Outline 4

IV. Control of Gene Expression in Eukaryotes

A. Why is it different than in Prokaryotes?

B. Levels of control of gene expression

1. Chromosomal level – gene amplification

2. Chromatin modification
   - DNA methylation
   - histone acetylation

3. Transcription
   - transcription factors
   - enhancer sequences

4. Post-transcriptional control

5. Control of translation

6. Post-translational control

Patterns of control of gene expression

Negative control - an active regulatory protein turns transcription OFF

Induction - signal molecule makes the regulatory protein active

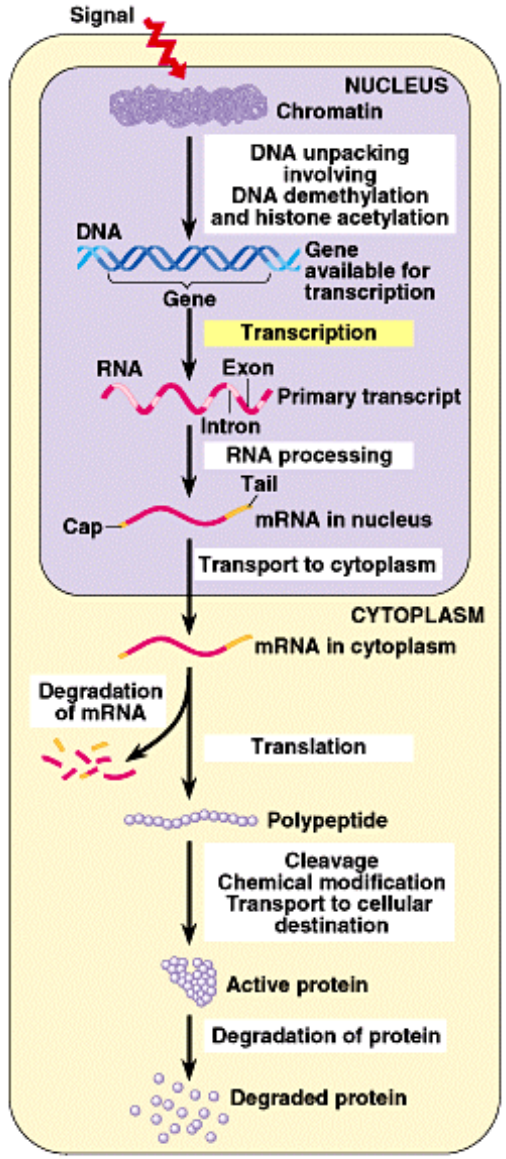
Repression - signal molecule makes the regulatory protein inactive

Positive control - an active regulatory protein enhances the rate Of transcription

