Maders Understanding Human Anatomy and Physiology 9th edition Longenbaker Solutions Manual

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2 Chemistry of Life

Chapter Summary

Chapter two relates chemistry to the study of human anatomy and physiology. The chapter describes elements, atoms, and molecules. Elements compose all matter and contain unique types of atoms. Atoms contain subatomic particles called protons, neutrons, and electrons. Molecules are formed when atoms bond to one another. Covalently bonded molecules contain atoms that share electrons, while ionically bonded molecules contain oppositely charged ions. Ions are charged atoms that have either lost or gained electrons. Inorganic molecules are those that generally contain a small number of atoms ionically bonded together. Water is an exception to this. Water is a covalently bonded inorganic molecule. The temperature stabilizing and solvent properties of water, and how hydrogen bonding relates to these are explained, as are electrolytes, acids, bases, buffers, and pH. Organic molecules like carbohydrates, lipids, proteins, nucleic acids, and ATP always contain carbon atoms. The structures of these molecules and their functions in humans are discussed.

Chapter Outline

2.1 Basic Chemistry
- A. Elements and Atoms
  - 1. Atoms
- B. Isotopes
  - 1. Low Levels of Radiation
  - 2. High Levels of Radiation
- C. Molecules and Compounds
  - 1. Ionic Bonds
  - 2. Covalent Bonds
  - 3. Double and Triple Bonds
  - 4. Polar and Non-Polar Covalent Bonds

2.2 Water, Acids, and Bases
- A. Hydrogen Bonds
- B. Properties of Water
- C. Acids and Bases
  - 1. pH Scale
  - 2. Electrolytes

2.3 Molecules of Life

2.4 Carbohydrates
- A. Simple Carbohydrates
- B. Complex Carbohydrates (Polysaccharides)
  - 1. Starch and Glycogen
  - 2. Cellulose

2.5 Lipids
- A. Fats and Oils
  - 1. Emulsification
  - 2. Saturated and Unsaturated Fatty Acids
- B. Phospholipids
- C. Steroids

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2.6 Proteins
- A. Structure of Proteins
- B. Enzymatic Reactions
  1. Enzyme-Substrate Complex
  2. Types of Reactions
     - a. Synthesis Reactions
     - b. Degradation (Decomposition) Reactions
     - c. Replacement (Exchange) Reactions

2.7 Nucleic Acids
- A. ATP (Adenosine Triphosphate)

Suggested Student Activities

1. Have students diagram the atomic structures of several different elements and label the subatomic particles, the nucleus, and the electron shells.
2. Demonstrate the use of pH indicators and discuss the pH of various body fluids.
3. Have the students match the subunit molecules to the biomolecules that they comprise.
4. Have the students bring in nutrition labels and ingredient lists from food items that they have purchased. Discuss the composition of those food items with regard to a healthy diet.
5. Using a hamburger as an example, discuss the components of the meal and how each component is broken down (starch in bun, protein and fat in burger).

Answers to Learning Outcome Questions

1. atoms
2. neutrons
3. ionic, covalent
4. hydrogen
5. hydrogen, lower
6. glucose, energy
7. glycerol, fatty acid
8. amino acids, helix, three-dimensional shape
9. enzymes
10. DNA, nucleotides

Answers to Medical Terminology Reinforcement Exercise

1. an/iso/ton/ic - pertaining to without equal (unequal) tension—having an osmotic pressure differing from that of a solution with which it is compared
2. de/hydra/tion - process of water being taken away
3. hypo/kal/emia - abnormally low level of potassium in the blood
4. hypo/vol/emia - abnormally low blood volume
5. non/electro/lyte - substance which is not an electrolyte—substance which does not conduct electricity in solution
6. lipo/meta/bol/ism - fat metabolism—changing the state of fat
7. hyper/lipo/protein/emia - excess of fats and proteins in the blood
8. hyper/glyc/emia - excess sugar in the blood
9. hyp/ox/emia - abnormally low level of oxygen in the blood
10. hydro/static pressure – pressure on a fluid
11. galactos/emia – galactose in the blood
12. hyper/calc/emia – excess calcium in the blood
13. hyper/natr/emia – low level of sodium in the blood
14. gluco/neo/genesis – production of new sugar from noncarbohydrate sources
15. ed/ema - swelling

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Audiovisual Materials

1. Periodic table of the elements
2. Three-dimensional models of various biomolecules
3. Nutrition labels and ingredient lists from various food items

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