Module 12: Gene Expression (DNA to Protein)

Keys to Success & Study Guide

Learning Objectives

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

1. **Describe** the chemical structure of DNA and the rules of complementary base pairing.
2. **Explain** the semi-conservative model of DNA replication.
3. **Transcribe** a DNA sequence into mRNA and translate it into a polypeptide.
4. **Differentiate** between the functions of mRNA, tRNA, and rRNA.

Key Terminology Checklist

Define these terms in your own words to ensure mastery.

- [ ] **Nucleotide**: The monomer of nucleic acids (sugar + phosphate + nitrogenous base).
- [ ] **Purine vs. Pyrimidine**: Double-ring bases (A, G) vs. single-ring bases (C, T, U).
- [ ] **Codon**: A three-nucleotide sequence in mRNA that specifies an amino acid.
- [ ] **Anticodon**: The complementary three-nucleotide sequence on tRNA.
- [ ] **Promoter**: A DNA sequence where RNA polymerase binds to initiate transcription.
- [ ] **Helicase**: The enzyme that unwinds the DNA double helix.

Concept Check

1. DNA Structure

- **Question**: What does "antiparallel" mean in DNA?
- **Key Answer**: The two DNA strands run in opposite directions: one 5′→3′, the other 3′→5′. This orientation affects replication (leading vs. lagging strand).

2. The Genetic Code

- **Question**: How many codons exist?

- **Key Answer**: 64 codons (4^3), but only 20 amino acids. The code is degenerate (redundant)—multiple codons specify the same amino acid, providing a buffer against point mutations.

3. RNA Processing

- **Question**: How is pre-mRNA processed in eukaryotes?
- **Key Answer**: Introns (non-coding) are spliced out; exons (coding) are joined. A 5′ cap and poly-A tail are added for stability and export.