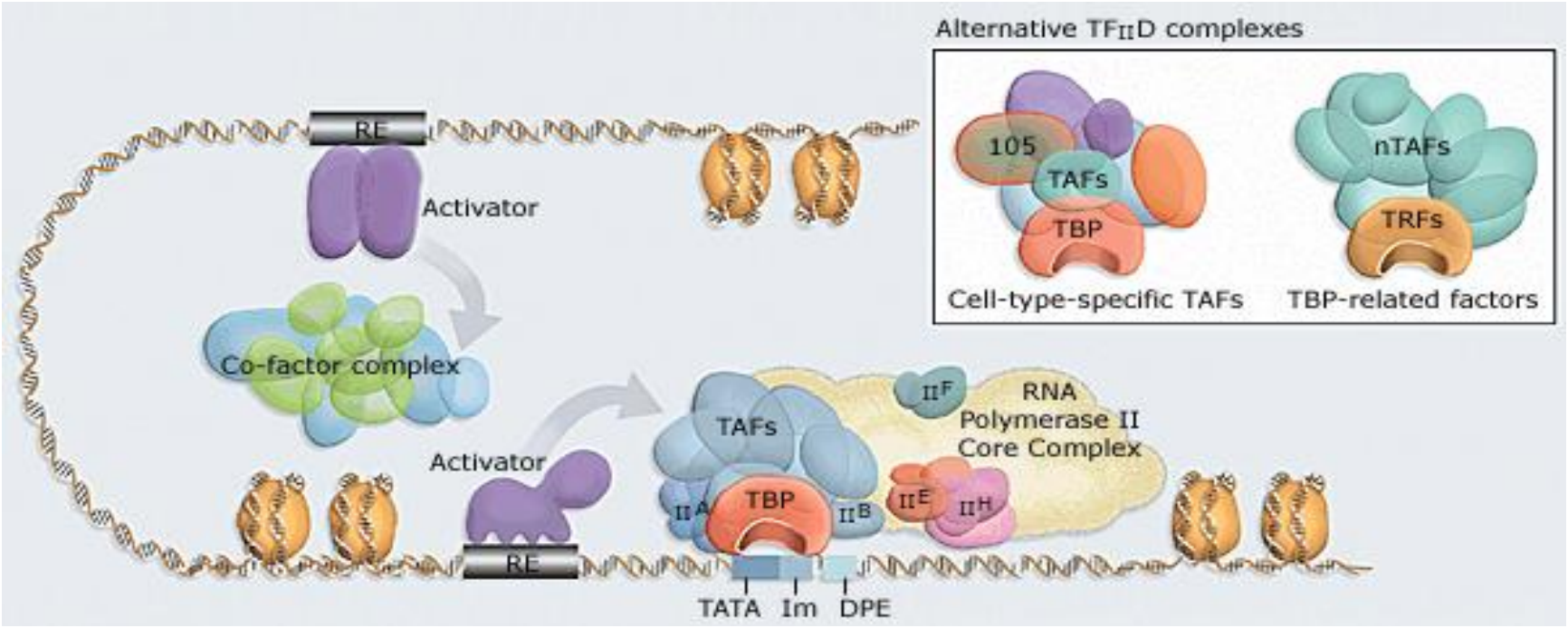
- In Immunoglobulin



Gene expression : Eukaryote

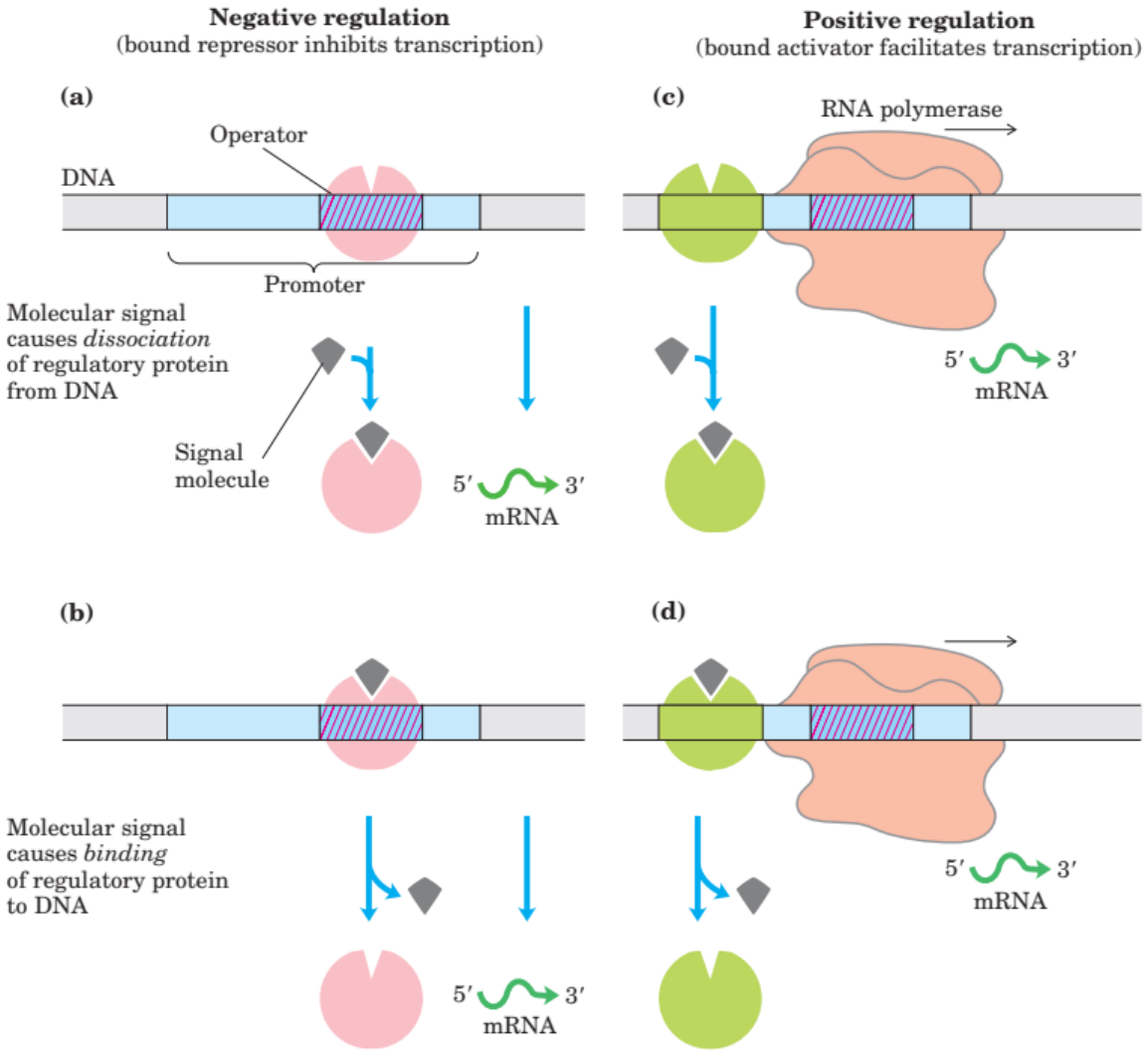


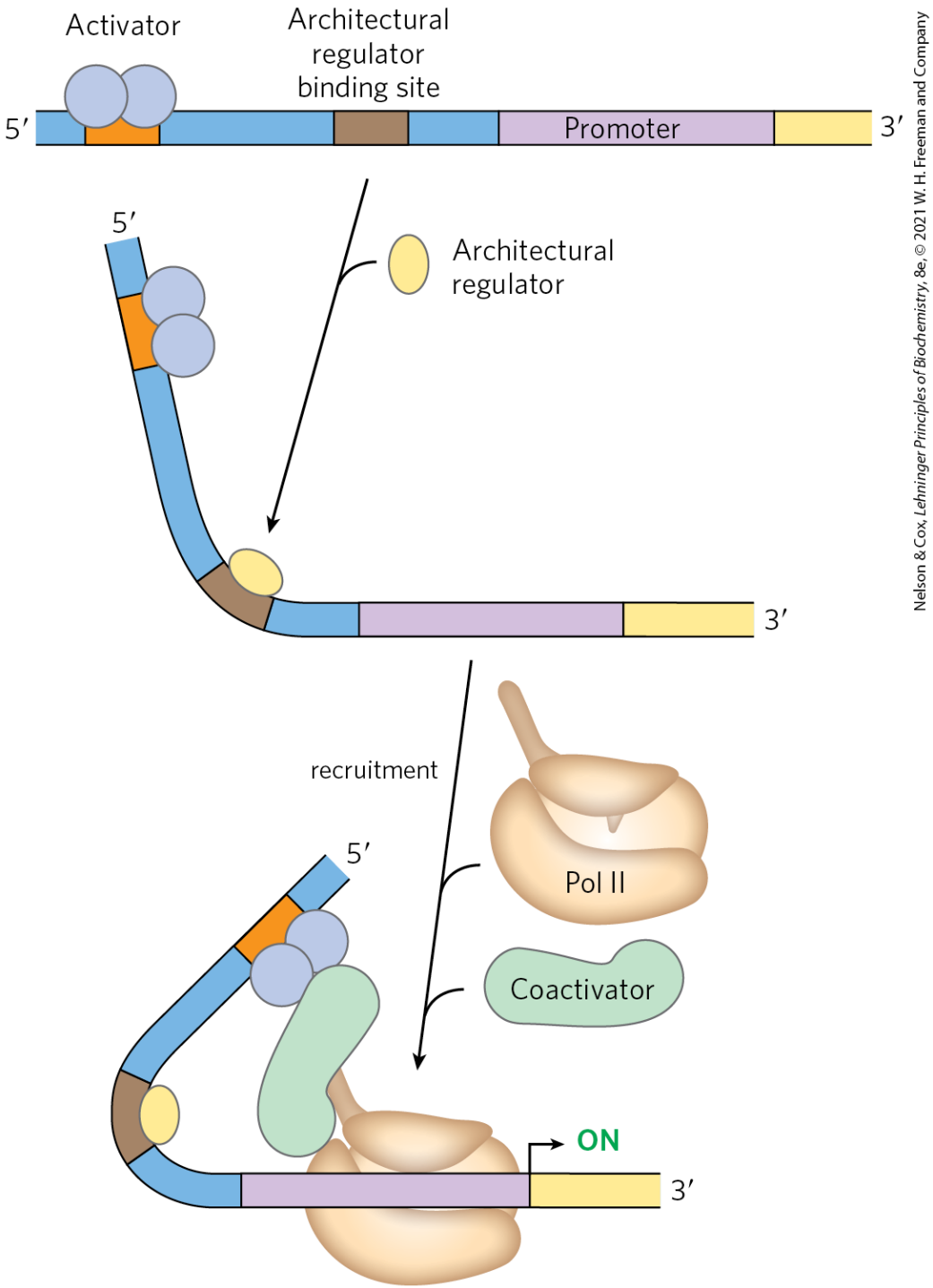
Gene regulatory control region



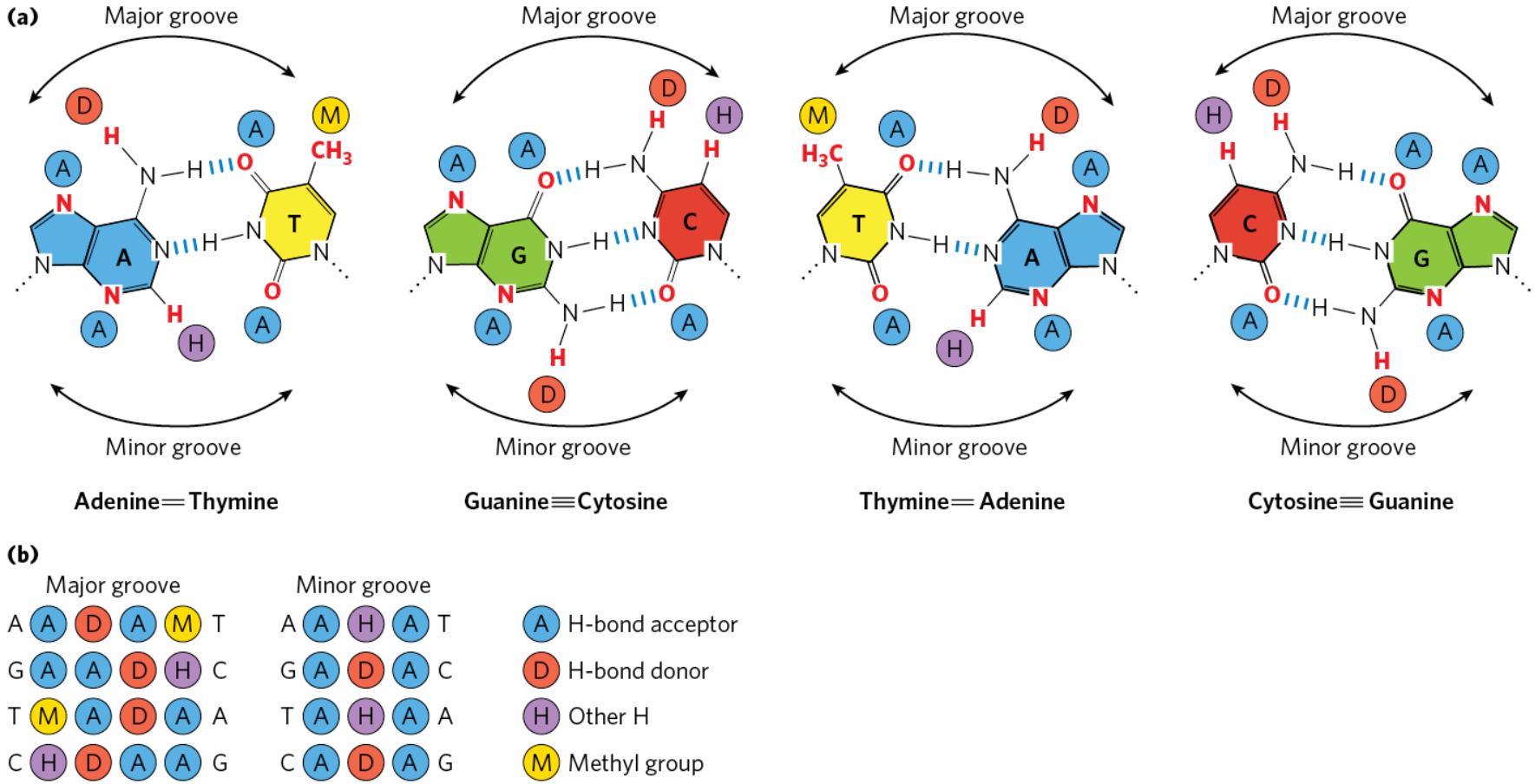
