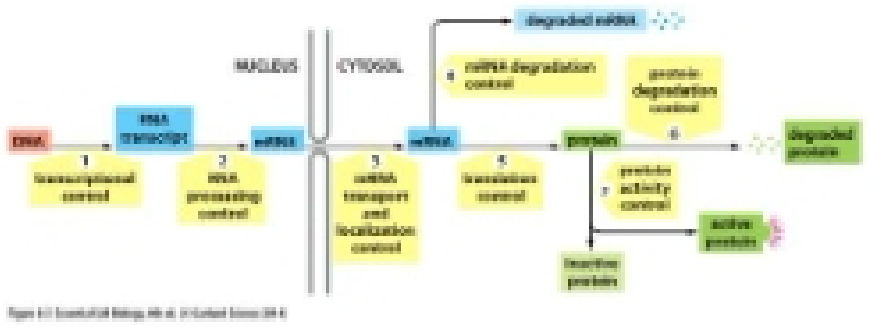
Gene Expression

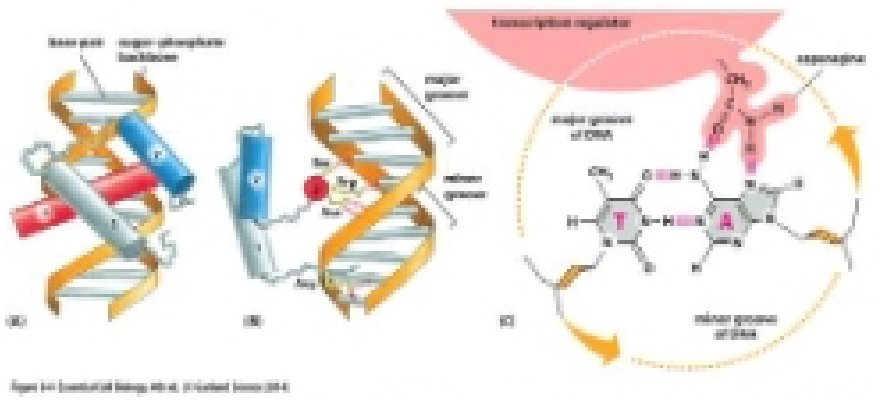
- Different cell types from the same organism have the same genome.
- Different cell types produce different sets of proteins accounting for differences in cell appearance and function.
- **Gene expression:** process that results in the generation of a specific protein or RNA molecule

Gene expression can be regulated at multiple steps.



- The **promoter** binds the RNA polymerase and correctly orients the enzyme to begin its task of making an RNA copy of the gene
- **Regulatory DNA sequences** are used to switch the gene on or off
- **Transcription regulators** binds to regulatory DNA sequences and control gene transcription

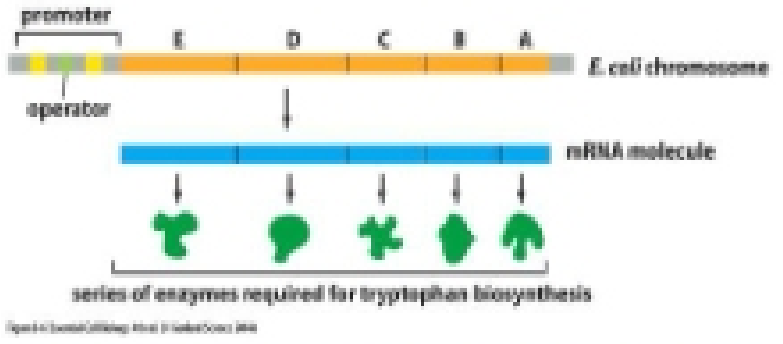
Transcriptional regulators bind to specific **regulatory DNA sequences.**



Protein-DNA interactions are among the tightest and most specific Molecular Interactions known in biology

