

SOLUTIONS MANUAL

JOHN H. POSTLETHWAIT | JANET L. HOPSON

LIFE

WHAT'S INSIDE:

A Student-Tested, Faculty-Approved
Approach to Learning *Life Biology*

Learn Anywhere with Tear-out
Chapter Review Cards

• PLUS •

INTERACTIVE ONLINE
STUDY TOOLS

STUDENT EDITION

You Spoke, We Listened.
An Innovative Solution
Designed for Today's Students.



\$83.00 suggested price

ISBN 10 0-07-305-102-9

ISBN 13 9-78-0-073-05102-9



0-07-305-102-9

2

CELLS AND THE CHEMISTRY OF LIFE

Chapter Overview

In Chapter 2, Dr. Jay Levy provides detail and commentary on AIDS (acquired immune deficiency disease). AIDS and its assault on human cells give us a highly relevant way to explore basic chemical concepts, biological molecules, and the anatomy and function of animal cells. Students will see how AIDS drugs work and how people can keep themselves safe from HIV (human immune deficiency virus) infection. Chapter 2 contrasts animal cells with plant and microbial cells. Chapter 2 is concluded with a discussion of how organelles and biochemistry unify all life on Earth and provides an unbroken link to Earth's earliest inhabitants.

Student Responsibilities Prior to Lecture

- 1) Read all of Chapter 2 with the goal of familiarizing yourself with the boldface terms.
- 2) Distinguish between AIDS and HIV.
- 3) Differentiate among protons, neutrons, and electrons (Figure 2.1).
- 4) Name the four classes of large biological molecules and give an example of each from the foods that you eat.
- 5) List the three statements of the cell theory.
- 6) Distinguish between eukaryotic and prokaryotic cells (Figure 2.11).
- 7) Differentiate among Eukarya, Eubacteria, and Archaea.

Student Objectives

Introduction

- Differentiate between HIV and AIDS.

LO 1: What Is HIV?

- Support the statement "HIV is not alive."

LO 2: What Are Atoms?

- Differentiate among elements, atoms, molecules, isotopes, and ions.
- Describe the basic structure of all atoms, using the terms "protons," "electrons," and "neutrons."
- Explain how gold and copper atoms can be different from each other when they are both made from protons, neutrons, and electrons.

LO 3: How Do Atoms Form Molecules?

- Explain the biological importance of chemical bonds.
- Compare and contrast covalent bonds, hydrogen bonds, and ionic bonds.

LO 4: What Makes Water So Special for Life?

- Describe the molecular structure of a water molecule.
- List the properties of water that make it so critical to life.
- Decide whether the following substances are hydrophobic or hydrophilic when compared to animal cells: Kool-Aid, creamer, motor oil, diesel fuel, body lotion, lipstick, lemon juice, milk, butter.
- Distinguish between acids and bases.

LO 5: What Are Biological Molecules?

- List and describe the four main types of biological molecules that are found in all living organisms.
- Explain why there are more organic molecules than inorganic molecules.
- Decide which molecules in your body are inorganic and which are organic.
- Differentiate among monosaccharides, disaccharides, and polysaccharides.
- Give examples of simple and complex carbohydrates in your diet.
- Describe the four levels of protein structure.
- Describe how the structure of proteins allows them to be the most functionally diverse of the four types of biological molecules.
- Describe some of the diverse functions of lipids.
- Describe the basic function of nucleic acids.

LO 6: What Is a Living Cell, and What Makes HIV a Nonliving Enemy?

- List and describe the three fundamental parts of a cell.
- Compare the characteristics of a virus and a cell that have lead scientists to reach the conclusion that a virus is not alive.
- Describe why elephant cells are not any larger than mouse cells.
- List the three parts of the cell theory, and describe the significance of the cell theory.
- Describe where the cells in your body today originally came from.
- Compare and contrast eukaryotic and prokaryotic cells.
- List and describe the three domains of life.

LO 7: What Are the Parts of the Cell, and How Does HIV Sabotage Them?

- Explain what is meant by the term “selectively permeable.”
- Describe some of the various functions of membrane proteins and surface carbohydrates.
- Describe the processes in cells that move molecules from one place to another.
- List the organelles and structures found in cells, and discuss their functions.
- Describe the various processes that allow cells to move.
- Trace the pathway of HIV as it infects a human cell. List the major organelles affected.