Lieberman M and Marks A, Marks' Basic Medical Biochemistry; a Clinical approach, 3rd edition, 2009

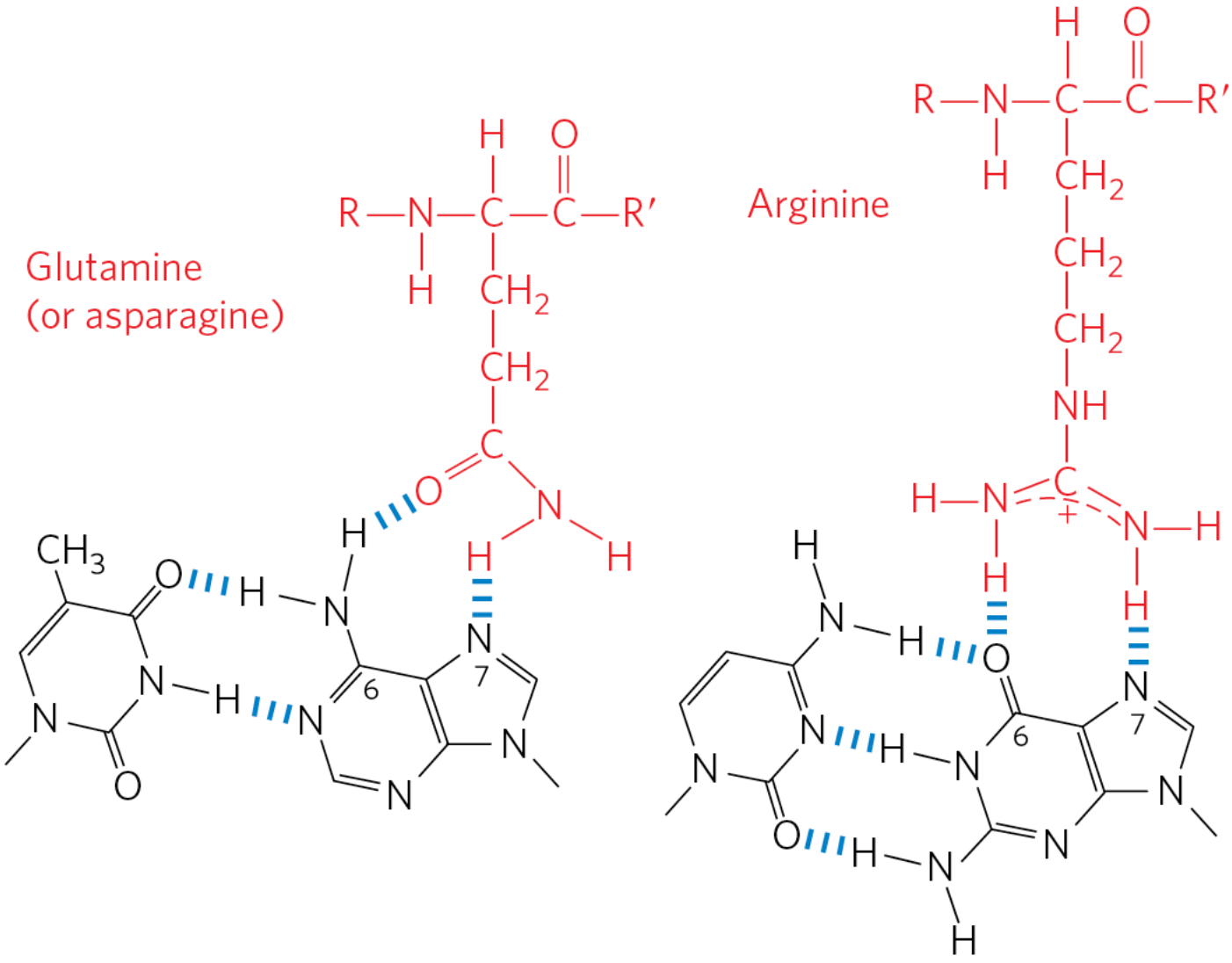
Transcription is regulated by proteins that bind to or near promoters