Induction - signal molecule makes the regulatory protein active

Repression - signal molecule makes the regulatory protein inactive

Fig. 19.7 Levels of control of gene expression in Eukaryotes

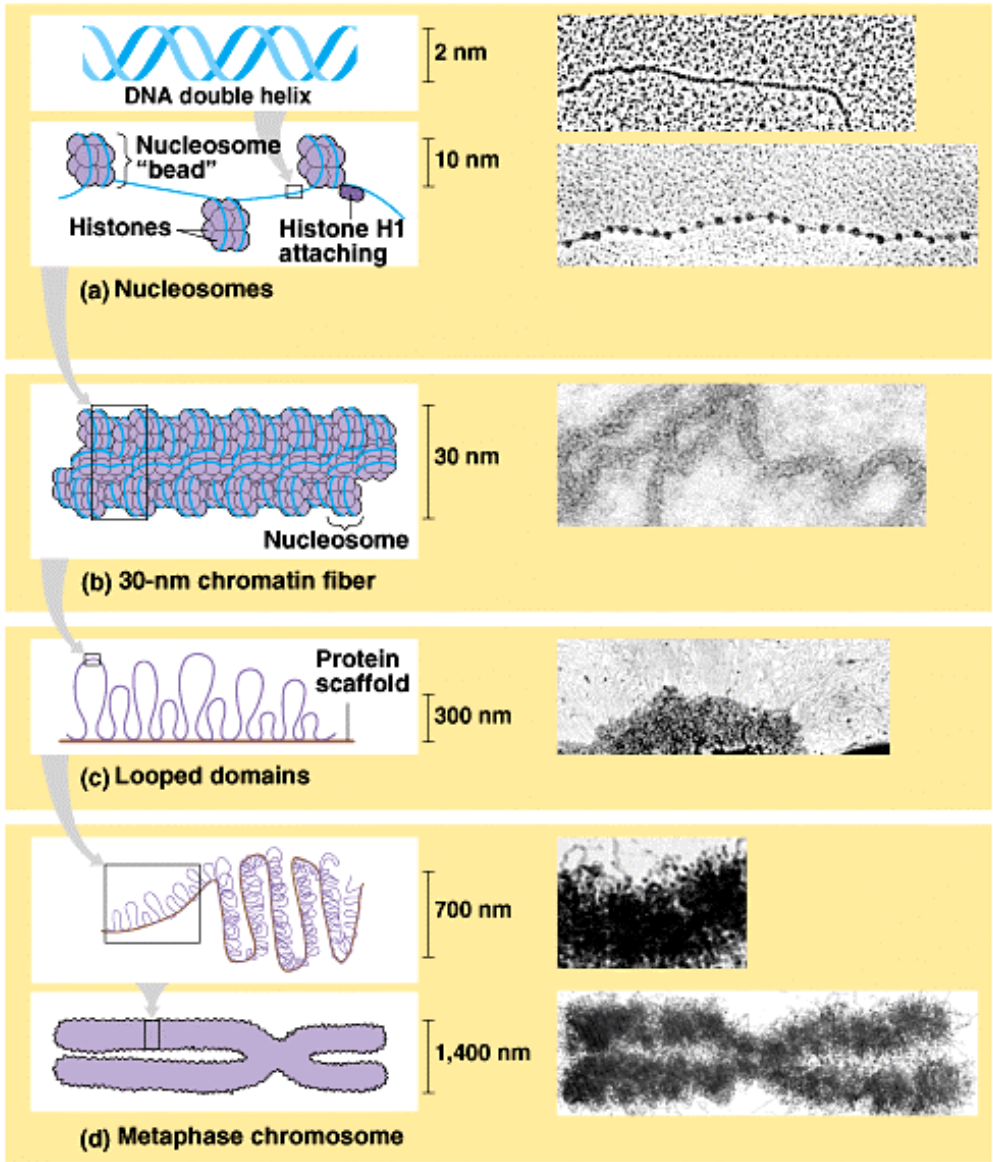


Control of Gene Expression

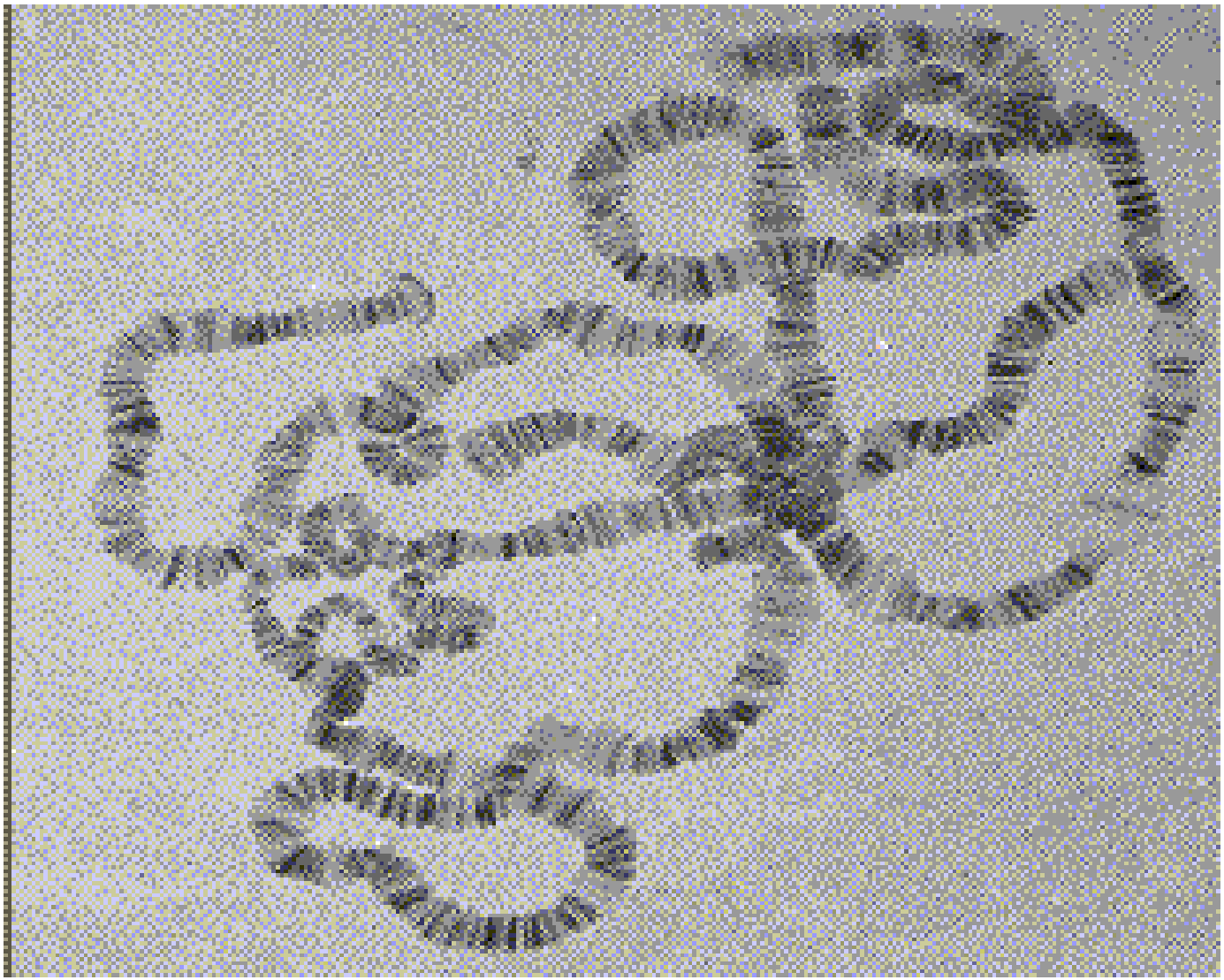
Level of Control	Control Mechanism
PROKARYOTES	
Transcriptional	1. Negative Induction: e.g. lac operon
	2. Negative repression: e.g. Tryp operon
	3. Positive Induction: e.g. lac operon enhanced at low [glucose]
	4. Positive repression: e.g. lac operon repression in the presence of glucose
EUKARYOTES	
Chromosomal/DNA	1. Gene amplification: e.g. polytene chromosomes
	2. Chromatin modification a. DNA methylation: inactivation of genes by methylation (e.g. Barr bodies) b. Histone acetylation: weakening of histone bonds by addition of acetyl groups
Transcriptional	1. Control elements: DNA sequences (e.g. enhancers) that interact with proteins (e.g. activators, transcription factors) to enhance binding of RNA polymerase
Post-transcriptional	1. RNA processing: intron removal and exon splicing
	2. Nucleotide additions: poly-A tail can prevent mRNA translation or transportation across nuclear membrane
	3. mRNA degradation: different mRNAs may have different lifetimes
Translational	1. Initiation factors: proteins required to initiate ribosome binding and tRNA binding to mRNA
Post-translational	1. Polypeptide modifications
	2. Metabolic regulation of gene product:

