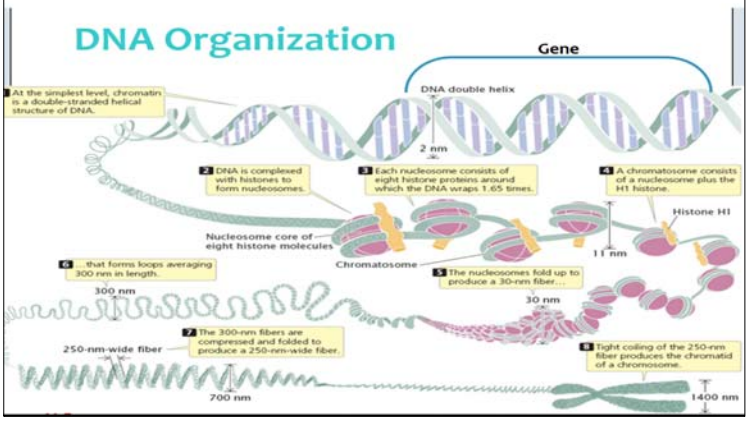
MI 3.1.4 GENE EXPRESSION EXTENSION ACTIVITY

DNA Organization

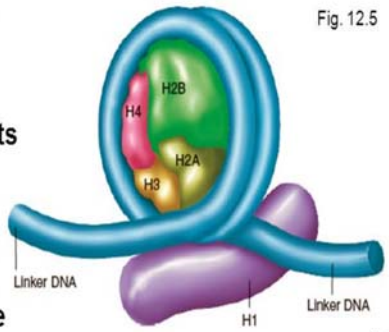


The nucleosome core is an octamer of two each of histones H2A, H2B, H3, and H4

160 bp of DNA wraps twice around a nucleosome core

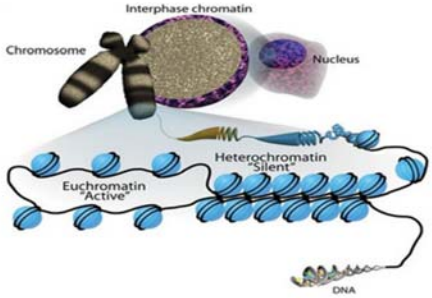
40 bp of linker DNA connects adjacent nucleosomes

Histone H1 associates with linker DNA as it enters and leaves the nucleosome core

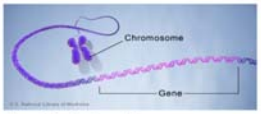


Chromatin Structure

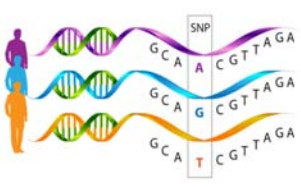
- **Heterochromatin** = Silent Genes
- **Euchromatin** = Active Genes

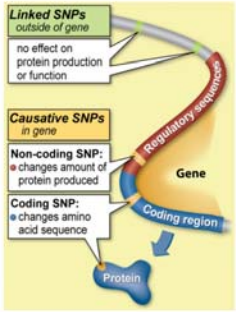


Genes

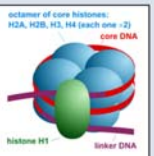


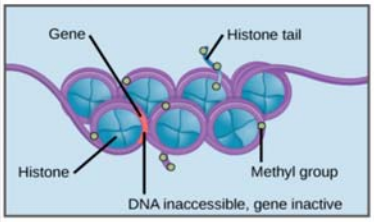
- Comparing DNA between individuals:
  - SNP's (Single Nucleotide Polymorphisms)
  - G-C Content
  - Coding regions: Exons



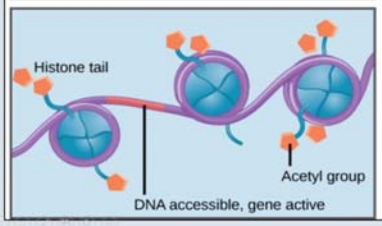


Preparing Genes to be Read





Methylation of DNA and histones causes nucleosomes to pack tightly together. Transcription factors cannot bind the DNA, and genes are not expressed.



Histone acetylation results in loose packing of nucleosomes. Transcription factors can bind the DNA and genes are expressed.