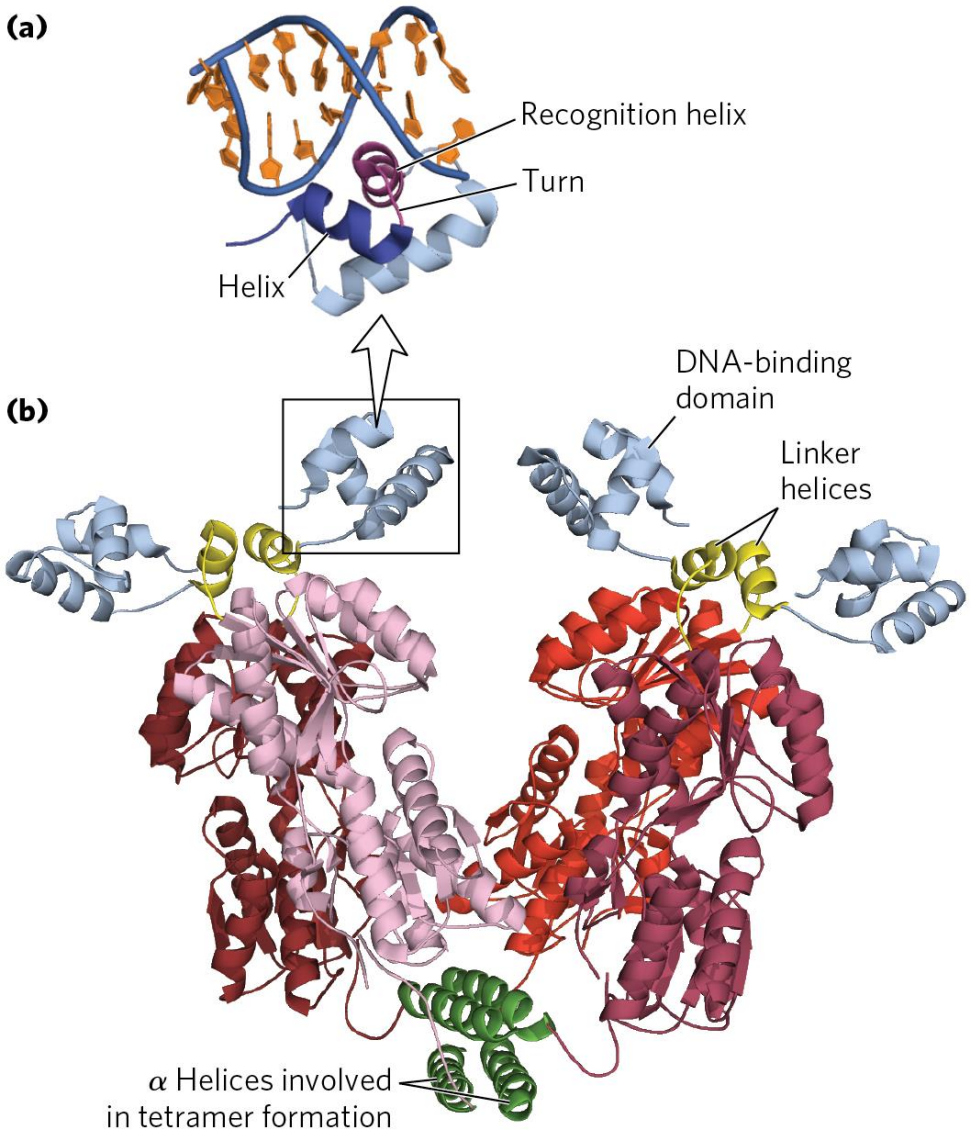


Groups in DNA available for protein binding

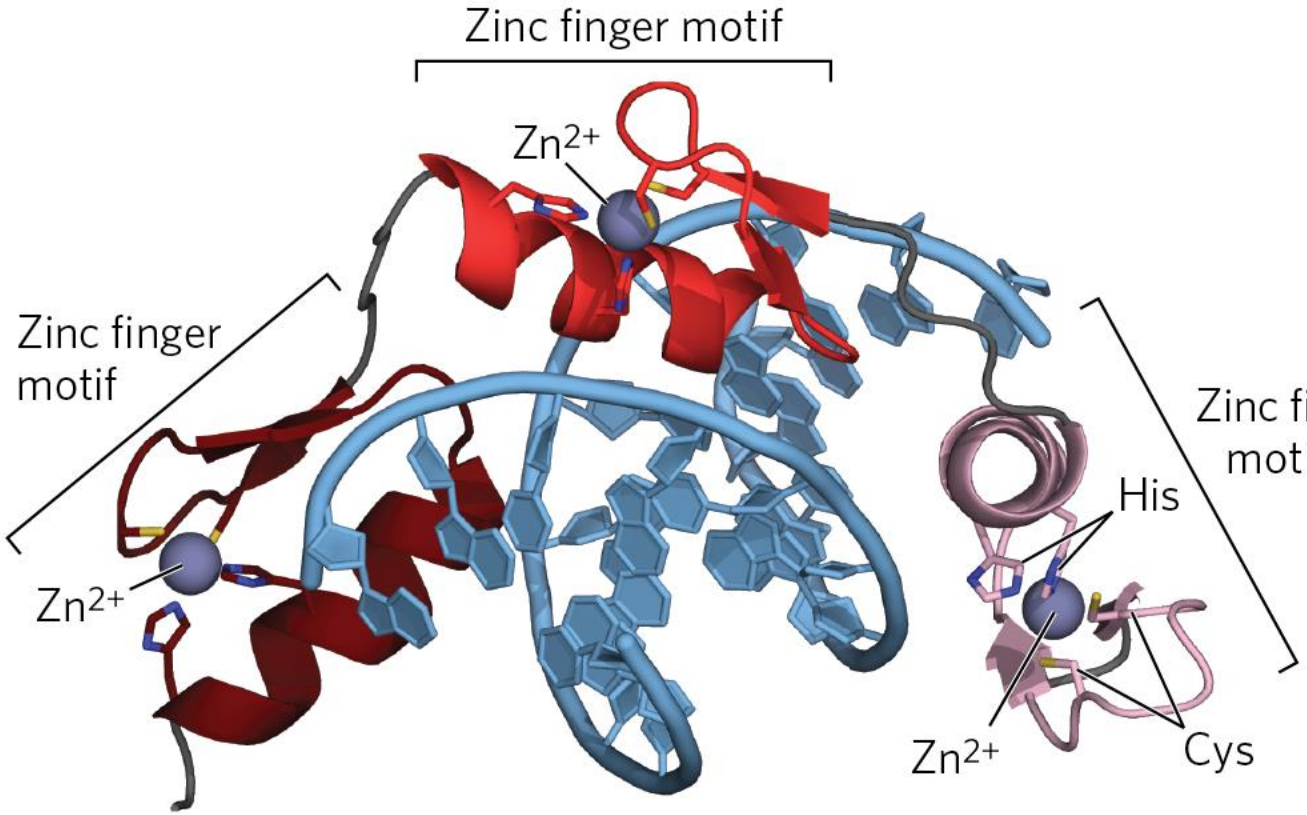



Glutamine
(or asparagine)
Arginine
Thymine═Adenine
Cytosine≡Guanine

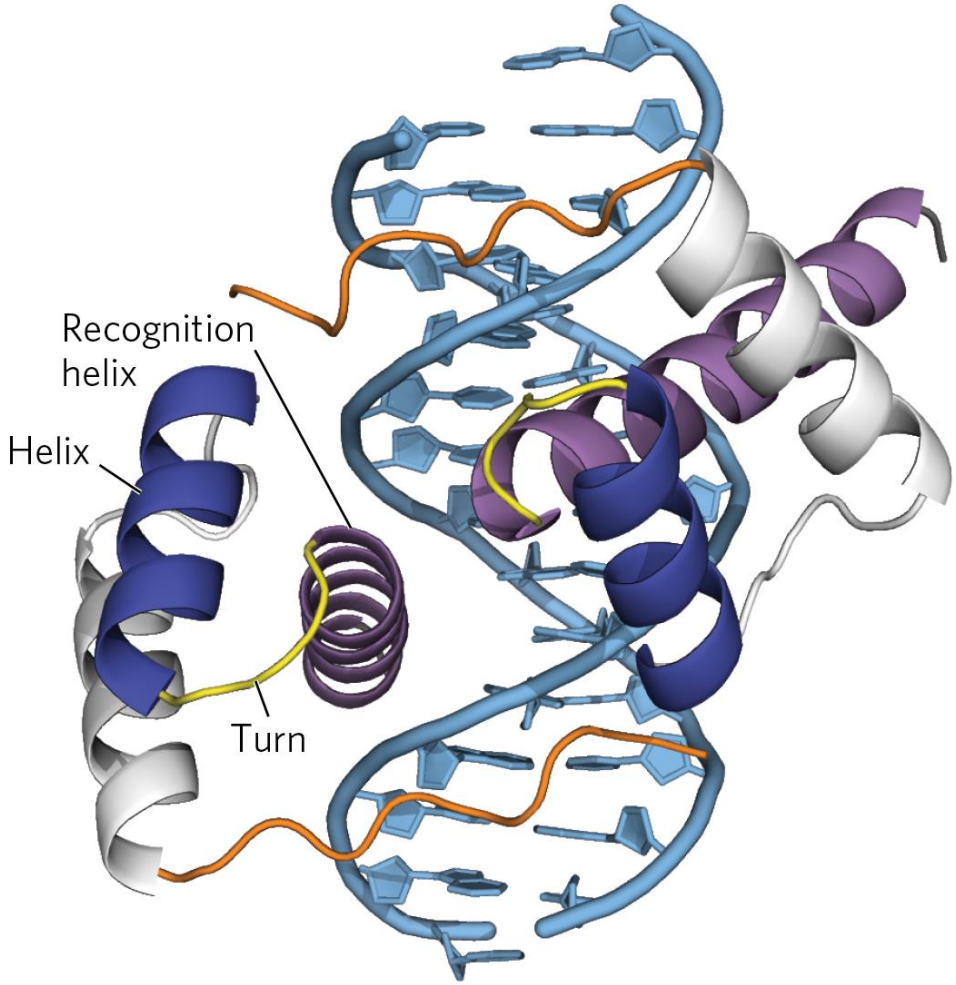
Helix-Turn-Helix motif



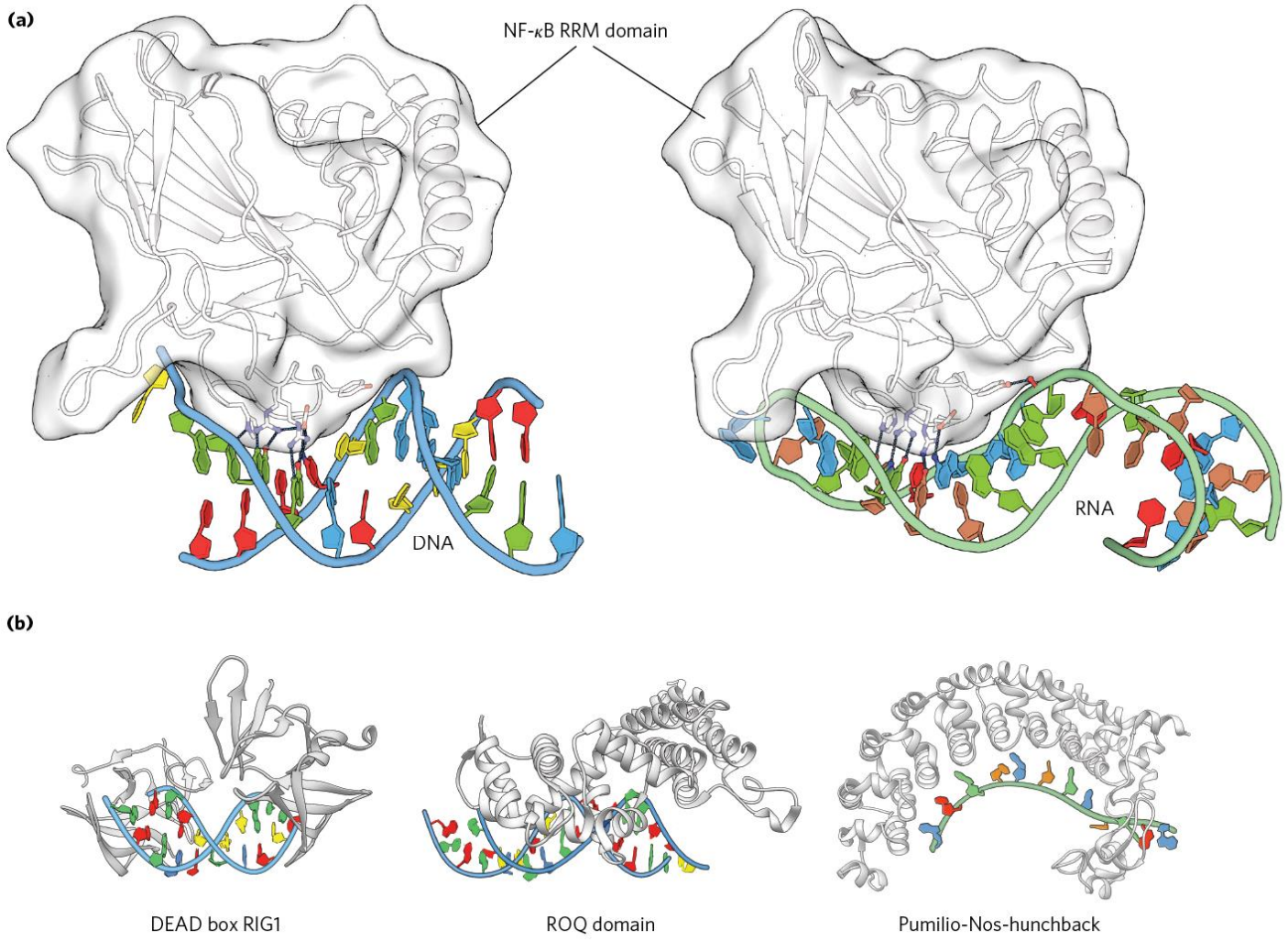