Fig. 19.1

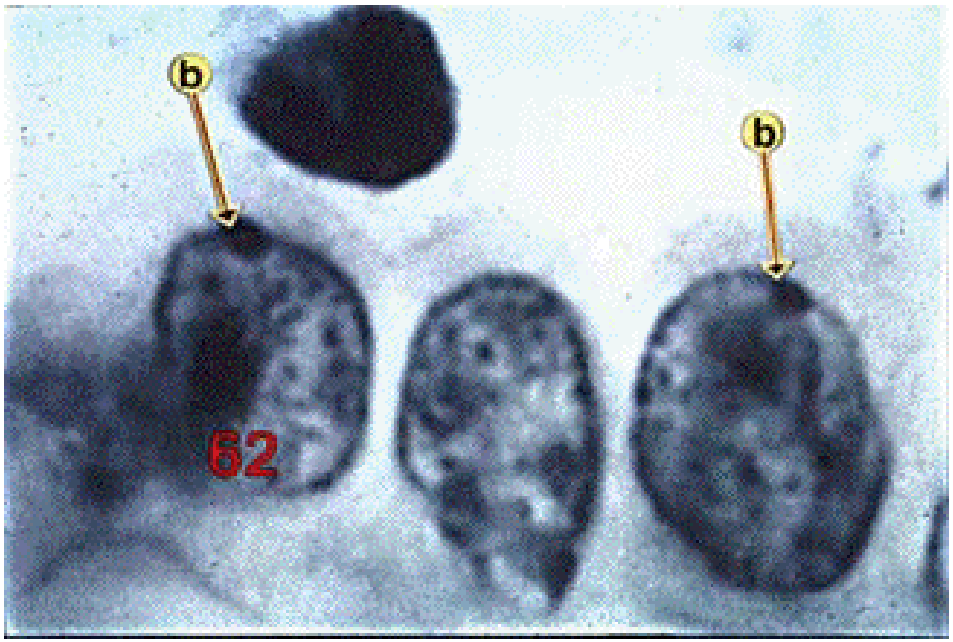
Levels of DNA packing

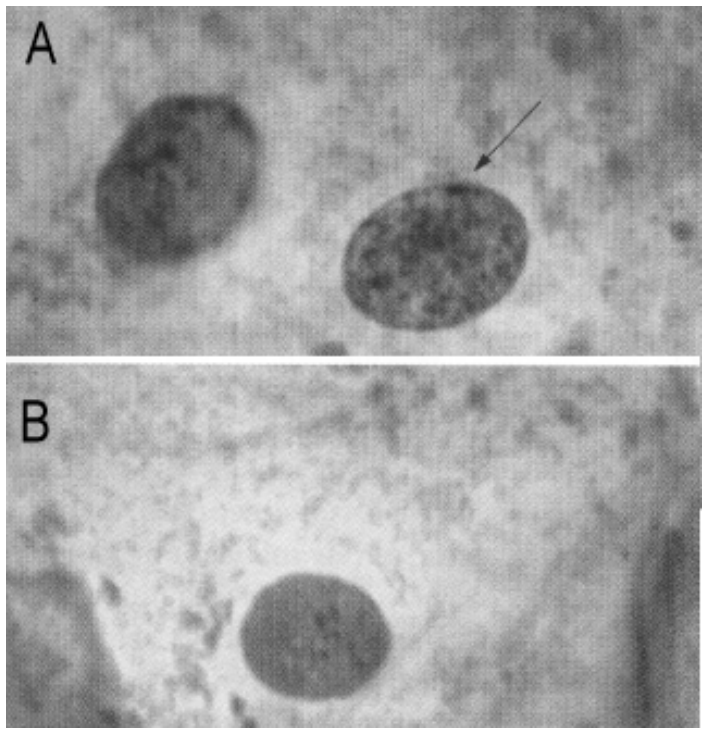


A polytene chromosome from a Drosophila salivary gland



Barr bodies - highly methylated mammalian X-chromosomes





Details of transcription in Eukaryotes

Fig. 17.7

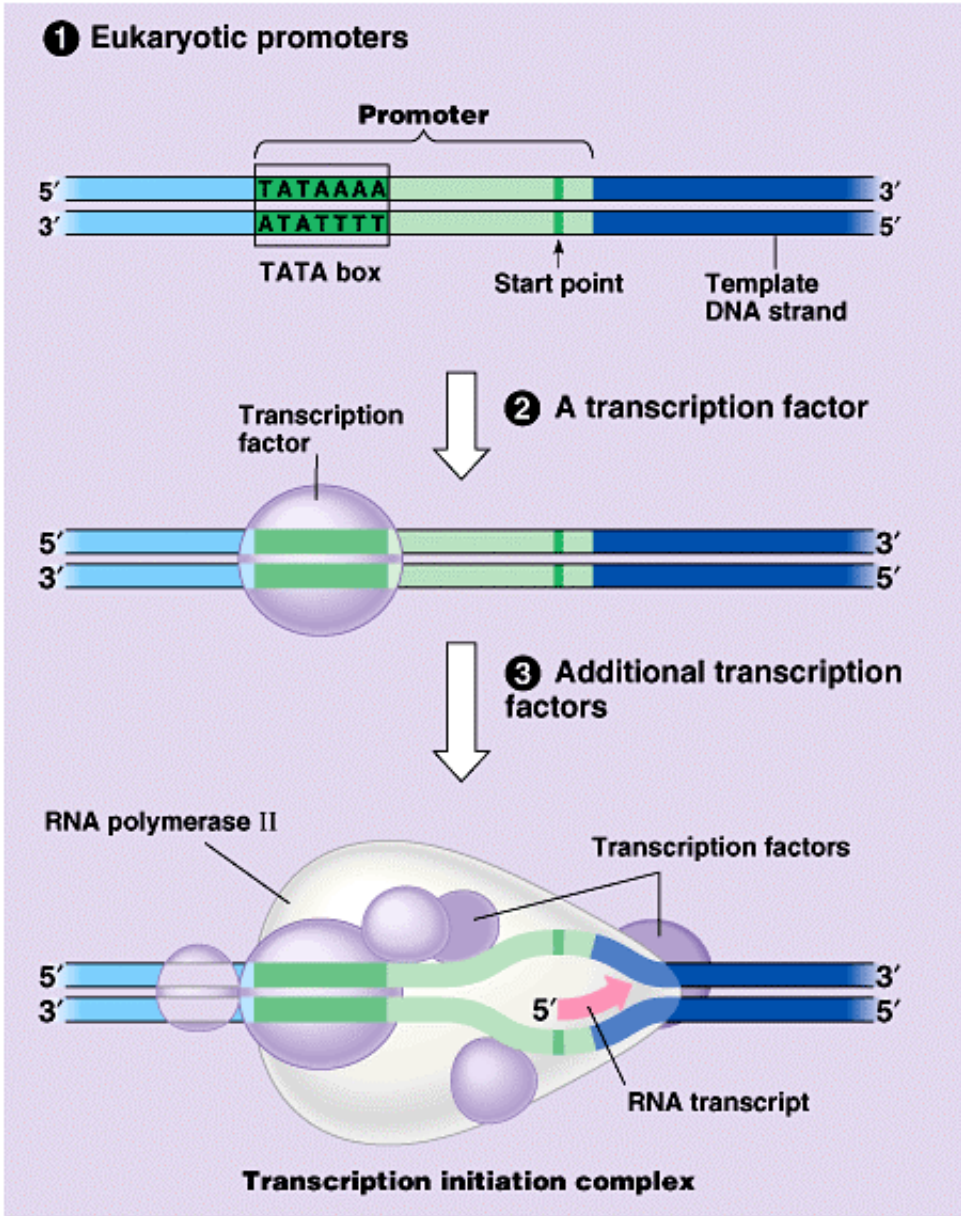


Fig. 19.8

Control elements - DNA sequences that react with proteins to facilitate the binding of RNA polymerase