DNA Methylation vs. Histone Acetylation

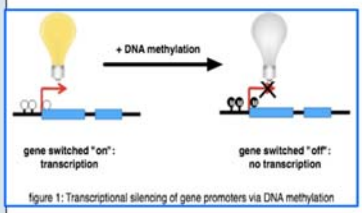
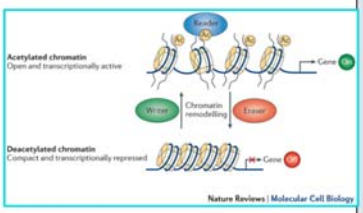


figure 1: Transcriptional silencing of gene promoters via DNA methylation



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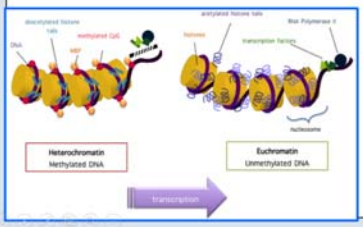

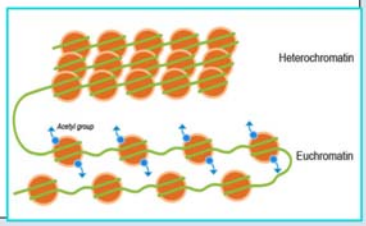

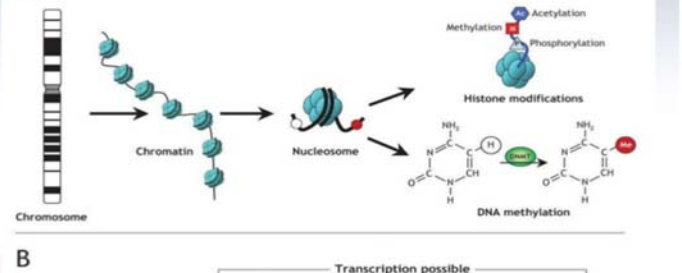

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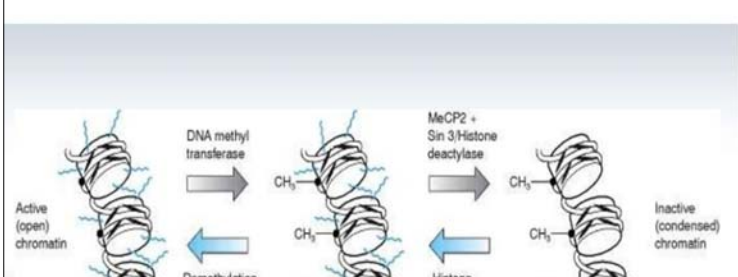

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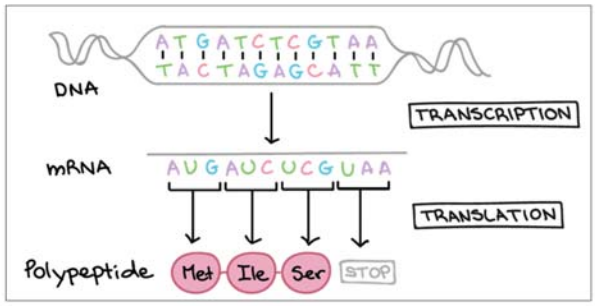
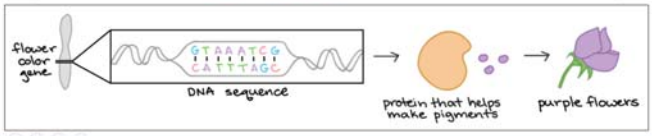
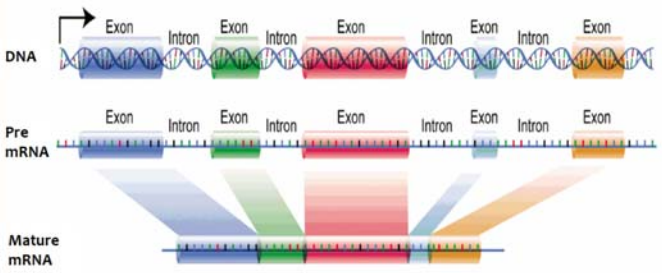
Central Dogma: Reading Our Genes





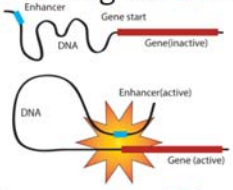
Finding Genes in the Genome

- **Introns:** non-coding regions
- **Exons:** coding regions; expressed as phenotypes