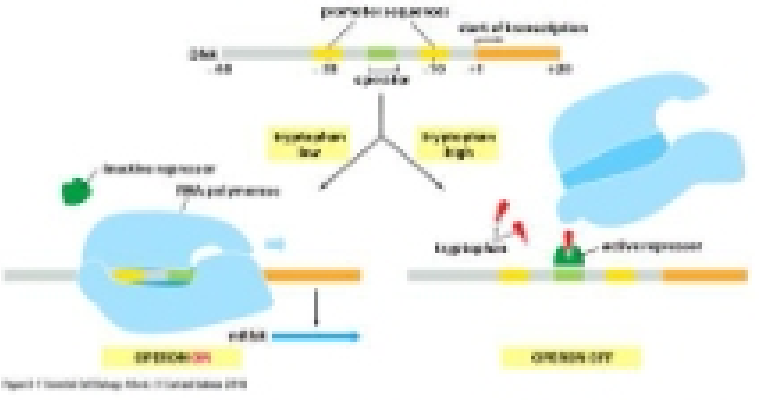
- **Transcriptional regulators**
  - generally recognize specific sequences in the DNA by binding to the edges of the bases
  - Form hydrogen bonds, ionic bonds, and hydrophobic interactions with DNA
  - Usually bind in the major groove of the DNA helix
  - Does not disrupt the hydrogen bonds that hold the double helix

A cluster of bacterial genes can be transcribed from a single promoter.



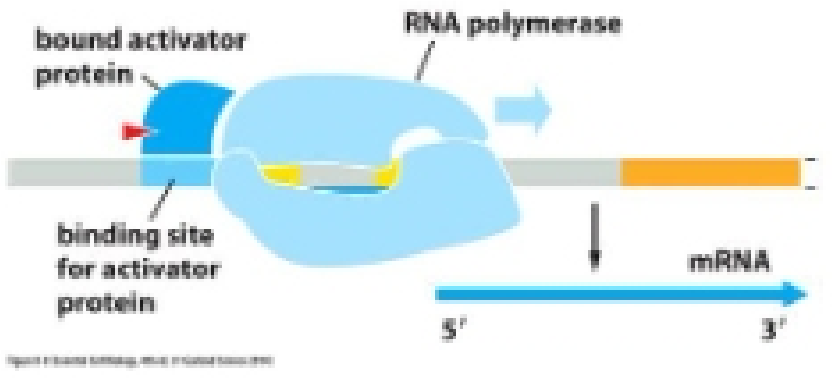
These five genes are transcribed as a single mRNA molecule, a feature that allows their expression to be coordinated

In bacteria, transcription regulators bind to regulatory DNA sequences close to where RNA polymerase binds

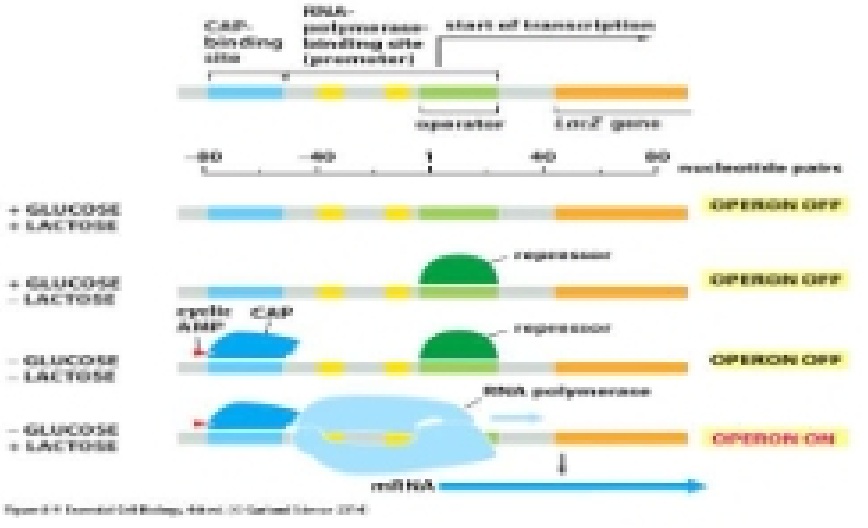


Genes can be switched off by repressor proteins.

