Module 13: Regulation of Gene Expression

Keys to Success & Study Guide

Learning Objectives

By the end of this module, you should be able to:

1. **Explain** the organization and regulation of prokaryotic operons (lac and trp).
2. **Identify** the multiple levels of eukaryotic gene regulation (chromatin to protein).
3. **Differentiate** between types of DNA mutations and predict their effects.
4. **Discuss** the implications of epigenetic inheritance.

Key Terminology Checklist

Define these terms in your own words to ensure mastery.

- [ ] **Promoter**: The DNA region where RNA polymerase binds.
- [ ] **Operator**: A DNA segment that controls access to the structural genes.
- [ ] **Repressor**: A protein that binds the operator and blocks transcription.
- [ ] **Epigenetics**: Heritable changes in gene expression without alterations to the DNA sequence.
- [ ] **Mutagen**: A physical or chemical agent that causes DNA mutations.
- [ ] **Barr Body**: An inactivated X chromosome in female mammalian cells.

Concept Check

1. Operons

- **Question**: Why do bacteria use operons?
- **Key Answer**: Operons coordinate the expression of functionally related genes under a single promoter and operator. This enables rapid, coordinated responses to environmental changes.

2. Chromatin Remodeling

- **Question**: How does chromatin structure affect gene expression?
- **Key Answer**:
  - **Heterochromatin** (tightly condensed): Genes are inaccessible and silenced.
  - **Euchromatin** (loosely condensed): Genes are accessible for transcription.
  - Histone acetylation loosens chromatin (activation); methylation often tightens it (silencing).

3. Mutation Types

- **Question**: What is a point mutation?
- **Key Answer**: A single nucleotide change. Types include:
  - **Silent**: No amino acid change (codon redundancy).
  - **Missense**: Different amino acid.
  - **Nonsense**: Premature stop codon.

4. X-Inactivation

- **Question**: Why do calico cats have patchy fur?
- **Key Answer**: The fur color gene is X-linked. In females (XX), one X is randomly inactivated in each cell during development, creating a mosaic pattern.