Zinc Finger domain



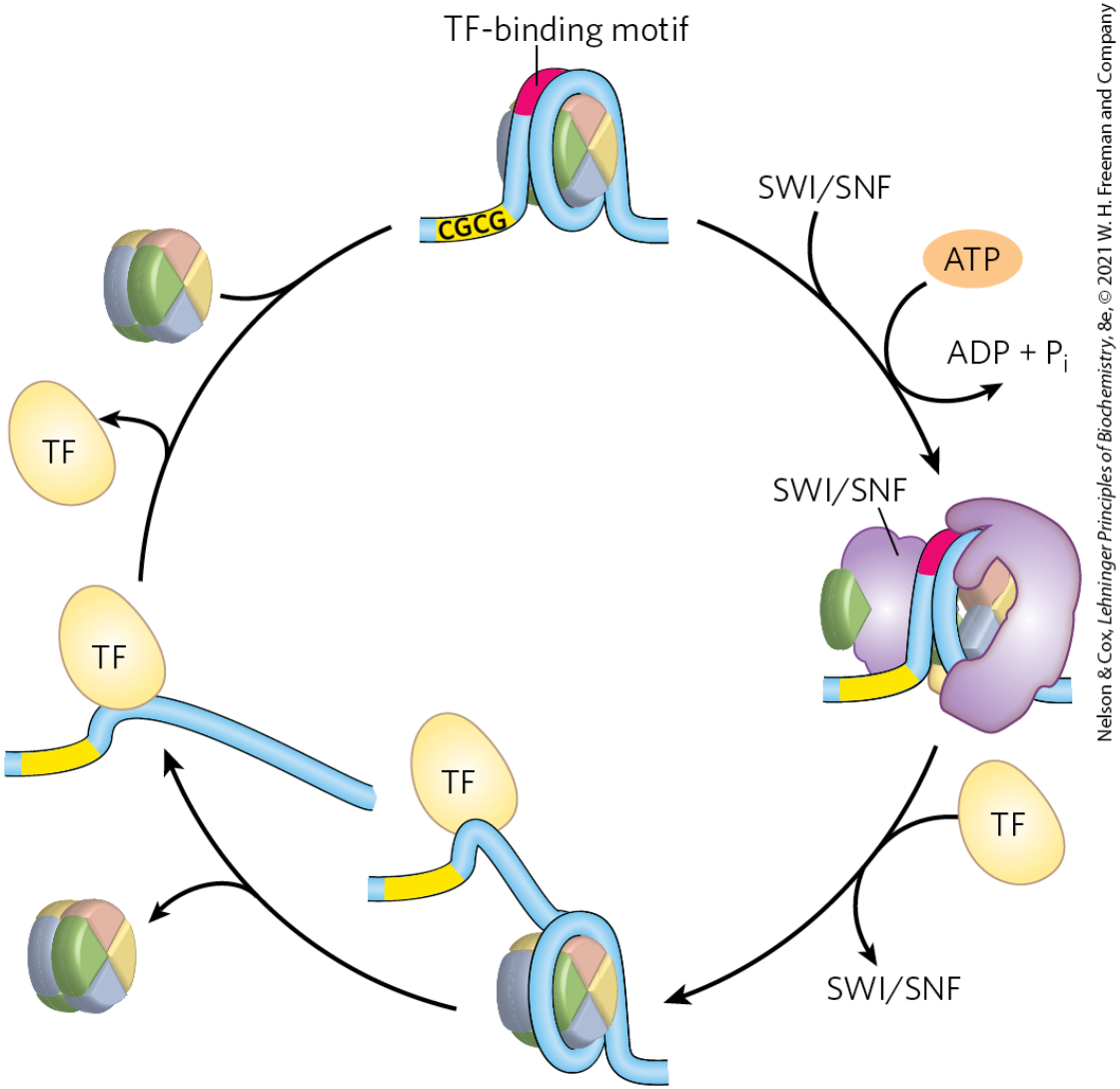
Homeodomain



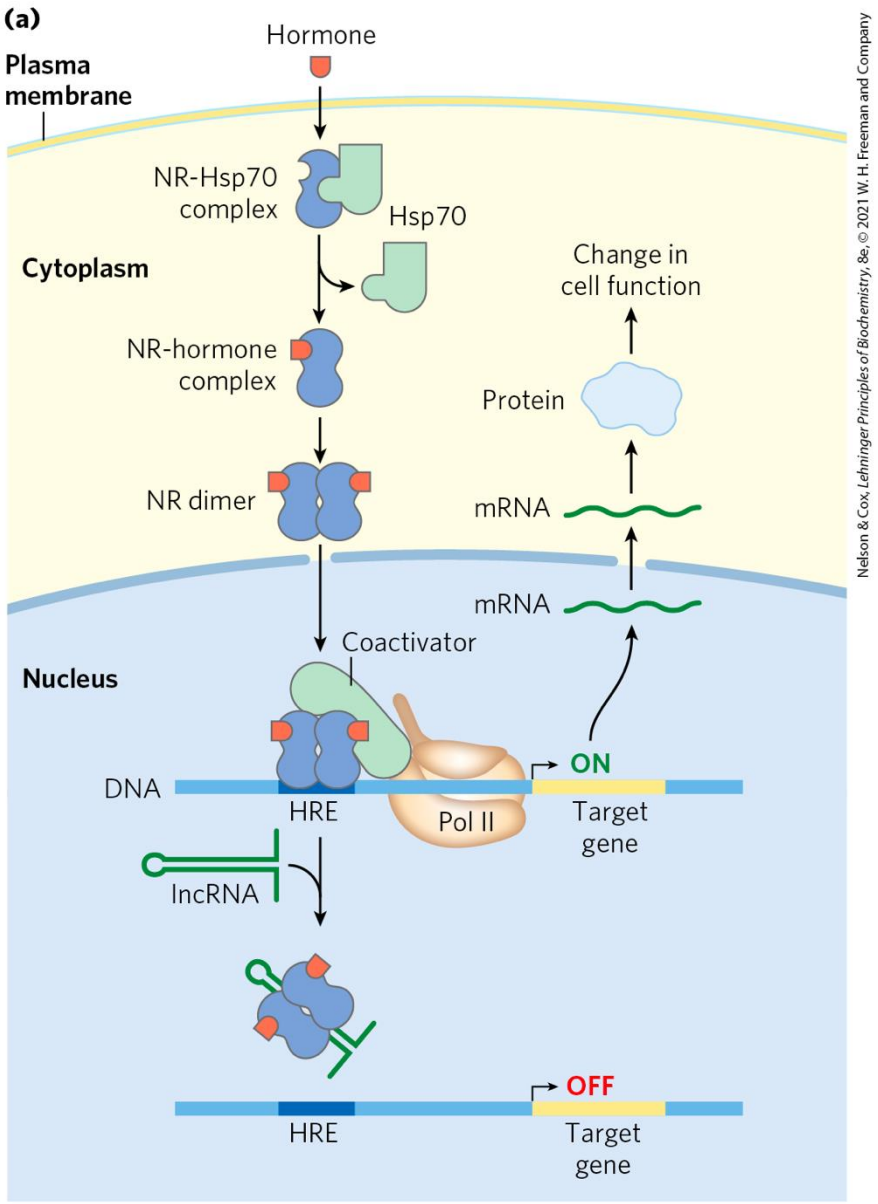
RNA Recognition Motif

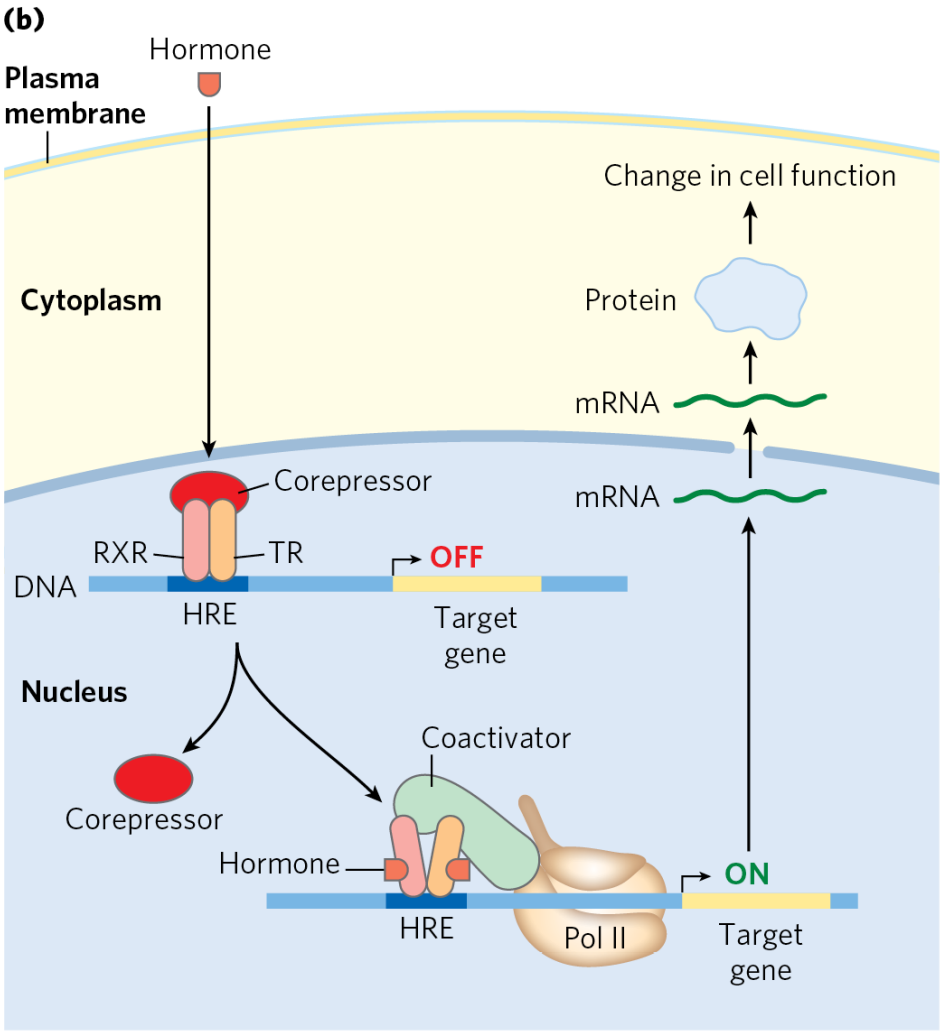


Nucleosome ejection by a SWI/SNF remodeler



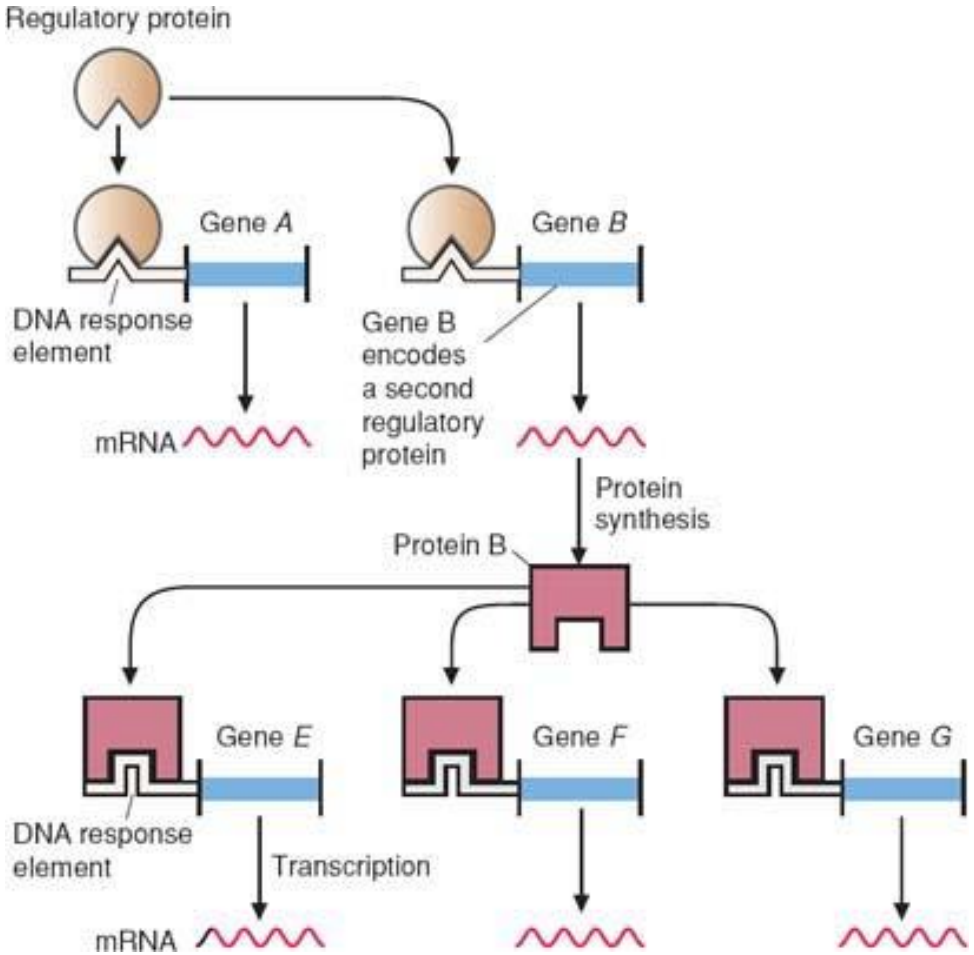
Mechanisms of steroid hormone receptor function



