

1200 – Learning Objectives – 1

Topic: Chemical context of life: chapter 2

Water: chapter 3

Carbon: chapter 4

Macromolecules: chapter 5

Elements and Compounds

1. Distinguish between an element and a compound.
2. Identify the four elements that make up 96% of living matter.
3. Define the term trace element and give an example.

Atoms and Molecules

4. Draw and label a simplified model of an atom. Explain how this model simplifies our understanding of atomic structure.
5. Distinguish between each of the following pairs of terms:
 - a. neutron and proton
 - b. atomic number and mass number
 - c. atomic weight and mass number
6. Explain how the atomic number and mass number of an atom can be used to determine the number of neutrons.
7. Explain how two isotopes of an element are similar. Explain how they are different.
8. Describe two biological applications that use radioactive isotopes.
9. Define the terms energy and potential energy. Explain why electrons in the first electron shell have less potential energy than electrons in higher electron shells.
10. Distinguish among nonpolar covalent, polar covalent and ionic bonds.
11. Explain why strong covalent bonds and weak bonds are both essential in living organisms.
12. Distinguish between hydrogen bonds and van der Waals interactions.
13. Give an example that illustrates how a molecule's shape can determine its biological function.
14. Explain what is meant by a chemical equilibrium.

The Properties of Water

15. With the use of a diagram or diagrams, explain why water molecules are:
 - a. polar
 - b. capable of hydrogen bonding with 4 neighboring water molecules
16. List four characteristics of water that are emergent properties resulting from hydrogen bonding.
17. Define cohesion and adhesion. Explain how water's cohesion and adhesion contribute to the movement of water from the roots to the leaves of a tree.

18. Distinguish between heat and temperature, using examples to clarify your definitions.
19. Explain the following observations by referring to the properties of water:
 - a. Coastal areas have milder climates than adjacent inland areas.
 - b. Ocean temperatures fluctuate much less than air temperatures on land.
 - c. Insects like water striders can walk on the surface of a pond without breaking the surface.
 - d. If you slightly overfill a water glass, the water will form a convex surface above the top of the glass.
 - e. If you place a paper towel so that it touches spilled water, the towel will draw in the water.
 - f. Ice floats on water.
 - g. Humans sweat and dogs pant to cool themselves on hot days.
20. Distinguish among a solute, a solvent, and a solution.
21. Distinguish between hydrophobic and hydrophilic substances.
22. Explain how you would make up a one molar (1M) solution of ethyl alcohol.
23. Name the products of the dissociation of water and give their concentration in pure water.
24. Define acid, base, and pH.
25. Explain how acids and bases may directly or indirectly alter the hydrogen ion concentration of a solution.
26. Using the bicarbonate buffer system as an example, explain how buffers work.
27. Briefly explain the causes and effects of acid precipitation.

The Importance of Carbon

28. Explain how carbon's electron configuration accounts for its ability to form large, complex, and diverse organic molecules.
29. Describe how carbon skeletons may vary, and explain how this variation contributes to the diversity and complexity of organic molecules.
30. Describe the basic structure of a hydrocarbon and explain why these molecules are hydrophobic.
31. Distinguish among the three types of isomers: structural, geometric, and enantiomer.
32. Name the major functional groups found in organic molecules. Describe the basic structure of each functional group and outline the chemical properties of the organic molecules in which they occur.

The Principles of Polymers

33. List the four major classes of macromolecules.
34. Distinguish between monomers and polymers.
35. Draw diagrams to illustrate condensation and hydrolysis reactions.

Carbohydrates Serve as Fuel and Building Material

36. Distinguish between monosaccharides, disaccharides, and polysaccharides.
37. Describe the role of symbiosis in cellulose digestion.

Lipids are a Diverse Group of Hydrophobic Molecules

38. Describe the building-block molecules, structure, and biological importance of fats, phospholipids, and steroids.
39. Identify an ester linkage and describe how it is formed.
40. Distinguish between saturated and unsaturated fats.
41. Name the principal energy storage molecules of plants and animals.

Proteins have Many Structures and Many Functions

42. Distinguish between a protein and a polypeptide.
43. Explain how a peptide bond forms between two amino acids.
44. List and describe the four major components of an amino acid. Explain how amino acids may be grouped according to the physical and chemical properties of the R group.
45. Explain what determines protein conformation and why it is important.
46. Explain how the primary structure of a protein is determined.
47. Name two types of secondary protein structure. Explain the role of hydrogen bonds in maintaining secondary structure.
48. Explain how weak interactions and disulfide bridges contribute to tertiary protein structure.
49. List four conditions under which proteins may be denatured.

Nucleic Acids Store and Transmit Hereditary Information

50. List the major components of a nucleotide, and describe how these monomers are linked to form a nucleic acid.
51. Distinguish between:
 - a. pyrimidine and purine
 - b. nucleotide and nucleoside
 - c. ribose and deoxyribose
 - d. 5' end and 3' end of a nucleotide
52. Briefly describe the three-dimensional structure of DNA.