

CHAPTER 5

THE STRUCTURE AND FUNCTION OF MACROMOLECULES

OUTLINE

- I. Polymer Principles
 - A. Most macromolecules are polymers
 - B. A limitless variety of polymers can be built from a small set of monomers
- II. Carbohydrates: Fuel and Building Material
 - A. Sugars, the smallest carbohydrates, serve as fuel and carbon sources
 - B. Polysaccharides, the polymers of sugars, have storage and structural roles
- III. Lipids: Diverse Hydrophobic Molecules
 - A. Fats store large amounts of energy
 - B. Phospholipids are major components of cell membranes
 - C. Steroids include cholesterol and certain hormones
- IV. Proteins: The Molecular Tools of the Cell
 - A. A polypeptide is a polymer of amino acids connected in a specific sequence
 - B. A protein's function depends on its specific conformation
- V. Nucleic Acids: Informational Polymers
 - A. Nucleic acids store and transmit hereditary information
 - B. A nucleic acid strand is a polymer of nucleotides
 - C. Inheritance is based on replication of the DNA double helix
 - D. We can use DNA and proteins as tape measures of evolution

SUMMARY

Most macromolecules are polymers.
An immense variety of polymers can be built from a small set of monomers.
Sugars, the smallest carbohydrates, serve as fuel and carbon sources.
Polysaccharides, the polymers of sugar, have storage and structural roles.
Fats store large amounts of energy.
Phospholipids are major components of cell membranes.
Steroids include cholesterol and certain hormones.
A polypeptide is a polymer of amino acids connected in a specific sequence.
A protein's function depends on its specific conformation.
Nucleic acids store and transmit hereditary information.
A nucleic acid strand is a polymer of nucleotides.
Inheritance is based on replication of the DNA double helix.
We can use DNA and proteins as 'tape measures' of evolution.

OBJECTIVES

After reading this chapter and attending lecture, the student should be able to:

1. List the four major classes of biomolecules.
2. Explain how organic polymers contribute to biological diversity.
3. Describe how covalent linkages are formed and broken in organic polymers.
4. Describe the distinguishing characteristics of carbohydrates, and explain how they are classified.
5. List four characteristics of a sugar.
6. Identify a glycosidic linkage and describe how it is formed.

7. Describe the important biological functions of polysaccharides.
8. Distinguish between the glycosidic linkages found in starch and cellulose, and explain why the difference is biologically important.
9. Explain what distinguishes lipids from other major classes of macromolecules.
10. Describe the unique properties, building block molecules and biological importance of the three important groups of lipids: fats, phospholipids and steroids.
11. Identify an ester linkage and describe how it is formed.
12. Distinguish between a saturated and unsaturated fat, and list some unique emergent properties that are a consequence of these structural differences.
13. Describe the characteristics that distinguish proteins from the other major classes of macromolecules, and explain the biologically important functions of this group.
14. List and recognize four major components of an amino acid, and explain how amino acids may be grouped according to the physical and chemical properties of the side chains.
15. Identify a peptide bond and explain how it is formed.
16. Explain what determines protein conformation and why it is important.
17. Define primary structure and describe how it may be deduced in the laboratory.
18. Describe the two types of secondary protein structure, and explain the role of hydrogen bonds in maintaining the structure.
19. Explain how weak interactions and disulfide bridges contribute to tertiary protein structure.
20. Using collagen and hemoglobin as examples, describe quaternary protein structure.
21. Define denaturation and explain how proteins may be denatured.
22. Describe the characteristics that distinguish nucleic acids from the other major groups of macromolecules.
23. Summarize the functions of nucleic acids.
24. List the major components of a nucleotide, and describe how these monomers are linked together to form a nucleic acid.
25. Distinguish between a pyrimidine and a purine.
26. List the functions of nucleotides.
27. Briefly describe the three-dimensional structure of DNA.