**CONCEPT:** EPIGENETICS, CHROMATIN MODIFICATIONS, AND REGULATION

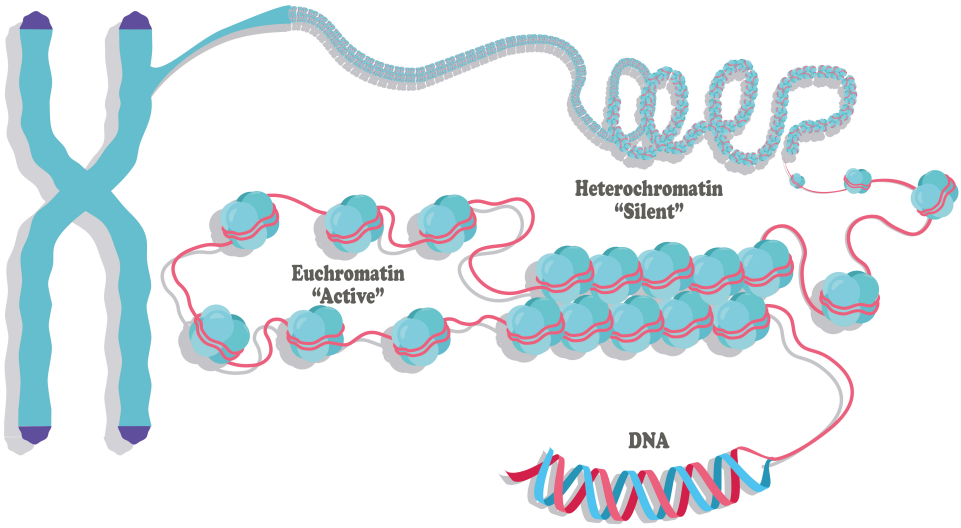
● Eukaryotic DNA packaging can _____ gene expression

□ There are two forms of **chromatin** (DNA and Proteins)

- **Euchromatin** is loosely packaged DNA, which contains genes being expressed

- **Heterochromatin** is tightly packaged DNA, which contains non-expressed DNA

**EXAMPLE:**



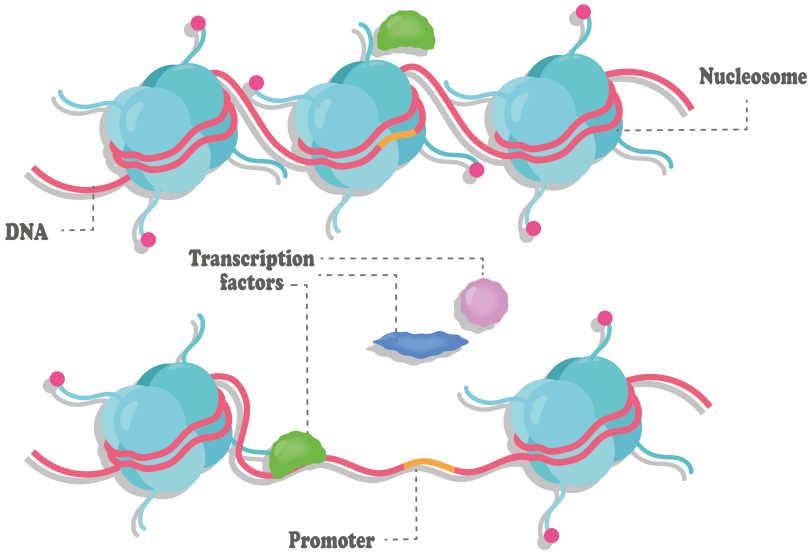

● There are _____- types of chromatin modifications that affect gene expression

1. **Chromatin re-modeling** is the process of moving *nucleosomes* to new DNA sequences

- Promoters wrapped in a nucleosome will be less accessible for transcription initiation

- **SWI-SNF complex** is a protein complex that repositions nucleosomes

**EXAMPLE:**



Histone protein modifications

2. **Histone protein modifications** can affect how _____ DNA is packaged in chromatin

- *Histone proteins* have protein tails with lysines and arginines

- These amino acids can be modified through **methyl** or **acetyl** groups

□ **Acetylation** is the process of adding acetyl groups onto the histone tails

- Addition of acetyl group results in open chromatin that promotes transcription

- Acetylation is reversible, and **histone deacetylase (HDAC)** removes acetyl groups

□ **Methylation** is the process of adding methyl groups onto the histone tails

- Methyl groups often cause closed chromatin, but can occasionally support open chromatin

- Methylation creates binding sites for additional proteins with activate/suppress transcription

□ The **histone code** is the combination of histone modifications that affect gene _____

