

Module 14: Biotechnology and Genomics

Comprehension & Critical Thinking Questions

Part 1: Understanding Core Concepts

1. The Toolbox

- What is a **Restriction Enzyme**? How do "sticky ends" help connect two different pieces of DNA?
- What is a **Vector** (e.g., a plasmid)? How is it used to get foreign DNA into a bacterium?

2. PCR (Polymerase Chain Reaction)

- Describe the three steps of PCR: **Denaturation**, **Annealing**, and **Extension**.
- Why is PCR often called "Molecular photocopying"? Why is it useful at a crime scene with a tiny blood sample?

3. Visualizing DNA

- Explain how **Gel Electrophoresis** separates DNA fragments.
- Do smaller fragments move faster or slower? Why? (Think about moving through a thick jungle).

Part 2: Applying Biological Principles

1. Genetic Engineering

- Define **Transgenic Organism** (GMO).
- **Scenario**: You want to make bacteria that produce human insulin. Outline the steps you would take. (Cut gene, cut plasmid, glue together, insert into bacteria).

2. DNA Fingerprinting

- **Application:** You are looking at a DNA gel from a paternity test. The Child has bands at position A and B. The Mother has a band at A.
- Does the Father *have* to have a band at B? Explain your reasoning.

Part 3: Analyzing & Evaluating

1. Gene Therapy

- Differentiate between **Ex Vivo** (cells treated outside body) and **In Vivo** (treated inside body) gene therapy.
- **Evaluate:** What are the biggest challenges in gene therapy? (Hint: Delivery and Immune response).

2. Genomics

- We have sequenced the entire human genome. **Analyze:** Why does knowing the sequence of letters (A,C,T,G) not immediately tell us what every gene does? What is distinct about **Functional Genomics**?