- Differentiate between fat-soluble and water-soluble molecules.
- Distinguish between mitochondria and chloroplasts.
- Compare and contrast plant and animal cells.

LO 8: How Does HIV Complete Its Infective Cycle?

- List the seven steps in HIV's infective cycle.
- Formulate a plan of attack against HIV for each of the seven stages of infection.

Presentation Suggestions

- Use a case study for AIDS and HIV to capture the students' interest in the chapter.
- Use several models and animations to help the students visualize atomic structure and chemical bonds.
- Bring in several examples of food and nutrition labels from the major food groups to convey the importance of the four organic molecules. Make sure students understand that most of the whole foods that they consume (cooked or raw) are made of cells, and that their body digests and uses whatever is in the cells.

Lecture Suggestions

LO 2: What Are Atoms?

- Use Figures 2.1–2.2 to illustrate the structure of atoms.
- Stress the concept that all atoms are built with the same three subatomic particles.
- Stress the similarities between the kinds of elements found in living organisms.

LO 3: How Do Atoms Form Molecules?

- Use Figure 2.3 to illustrate the properties of chemical bonds.
- Remind students that all of the chemical reactions that are keeping them alive are due to chemical bond interactions.
- Prepare students for future important chemical reactions like photosynthesis and cellular respiration where the making and breaking of chemical bonds is critical.

LO 4: What Makes Water So Special for Life?

- Use Figure 2.4 to explain the physical properties of water in more detail.
- Remind students that their tissues (like most living things) are approximately 70% water. Indicate why that is so important for allowing chemical reactions to occur. A good analogy is to ask how easy it is to mix two dry substances (Kool-Aid and sugar, for example) together without water.

LO 5: What Are Biological Molecules?

- Use Figures 2.6–2.8 to illustrate the structure and function of the four organic compounds.
- Describe the unique effects of carbon's bonding behavior and why life on Earth is described as being carbon-based.

- As you discuss the properties of each of the four organic molecules, be sure to use several common food examples that illustrate them.
- Give several examples of inorganic and organic molecules.

LO 7: What Are the Parts of the Cell, and How Does HIV Sabotage Them?

- Use Figures 2.9-2.14 to illustrate the various cell structures and their functions.
- Discuss how cell surface-to-volume ratio limits cell size.
- Emphasize the fact that at the cellular level, living organisms are more alike than different.
- After introducing the cell theory, ask students to reflect on where they came from (one of their mother's egg cells and one of their father's sperm).
- Although this can be a lengthy block of material to cover, it is better to slow down and cover it thoroughly to ensure that students have a good grasp of cellular concepts.

Enrichments

- Ask the students to list the different chemicals that they ingest each day in their food and water. What elements (chlorine, fluorine) are found dissolved in tap water? Why are those chemicals there?
- Ask students to list foods that would provide the following atoms in their diet and why they might be important: calcium, iron, phosphorus.
- Ask students if they would be surprised to know that the following atoms are found in their foods and bodies, and are very important in maintaining homeostasis: zinc, magnesium, copper, iodine, sulfur.
- Describe how chemicals in the environment (water, soil, air, foods, toothpaste, etc.) can ultimately affect chemical reactions in a human body.
- What evidence can you present to prove that there are tiny invisible gaseous molecules floating around the room?

Special Assignments

- Nuclear magnetic resonance (NMR) and mass spectrophotometry are two techniques that allow scientists to elucidate the internal structure of atoms. Research how these techniques work and if they are being used in your community.
- Describe the chemical structure of artificial fats and sugar substitutes, how they simulate the tastes that humans crave, and why they are low in calories.
- Measure the pH of several bodies of water in your local community and decide whether there is the potential for acid precipitation problems.
- Research how cells that line your stomach are able to survive the acidic environment that typically destroys the cells of the foods that you eat.
- "Mad cow" disease is caused by a prion (a small protein that has an altered form that is found on the surface of nerve cells). Describe what influences the shape of a protein, and why an altered protein could cause a problem for a nerve cell.
- Using your knowledge of atoms, describe why atomic fusion (solar energy) and atomic fission (atomic bombs and nuclear power plants) release so much heat energy.

- Describe the latest research being done to control the AIDS epidemic.
- List the countries that are most affected by AIDS and explain why you believe these countries are the most severely affected.
- Describe the different government policies that are being used to deal with the AIDS epidemic in Africa and Asia.