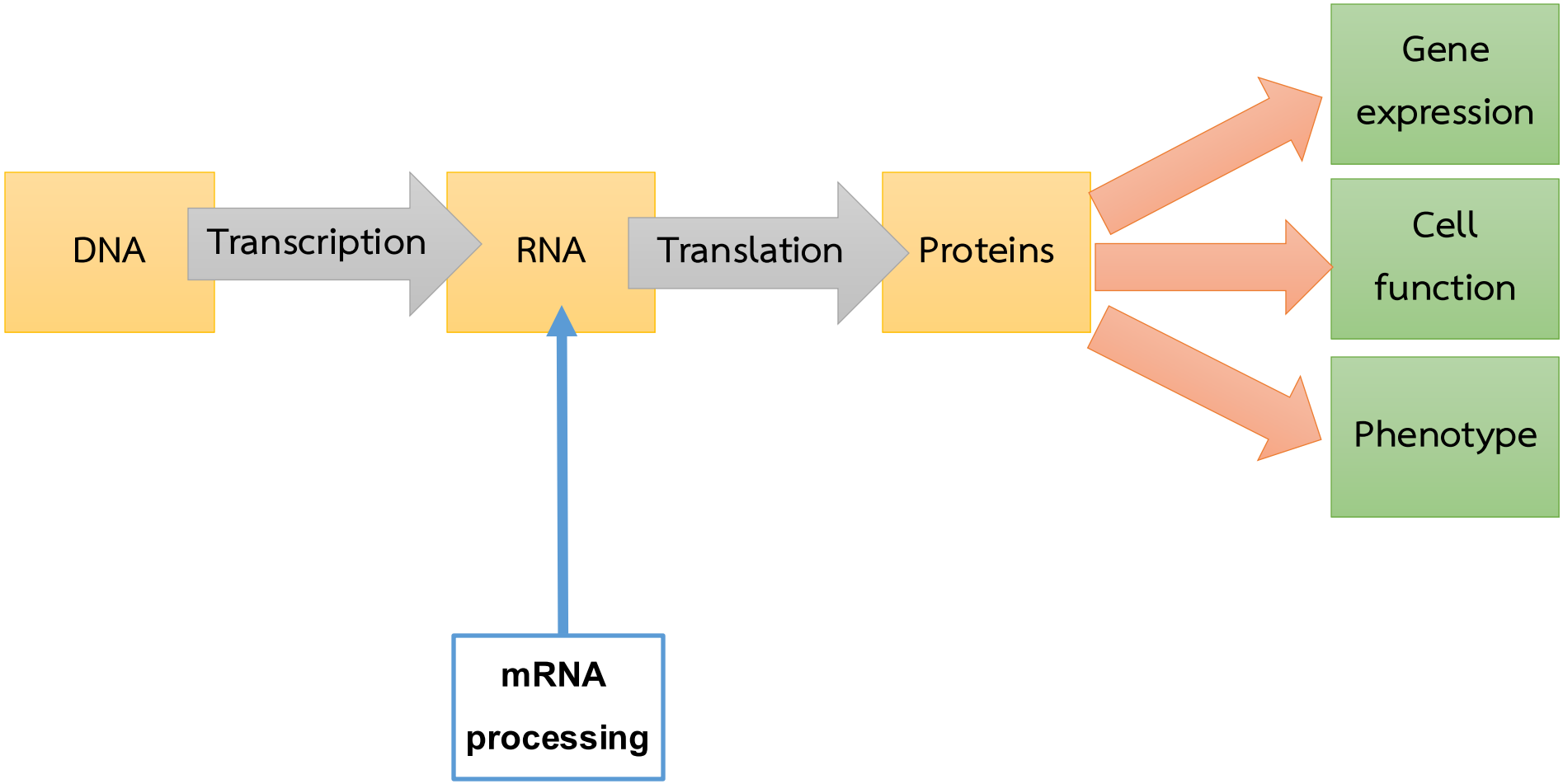


Transcriptional control

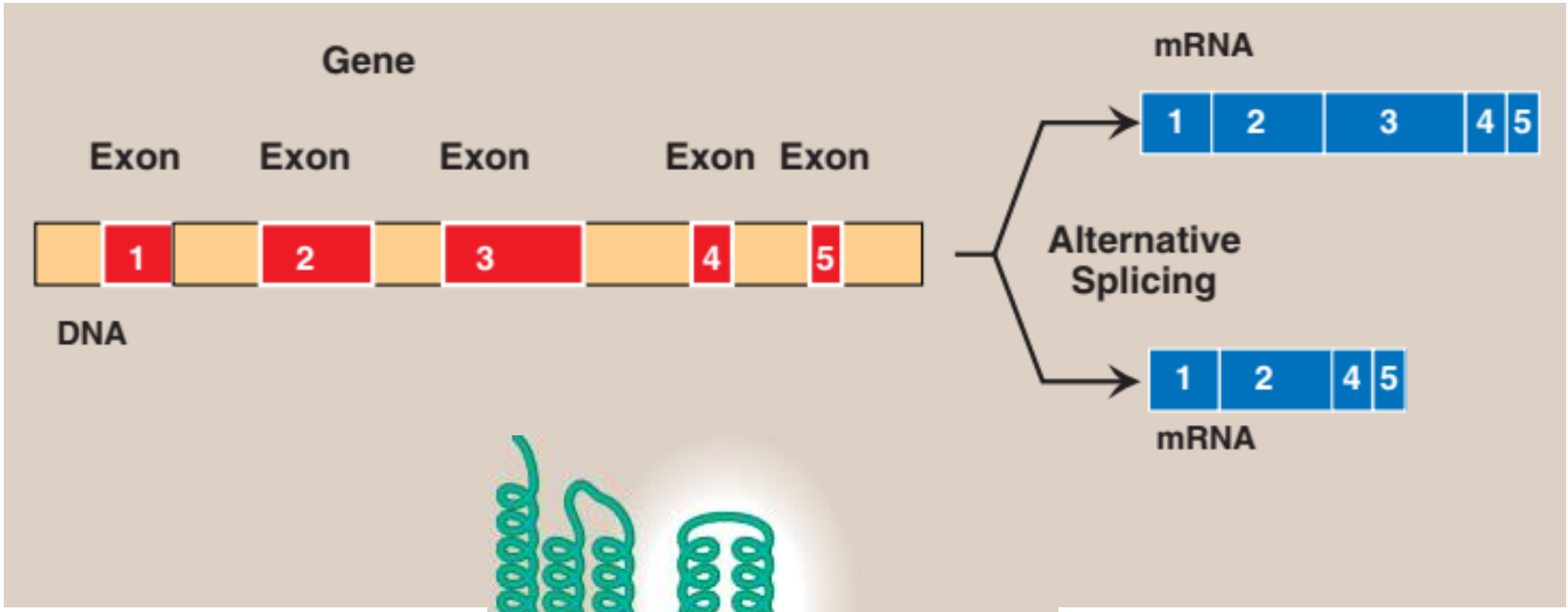
- Activation of sets of genes by a single inducer

