

FIFTH EDITION

BIOLOGY



Sylvia S. Mader



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BIOLOGY AND TECHNOLOGY

LIFE SCIENCE ANIMATIONS

The following illustrations in *Biology* are correlated to the *Life Science Animations* videotapes by Wm. C. Brown Publishers.

Tape 1

Chemistry, the Cell, and Energetics

1. Formation of an Ionic Bond (fig. 3.7)
2. Journey into a Cell (figs. 5.3–5.8, 5.11, 5.12, 6.3, 6.14, 6.15, 8.3)
3. Endocytosis (figs. 5.8, 6.12, 6.13)
4. Cellular Secretion (fig. 5.8)
5. Glycolysis (figs. 9.2, 9.4)
6. Oxidative Respiration (including Krebs cycles) (figs. 9.3, 9.7)
7. The Electron Transport Chain and the Production of ATP (figs. 7.7, 7.10, 9.4, 9.8, 9.9, 9.10)
8. The Photosynthetic Electron Transport Chain and Production of ATP (figs. 7.8, 8.5, 8.6, 8.7)
9. C₃ Photosynthesis (Calvin Cycle) (figs. 7.8, 8.9, 8.10)
10. C₄ Photosynthesis (fig. 8.10)
11. ATP as an Energy Carrier (figs. 7.10, 9.3, 9.11)

Tape 2

Cell Division/Heredit/Genetics/Reproduction and Development

12. Mitosis (figs. 10.3–10.8, 10.10, 11.6, 11.7)
13. Meiosis (figs. 11.2, 11.5–11.8)
14. Crossing Over (figs. 11.3, 11.4)
15. DNA Replication (figs. 15.7, 15.8, 15A)
16. Transcription of a Gene (figs. 16.5, 16.6, 16.11, 17.2, 17.3, 17.6, 17.7)
17. Protein Synthesis (figs. 16.8–16.11, 17.2, 17.8)
18. Regulation of *Lac* Operon (fig. 17.1)
19. Spermatogenesis (figs. 11.8, 45.7)
20. Oogenesis (figs. 11.8, 45.10)
21. Human Embryonic Development (figs. 46.9–46.12)

Tape 3

Animal Biology I

22. Formation of Myelin Sheath (fig. 41.3)
23. Saltatory Nerve Conduction (fig. 41.6)
24. Signal Integration (figs. 41.4, 41.5, 41.7)
25. Reflex Arcs (fig. 41.9)

26. Organ of Static Equilibrium (figs. 42.11–42.13)
27. The Organ of Corti (fig. 42.13)
28. Peptide Hormone Action (cAMP) (fig. 44.2)
29. Levels of Muscle Structure (fig. 43.13)
30. Sliding Filament Model of Muscle Contraction (figs. 43.12, 43.14)
31. Regulation of Muscle Contraction (fig. 43.15)
32. The Cardiac Cycle and Production of Sounds (fig. 36.7)
33. Peristalsis (fig. 38.7)
34. Digestion of Carbohydrates
35. Digestion of Proteins

Tape 4

Animal Biology II

36. Digestion of Lipids
37. Blood Circulation (figs. 36.2–36.4, 36.6, 36.8)
38. Production of Electrocardiogram (figs. 36.7, 36.9, 36.10)
39. Common Congenital Defects of the Heart (fig. 36.12)
40. A, B, O Blood Types (figs. 36.15, 36.16)
41. B-Cell Immune Response (fig. 37.6)
42. Structure and Function of Antibodies (fig. 37.7)
43. Types of T-cells (figs. 37.8, 37.9)
44. Relationship of Helper T-cells and Killer T-cells (figs. 37.8, 37.9)
45. Life Cycle of Malaria (fig. 25.13)

Tape 5

Plant Biology/Evolution/Ecology

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49. How Leaves Change Color and Drop in Fall
50. Mitosis and Cell Division in Plants (figs. 10.10, 33.11)
51. Carbon and Nitrogen Cycles (figs. 50.9, 50.10)
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53. Continental Drift and Plate Tectonics (figs. 21.7, 21.8)

CD-ROM CORRELATIONS

The following illustrations in *Biology* are correlated to the sixteen topic modules in *Explorations in Human Biology CD-ROM* by George B. Johnson:

1. Cystic Fibrosis (figs. 6.5, 14.7)
2. Active Transport (figs. 6.10–6.12)
3. Life Span and Lifestyle (figs. 36B, 36.9, 39.10, 48A)
4. Muscle Contraction (figs. 43.11–43.15)
5. Evolution of the Heart (figs. 36.5–36.8)
6. Smoking and Cancer (fig. 39.10)
7. Diet and Weight Loss (fig. 38.11)
8. Nerve Conduction (figs. 41.2–41.6, 41.9)
9. Synaptic Transmission (figs. 41.7, 41.10, 43.15)
10. Drug Addiction
11. Hormone Action (figs. 44.1–44.3, 44.8)
12. Immune Response (figs. 37.3–37.9)
13. AIDS (figs. 37B, 37.10)
14. Constructing a Genetic Map (p. 205, figs. 18.3, 18.4, 18.9)
15. Heredity in Families (figs. 14.6a, 14.7a, 14.9, 14.12, 14.13)
16. Pollution of a Freshwater Lake (figs. 51.1, 52.7, 52.8)

The following illustrations in *Biology* are correlated to the second CD-ROM by George B. Johnson entitled *Explorations in Cell Biology, