

Module 13: Regulation of Gene Expression

Comprehension & Critical Thinking Questions

Part 1: Understanding Core Concepts

1. Prokaryotic Regulation

- Define **Operon**.
- Compare an **Inducible Operon** (like *lac*) vs. a **Repressible Operon** (like *trp*). Which one is normally "OFF" and needs to be turned on? Which is normally "ON"?

2. Eukaryotic Regulation

- Gene expression isn't just ON/OFF; it's a dimmer switch controlled at many levels. Briefly explain:
 - **Chromatin Remodeling** (Histone acetylation).
 - **Transcriptional Control** (Transcription factors).
 - **Post-Translational Control** (Protein folding/degradation).

3. Mutations

- Define **Point Mutation** (Substitution) vs. **Frameshift Mutation** (Insertion/Deletion).
- Why is a frameshift usually much more damaging?

Part 2: Applying Biological Principles

1. The Lac Operon

- **Scenario:** *E. coli* bacteria are living for weeks in a petri dish with ample Glucose and NO Lactose.
- **Apply:** Is the *lac* operon on or off? Is the Repressor protein bound to the operator?

- **Change:** You suddenly add Lactose. What happens to the repressor? What happens to transcription?

2. X-Inactivation

- Female mammals have two X chromosomes, but males survive with only one. Explain **Dosage Compensation** and **Barr Bodies**.
- How does this explain the patchy color of a Tortoiseshell/Calico cat?

Part 3: Analyzing & Evaluating

1. Cancer and Regulation

- Cancer is essentially a disease of gene regulation.
- **Analyze:** How might a mutation in a **Tumor Suppressor Gene** (which normally stops division) lead to cancer?
- How might a mutation in a **Proto-Oncogene** (which normally promotes division) lead to cancer?

2. Epigenetics

- "Inheritance above the genes." Explain how environmental factors (diet, stress) might modify chemical tags on DNA (Methylation) without changing the sequence itself. Can these changes be passed to offspring?