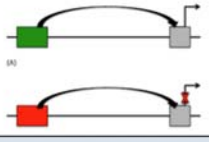


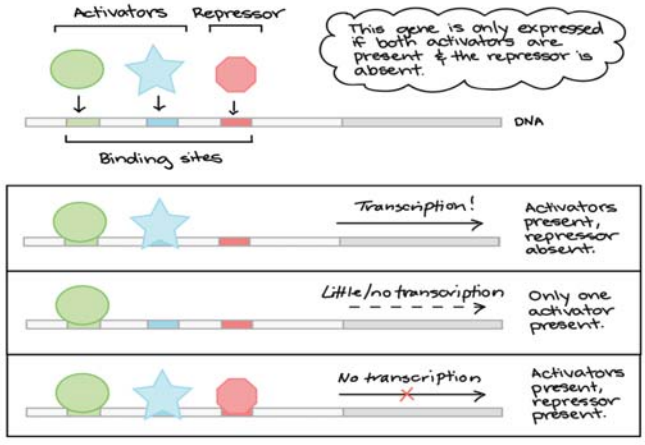
Transcription Factor Binding Sites

- **Enhancer Region** – turns gene on in specific cells

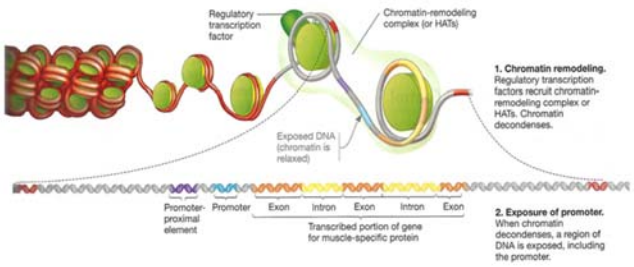


- **Silencer Region**– turns gene off in specific cells



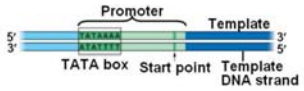


Chromatin remodeling exposes the promoter

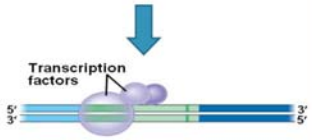


Transcription

- Transcription factors (proteins) bind to promoter region



- Initiates Transcription



Transcription: RNA Polymerase

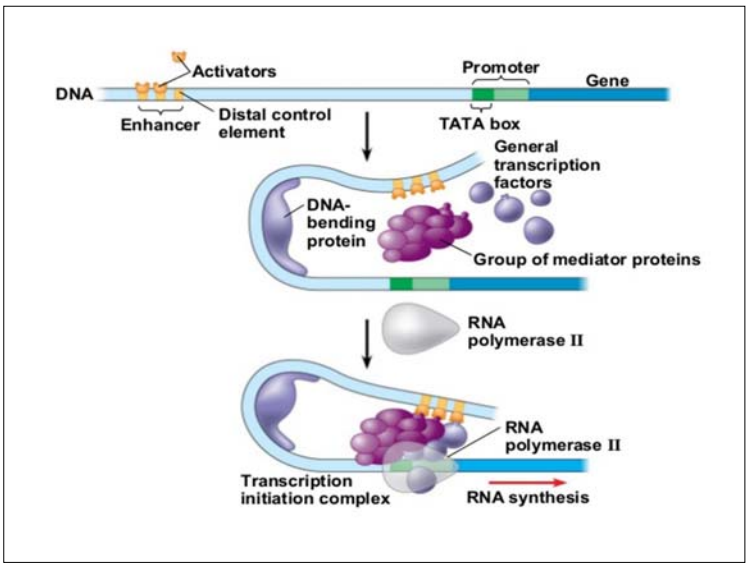
- RNA Polymerase binds to transcription factors (@ promoter region)
  - Creates pre-mRNA (messenger RNA)

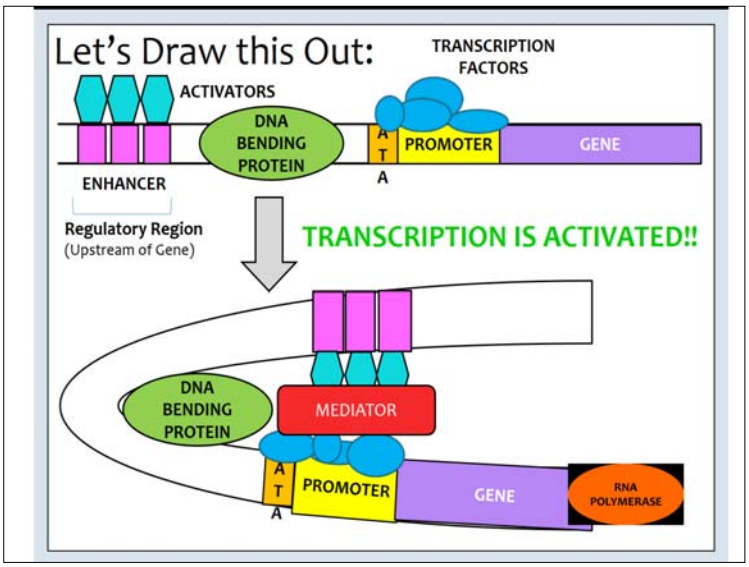
- Steps in Transcription
  1. Initiation begins at start codon (AUG)
  2. Elongation of RNA nucleotides
  3. Termination at stop codon

Sections of DNA vs. Proteins

Summary of common **types** of **regulating proteins** and associated **sequences** found in **eukaryotes**.