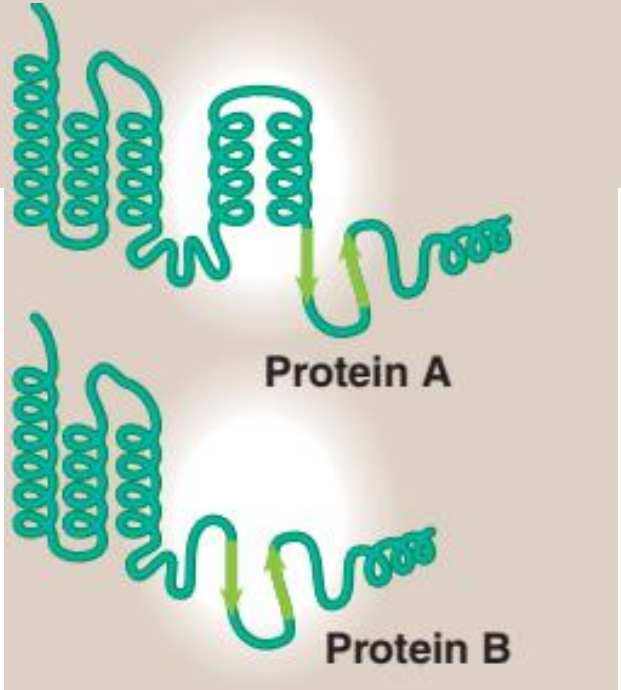


Gene expression : Eukaryote

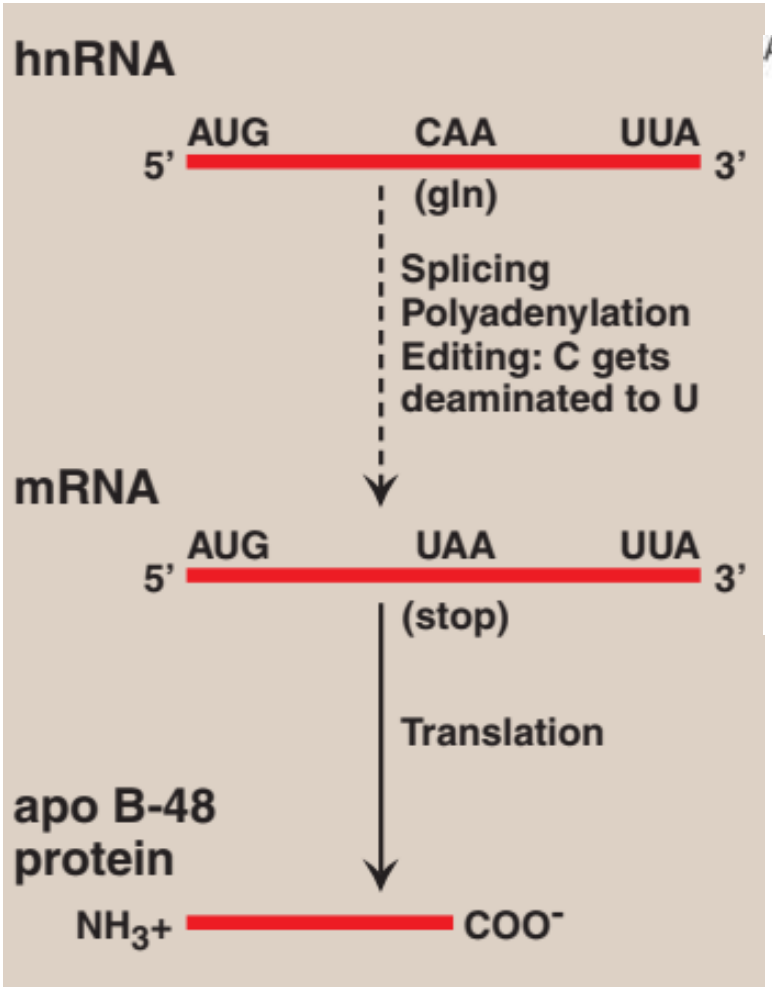


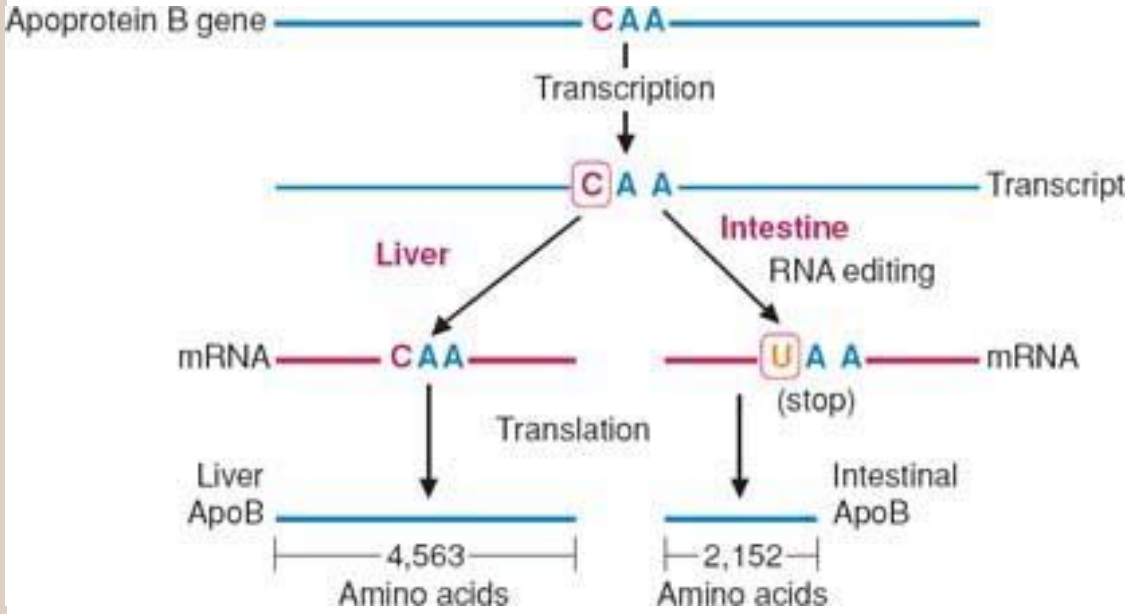
Alternative splicing



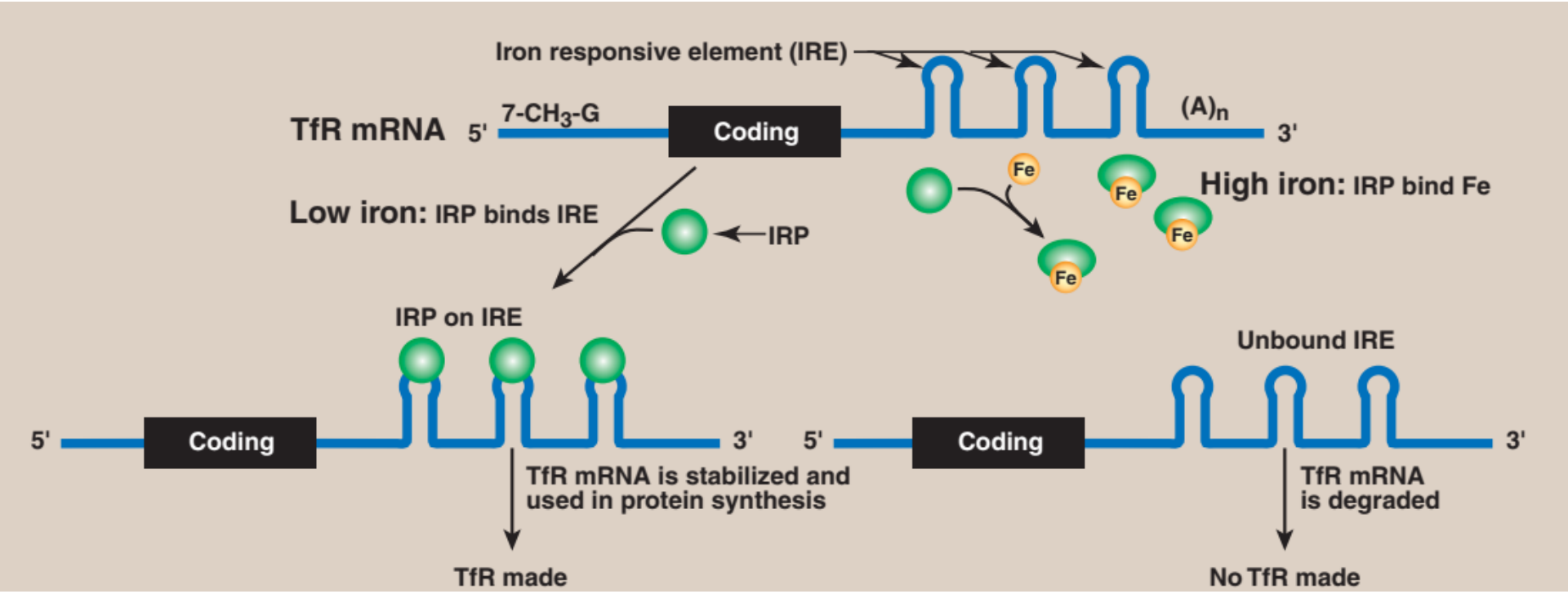


Posttranscriptional processing of RNA

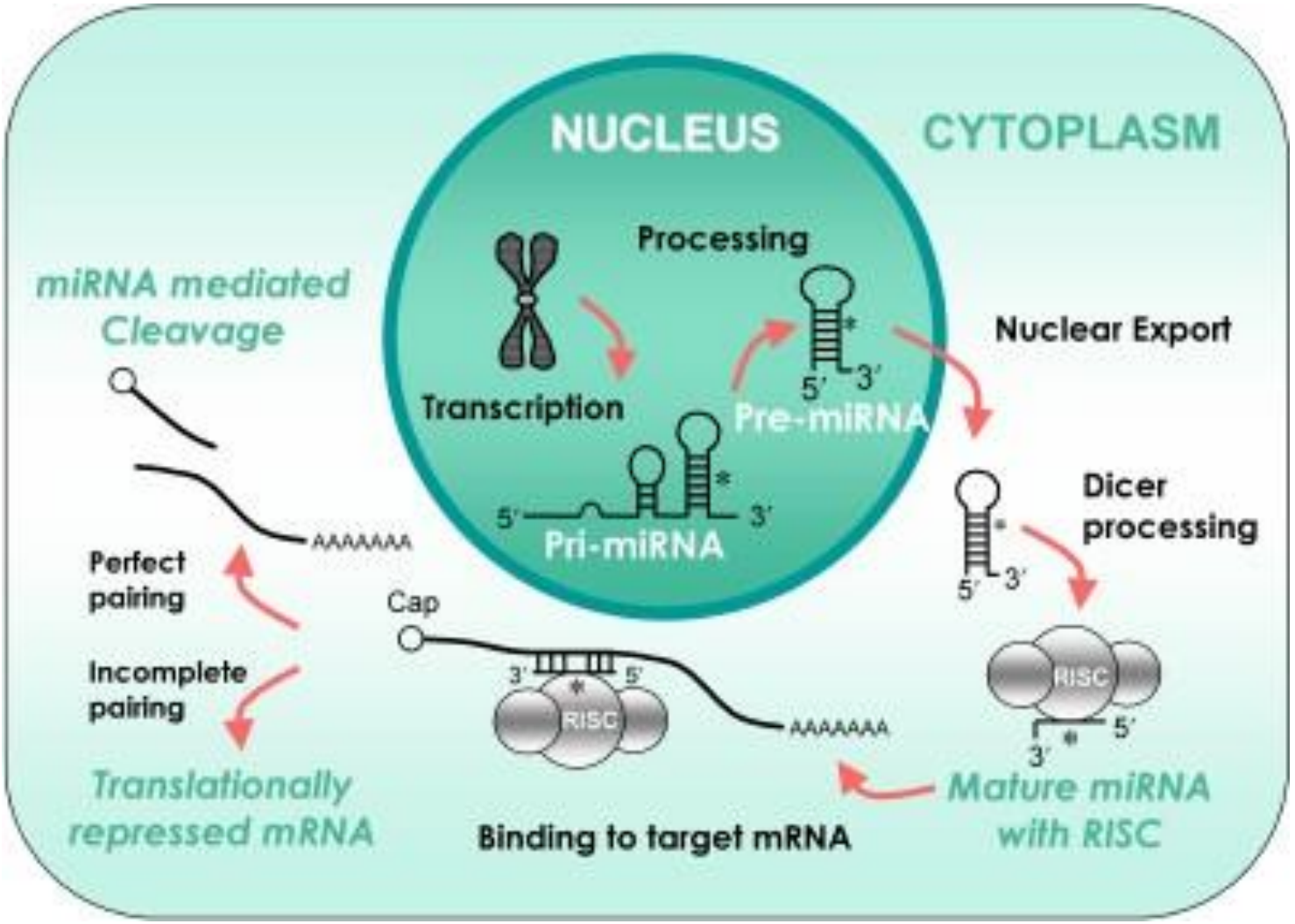




Translation and mRNA stability

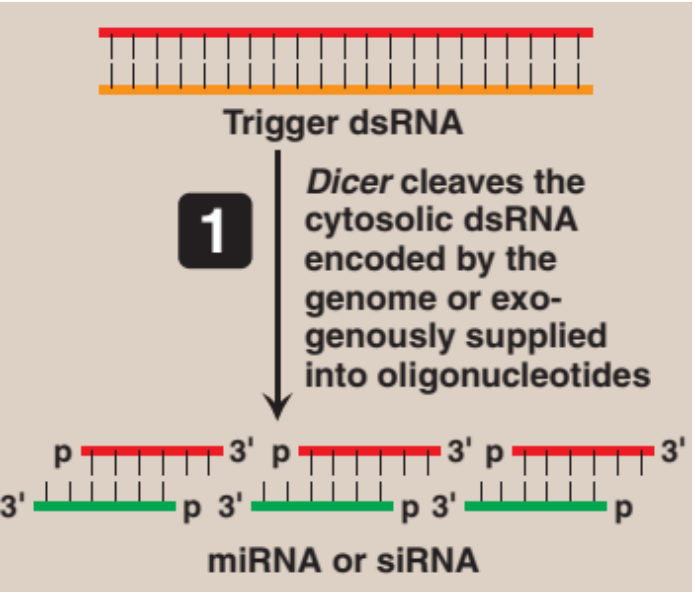


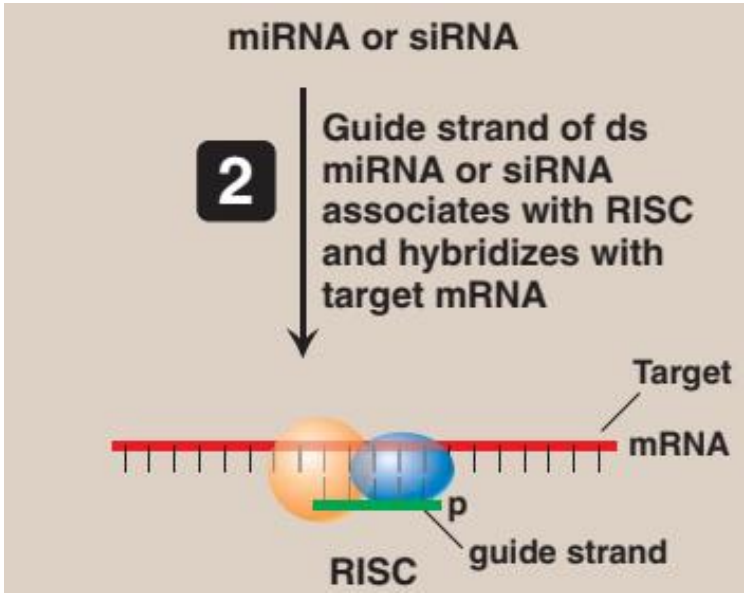
mRNA stability (microRNA, miRNA)

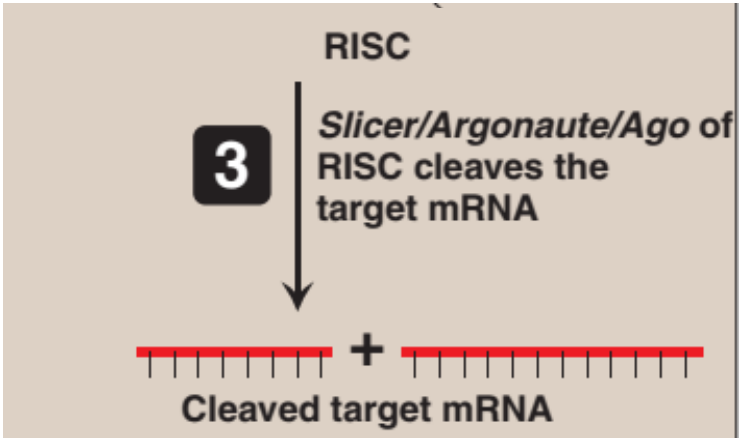


http://www.vertis-biotech.de/images/miRNA_scheme.jpg

mRNA stability (microRNA, miRNA)





