CHAPTER 17
FROM GENE TO PROTEIN

Learning Objectives

The Connection between Genes and Proteins
1. Explain the reasoning that led Archibald Garrod to suggest that genes dictate phenotypes through enzymes.
2. Describe Beadle and Tatum's experiments with *Neurospora* and explain the contribution they made to our understanding of how genes control metabolism.
3. Distinguish between the "one gene-one enzyme" hypothesis and the "one gene-one polypeptide" hypothesis and explain why the original hypothesis was changed.
4. Explain how RNA differs from DNA.
5. Briefly explain how information flows from gene to protein. Is the central dogma ever violated?
6. Distinguish between transcription and translation.
7. Compare where transcription and translation occur in bacteria and in eukaryotes.
8. Define "codon" and explain the relationship between the linear sequence of codons on mRNA and the linear sequence of amino acids in a polypeptide.
9. Explain the early techniques used to identify what amino acids are specified by the triplets UUU, AAA, GGG, and CCC.
10. Explain why polypeptides begin with methionine when they are synthesized.
11. Explain what it means to say that the genetic code is redundant and unambiguous.
12. Explain the significance of the reading frame during translation.
13. Explain the evolutionary significance of a nearly universal genetic code.

The Synthesis and Processing of RNA
14. Explain how RNA polymerase recognizes where transcription should begin. Describe the role of the promoter, the terminator, and the transcription unit.
15. Explain the general process of transcription, including the three major steps of initiation, elongation, and termination.
16. Explain how RNA is modified after transcription in eukaryotic cells.
17. Define and explain the role of ribozymes. What three properties allow some RNA molecules to function as ribozymes?
18. Describe the functional and evolutionary significance of introns.
19. Explain why, due to alternative RNA splicing, the number of different protein products an organism can produce is much greater than its number of genes.

The Synthesis of Protein
20. Describe the structure and function of tRNA.
21. Explain the significance of wobble.
22. Explain how tRNA is joined to the appropriate amino acid.
23. Describe the structure and functions of ribosomes.
24. Explain the statement, "A ribosome can be regarded as one colossal ribozyme."

25. Describe the process of translation (including initiation, elongation, and termination) and explain which enzymes, protein factors, and energy sources are needed for each stage.
26. Describe the significance of polyribosomes.
27. Explain what determines the primary structure of a protein and describe how a polypeptide must be modified before it becomes fully functional.
28. Describe what determines whether a ribosome will be free in the cytosol or attached to the rough endoplasmic reticulum.
29. Define "point mutations". Distinguish between base-pair substitutions and base-pair insertions. Give an example of each and note the significance of such changes.
30. Distinguish between a missense and a nonsense mutation.
31. Why is an insertion or deletion more likely to be deleterious than a substitution?
32. Define the term 'mutation'. Give an example of a physical and a chemical agent of mutation.
33. Briefly compare gene expression in bacteria, archaea and eukarya. In general, is archaeal gene expression more similar to bacterial or eukaryotic gene expression?
34. Describe the historical evolution of the concept of a gene.