Genes can be switched on by activator proteins



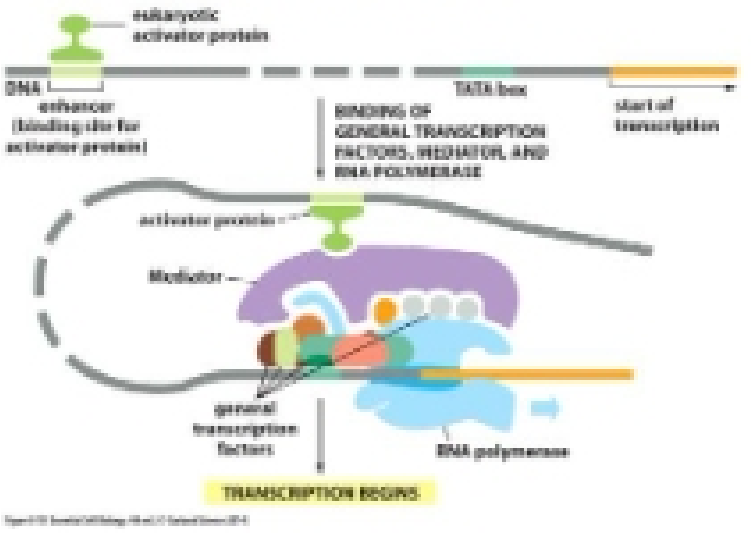
The *Lac* operon is controlled by two transcription regulators



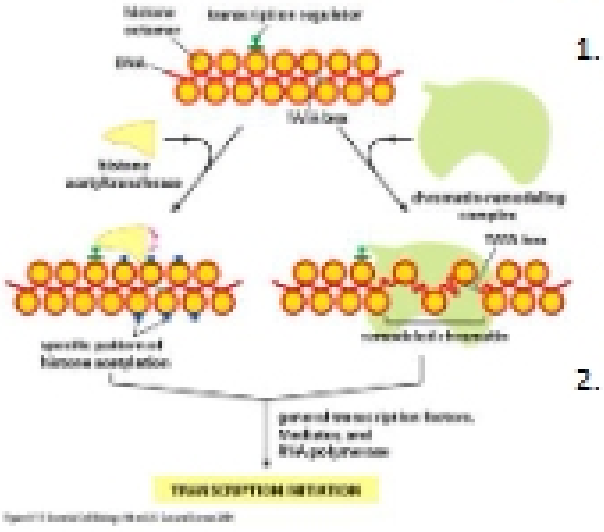
- In bacteria, transcription regulators usually bind to regulatory DNA sequences **close to where RNA polymerase binds.** This binding can either activate or repress transcription of the gene.

- In eukaryotes, regulatory DNA sequences are **often separated from the promoter by many thousands of nucleotide pairs**

Eukaryotic transcription is regulated by **transcriptional activators** and **repressors** that act at a distance.



Some transcriptional regulators recruit chromatin modifying proteins.



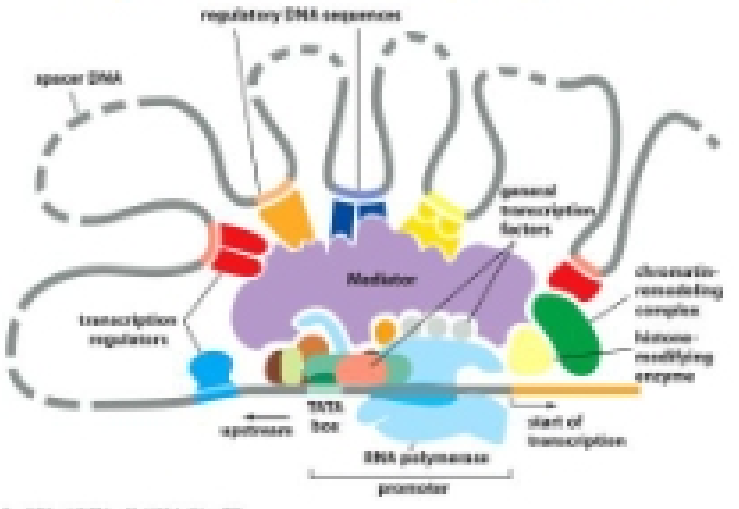
1. Histone tail modifying enzymes
   a. histone acetyltransferase =promote txn
   b. histone deacetyltransferase =inhibit txn
2. Chromatin modifying complexes