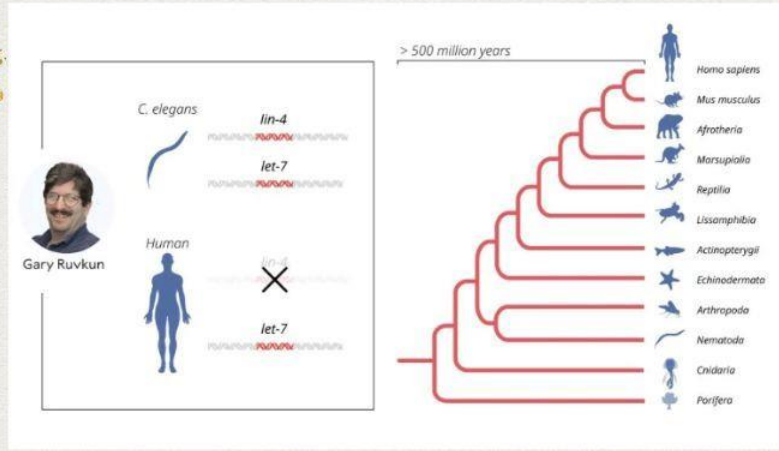


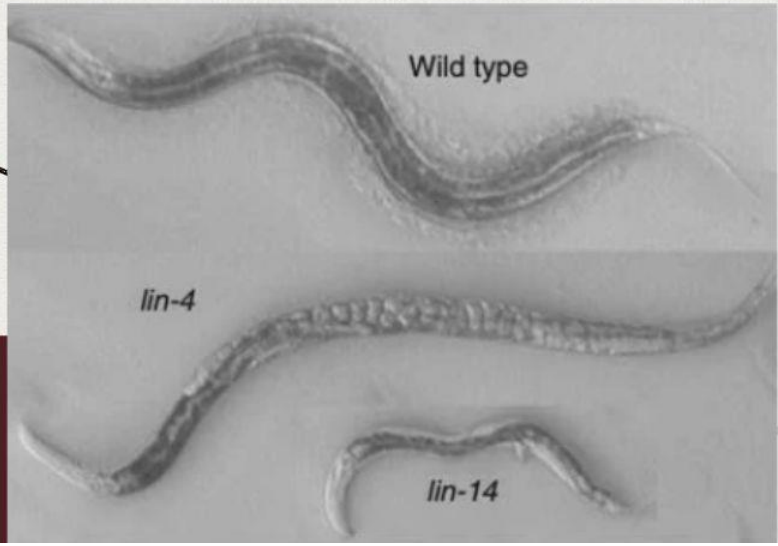
2024 NOBEL PRIZE: THE ANIMAL RESEARCH BEHIND THE DISCOVERY OF MICRO RNA

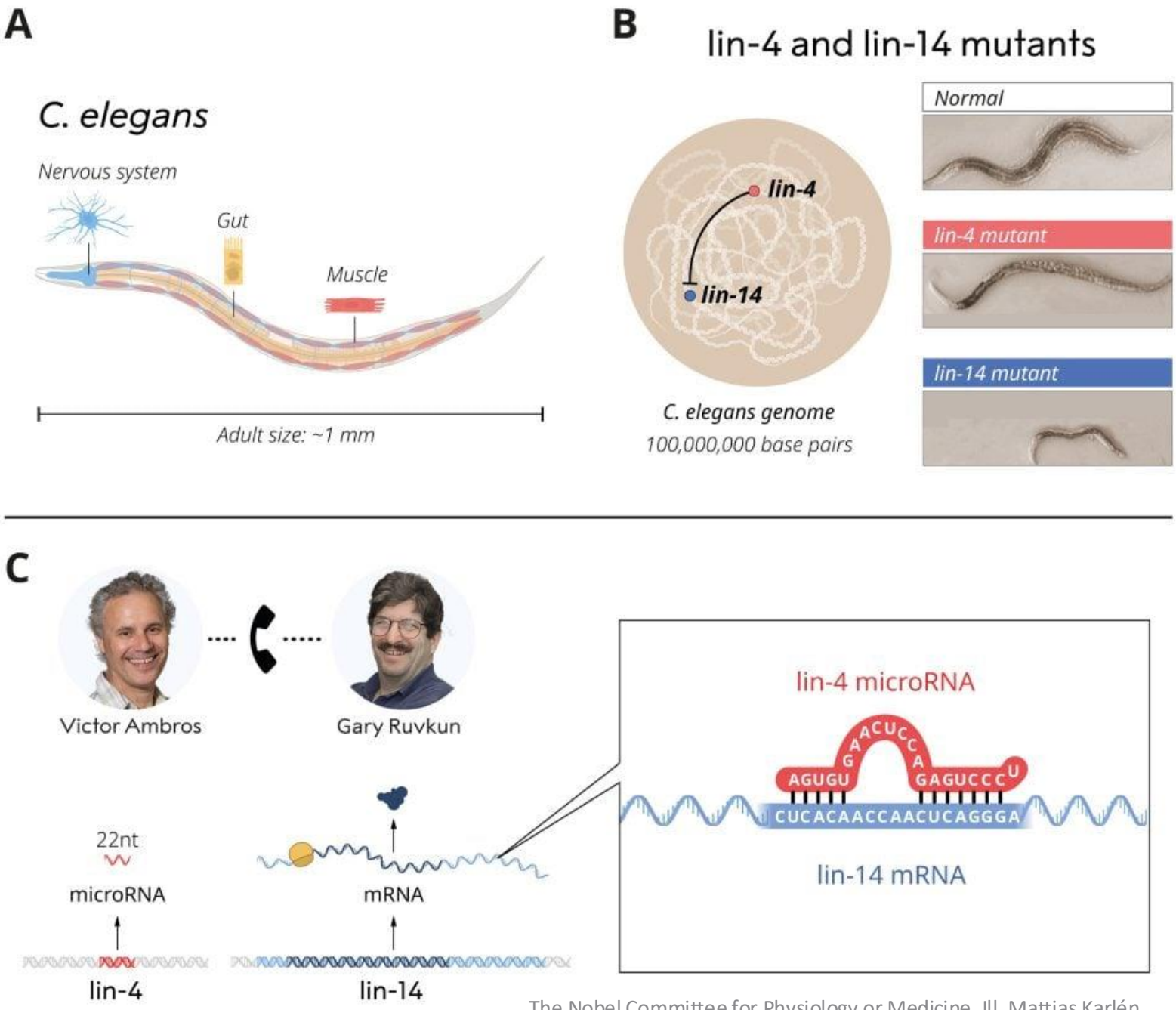
Illustrations: Niklas Elmehed

Victor Ambros Gary Ruvkun

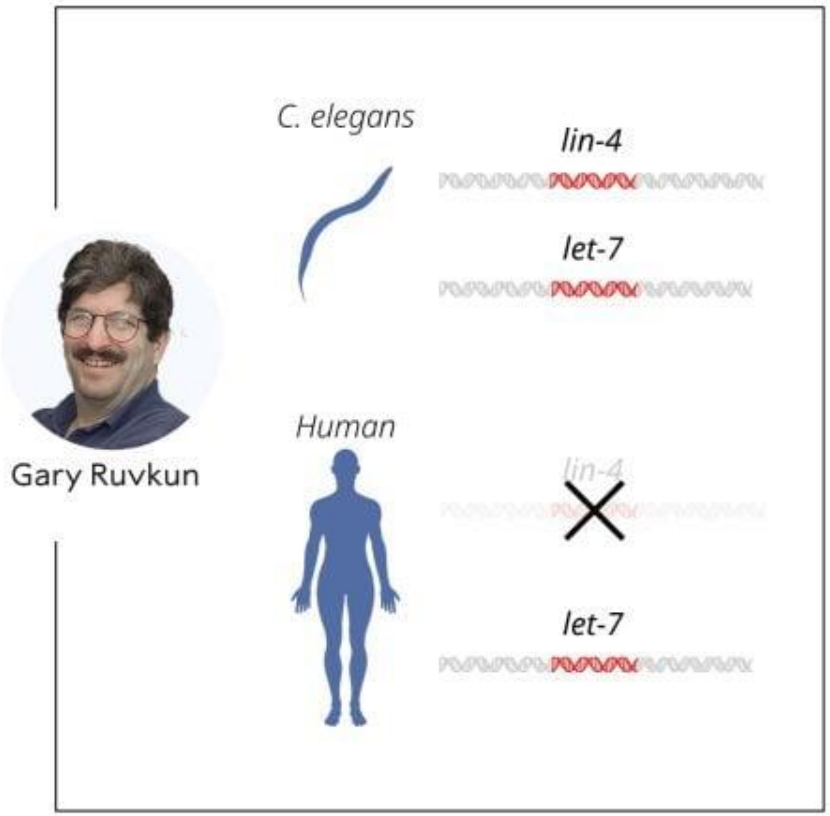
"for the discovery of microRNA and its role in post-transcriptional gene regulation"

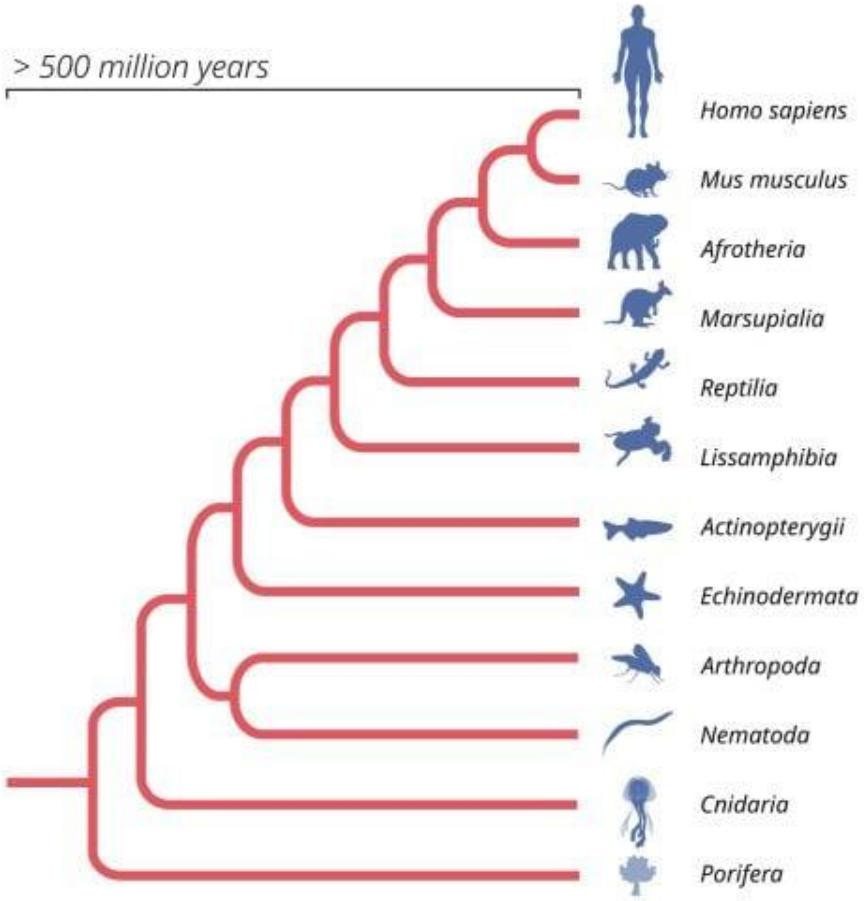






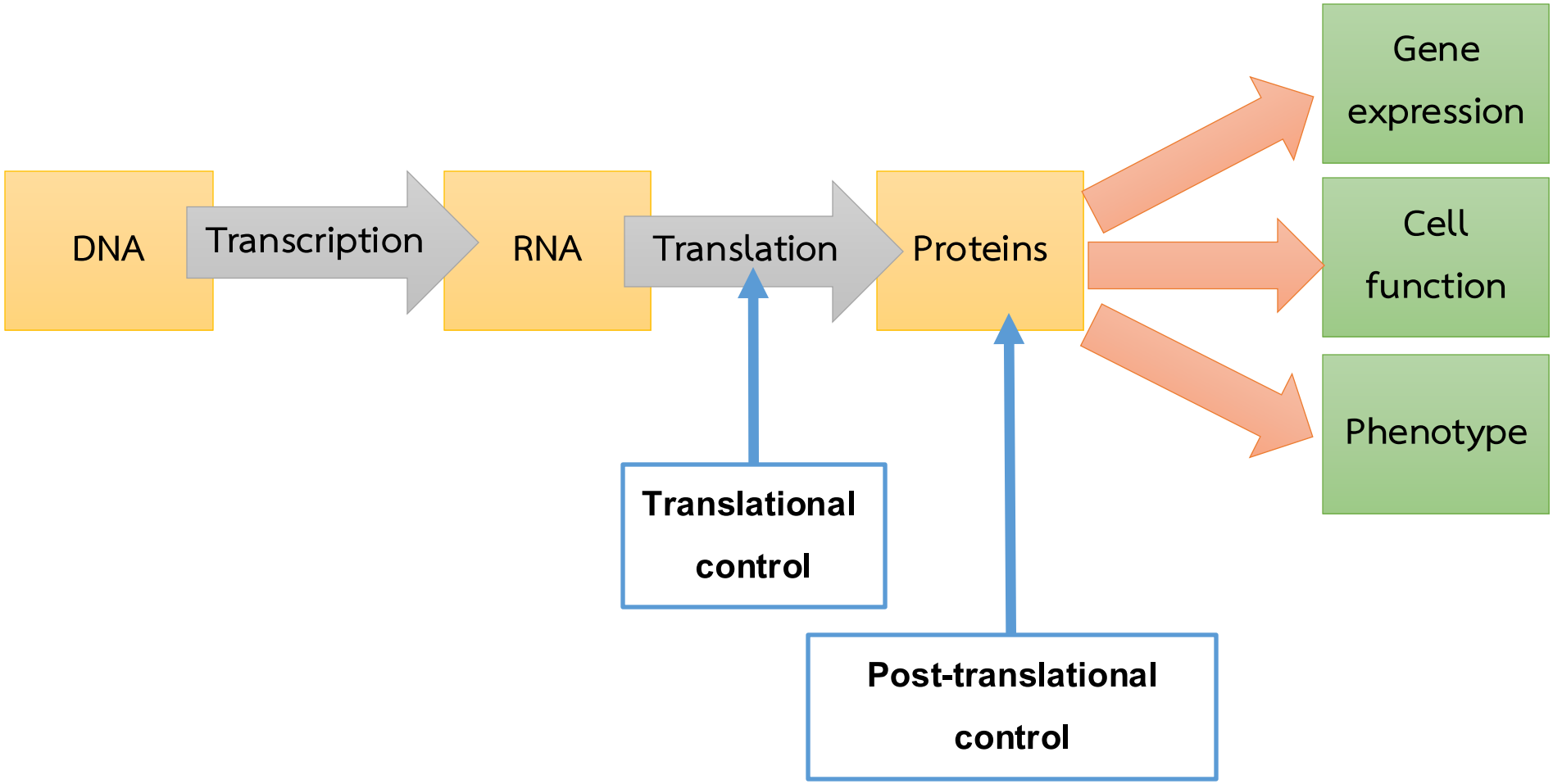
The Nobel Committee for Physiology or Medicine. Ill. Mattias Karlén