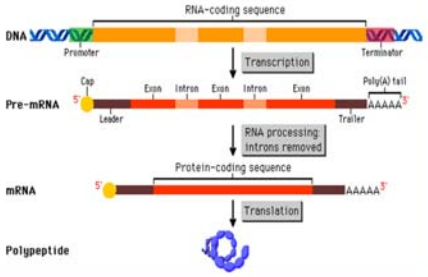
DNA Sequence	Binding protein	Function
Enhancers	Activator	Activator proteins bind to enhancer sequences of DNA to greatly increase the rate of transcription of a gene.
Silencers	Repressor	Repressor proteins bind to non-coding regions of DNA to either block or reduce the transcription of a gene.
Promoter	RNA Polymerase	A region of DNA located close to a specific gene. Once bound to the sequence RNA polymerase transcribes the gene.





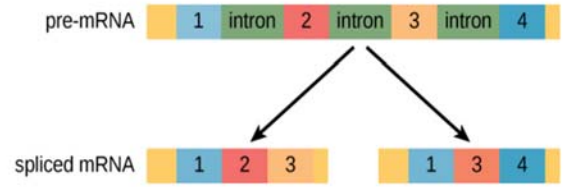
Post-Transcriptional Control

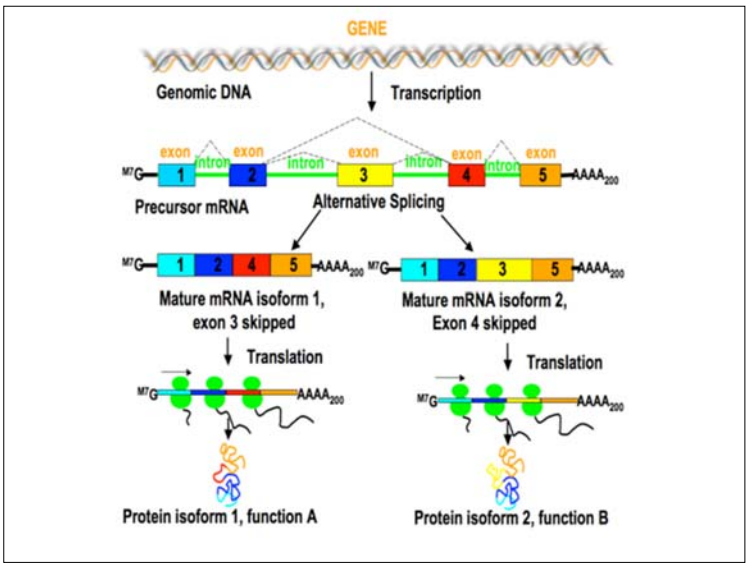
- Creates Mature mRNA
  - 5' cap
  - Alternative spliced introns
  - 3' Poly-A tail
  - Animation