Eukaryotic transcription regulators

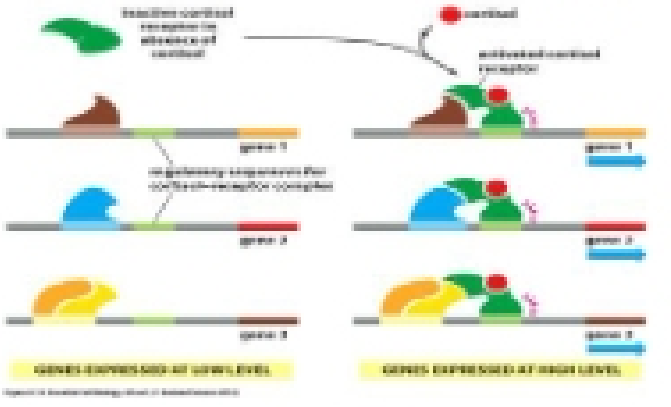
- Eukaryotic transcription regulators act in two main ways.

1. They can directly affect the assembly process that require RNA polymerase and the general transcription factors at the promoter.
2. They can locally modify the chromatin structure of promoter regions.

Combinatorial control: multiple transcriptional regulators act to control the expression of a single gene



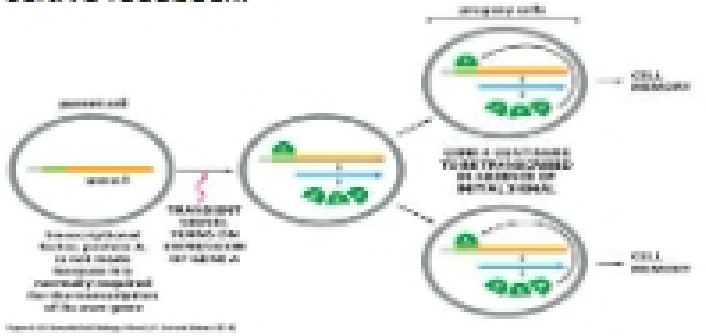
A single transcriptional regulator can control the expression of many genes.



The cortisol-responsive genes share a DNA sequence in their regulatory regions that binds the cortisol-responsive transcriptional activator.

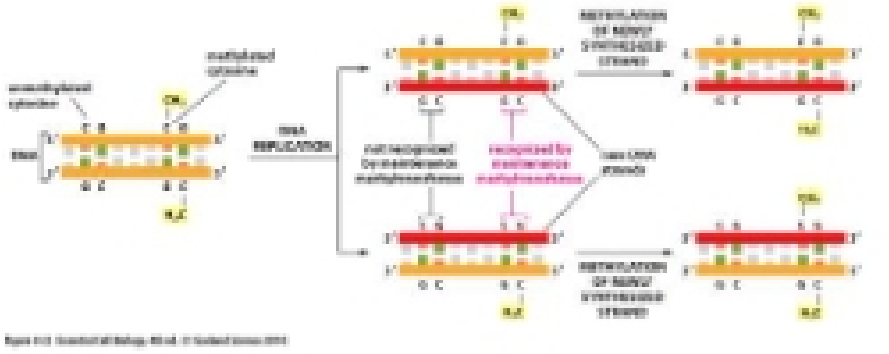
Cell memory allows a proliferating cell to transmit its cell identity to its daughter cells.

1. Positive feedback:



All of the descendants of the original cell will remember that the progenitor cell had experienced a transient signal that initiated the production of protein A

2. Transmission of DNA methylation patterns: (inactive genes are methylated)



DNA methylation patterns are passed on to progeny cells by the action of an enzyme that copies the methylation pattern DNA strand to the daughter DNA strand as it is synthesized