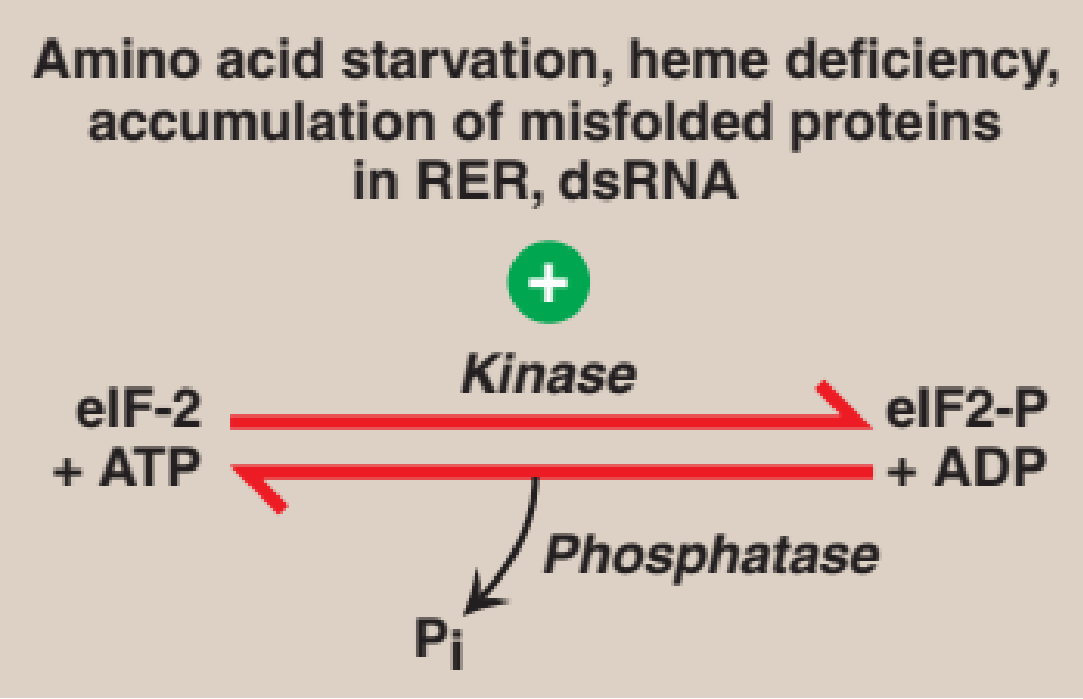
The Nobel Committee for Physiology or Medicine. Ill. Mattias Karlén

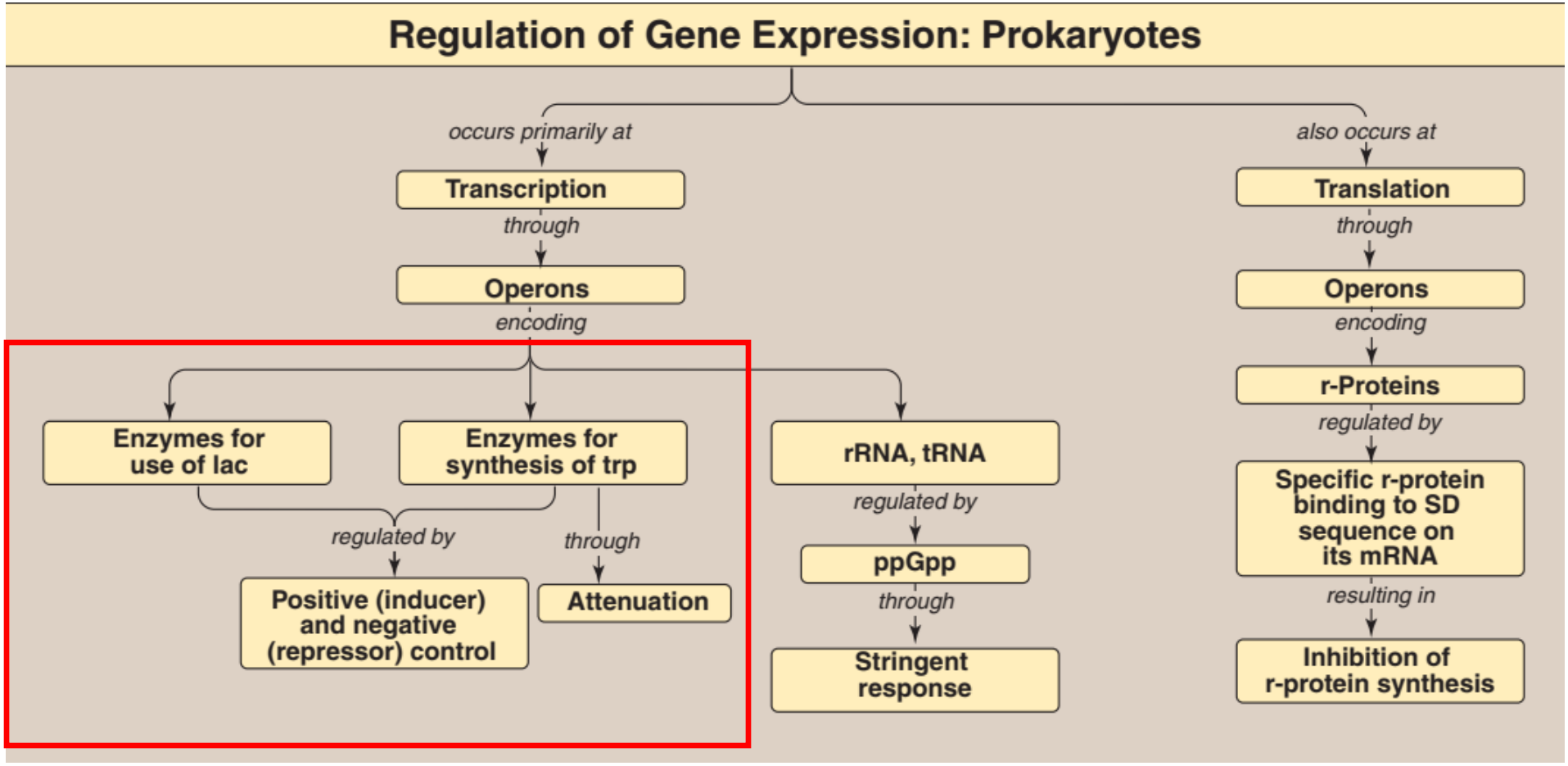
Gene expression : Eukaryote



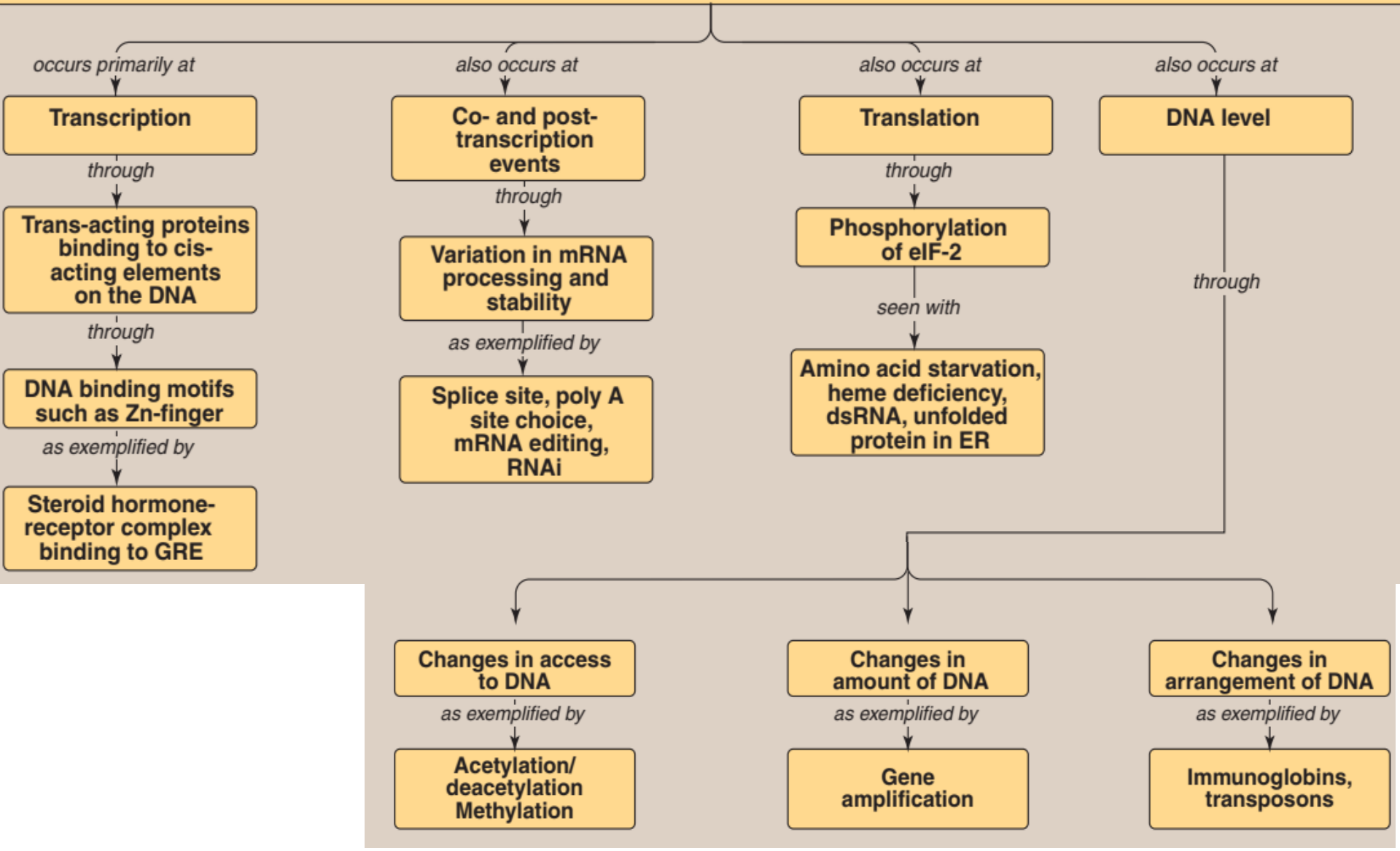
Phosphorylation of eEF-2 leads to inhibition of the elongation phase

- The phosphorylation is thought to reduce the affinity of eEF-2 for the ribosome, thereby slowing down the overall rate of elongation phase of protein synthesis.




Regulation of Gene Expression: Prokaryotes
occurs primarily at
Transcription
through
Operons
encoding
Enzymes for use of lac
Enzymes for synthesis of trp
regulated by
Positive (inducer) and negative (repressor) control
through
Attenuation
rRNA, tRNA
regulated by
ppGpp
through
Stringent response
also occurs at
Translation
through
Operons
encoding
r-Proteins
regulated by
Specific r-protein binding to SD sequence on its mRNA
resulting in
Inhibition of r-protein synthesis

Regulation of Gene Expression: Eukaryotes



How can we do researches on gene regulations?

How can we apply knowledge of "Regulation of gene expression" to apply in medicine?

Suggested reading