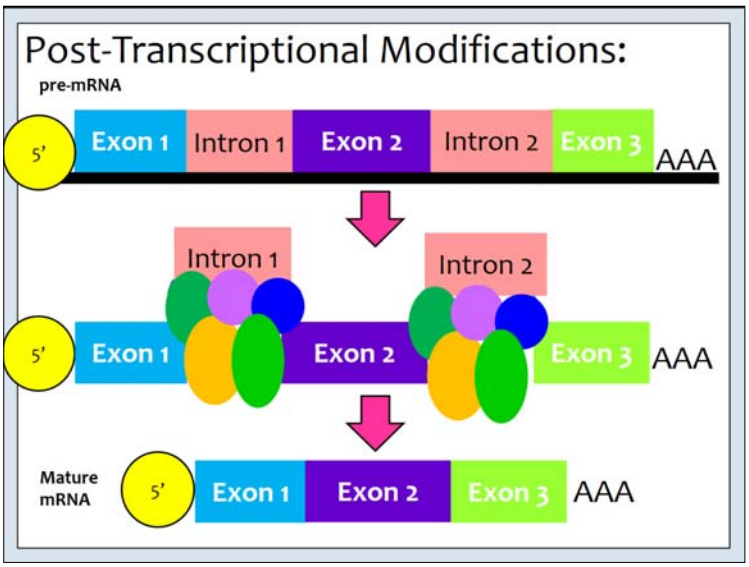


Post-Transcriptional Control

- Alternative Spliced Introns
  - Spliceosomes remove introns

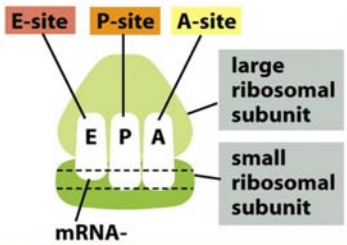


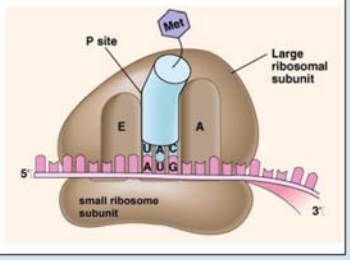




Translation

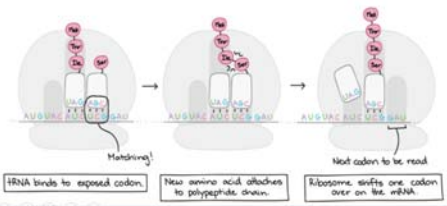
- mRNA attaches to rRNA (ribosomal RNA)
- rRNA reads codons (3 mRNA bases)

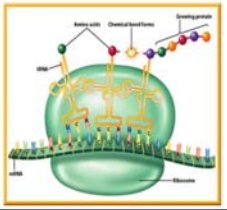


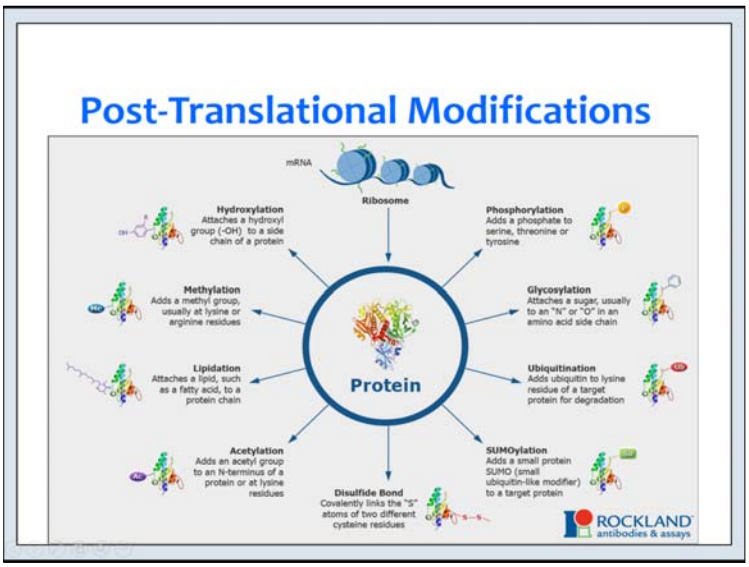


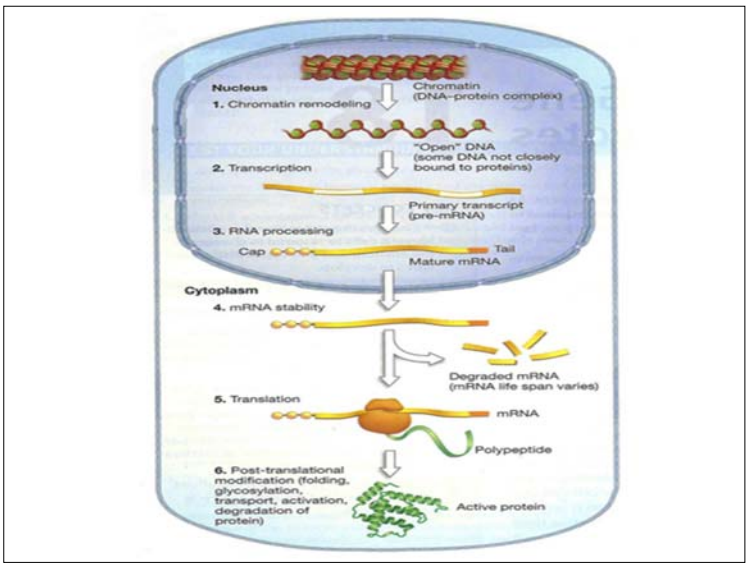
Translation (Animation)

- tRNA (transfer RNA) anticodon recognizes mRNA codons at the **A site** of rRNA
  - Transfers specific amino acid to create a growing polypeptide chain
    - tRNA shifts to **P site**, then exits from the **E site**









Proteomics

- Study of proteins & their functions
  - How proteins interact with each other
  - Post-translational modifications