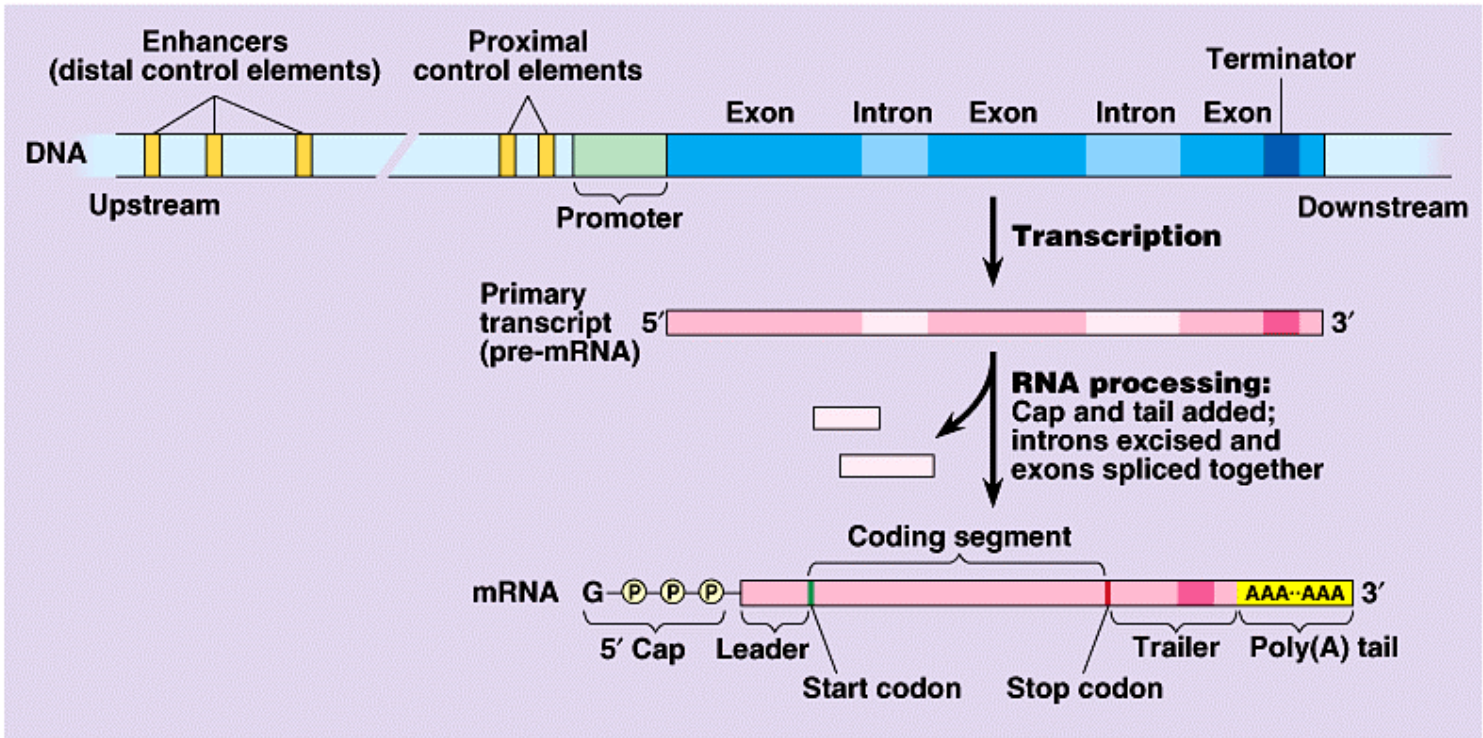
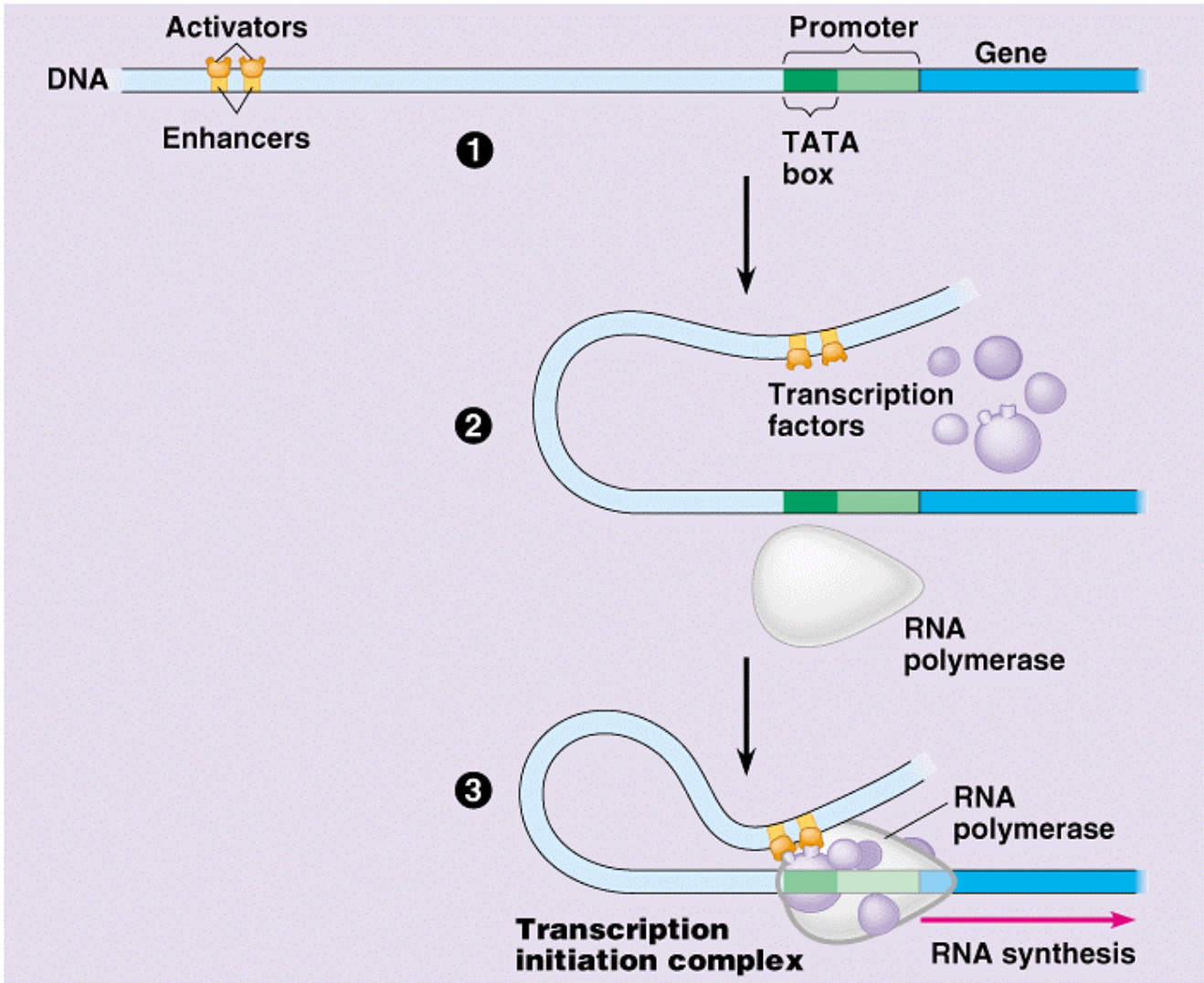


Fig. 19.9

Interaction between activator proteins, enhancer sequences, and transcription factors



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