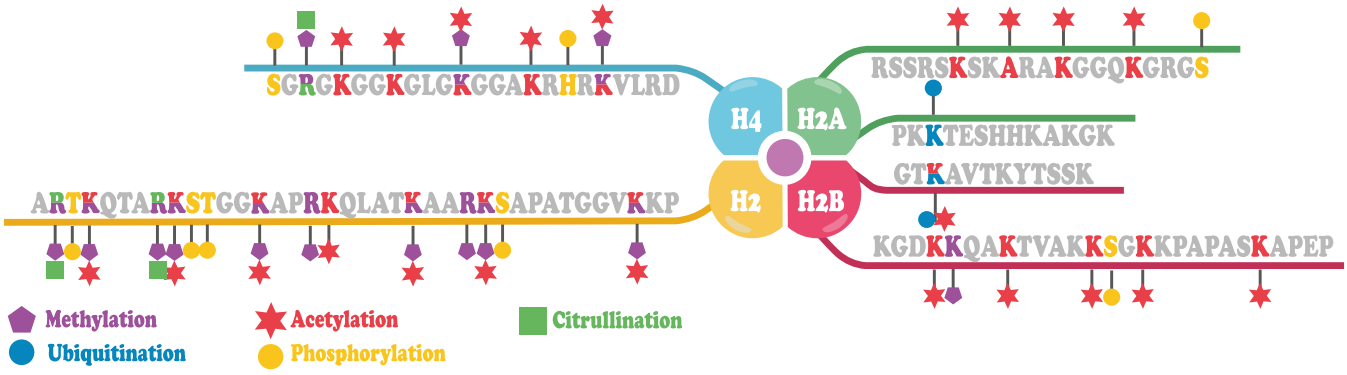
- There are 150+ histone modifications, and the pattern of activation/suppression is not understood

□ **CpG** islands are regions of unmethylated CG dinucleotides

- Most CG dinucleotides are methylated

- Unmethylated CpG islands are often found in promoter regions

**EXAMPLE:**



3. **Histone variants** are slightly altered histone proteins which can effect gene expression

- Histone variants are rare, but often found in unique chromosomal regions

- Centromeres contain their own histone H3 protein variant

Other Chromatin Regulatory Mechanisms

● Eukaryotic DNA packaging can cause entire _____ effects

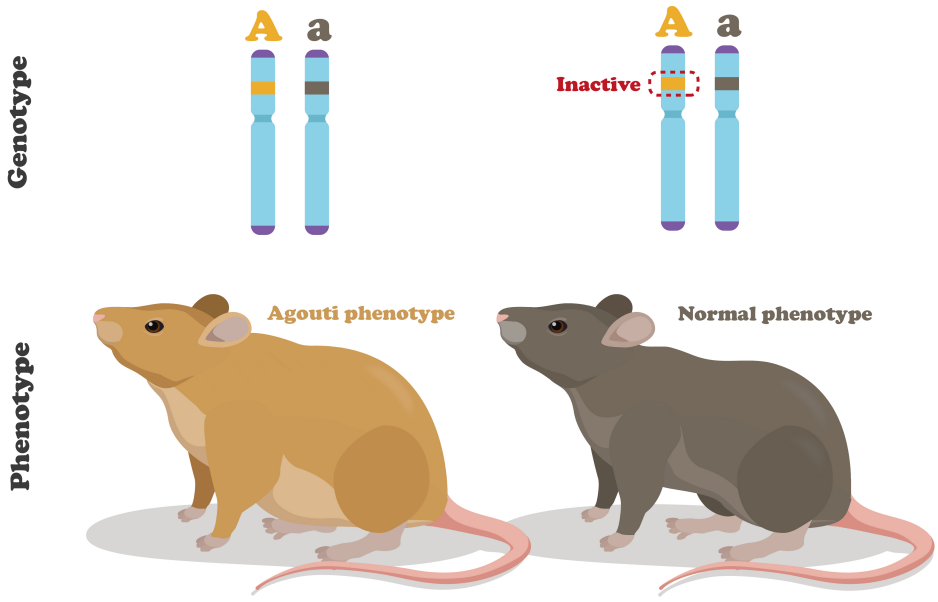
□ **X-inactivation** is the process of creating an entirely inactivated X chromosome (*barr body)*

- X-inactivation is created via heterochromatin

□ **Genetic imprinting** is when one copy (either paternal or maternal) of a chromosome is inherited as inactive

- Genes are expressed as if there is only one allele (from the other parent)

**EXAMPLE:**



**PRACTICE:**

1. Chromosomal regions that form heterochromatin contain:
    a. Highly expressed genes
    b. Associations with the nucleolus
    c. Few genes
    d. Lots of open chromatin

2. Which of the following are examples of epigenetic marks?
    a. Acetylated guanines in DNA
    b. Methylated nucleotides in histone tails
    c. Methylated amino acids in histone tails
    d. All of the above

3. CpG islands are defined as which of the following?
    a. Highly methlayed CG dinucleotides
    b. Groups of unmethylated CG dinucleotides
    c. Methylated CG dinucleotides found in gene coding regions
    d. CG nucleotides that become methylated to activate the gene

4. Which of the following terms is associated with closed chromatin?
    a. CpG islands
    b. Heterochromatin
    c. Methylation
    d. Euchromatin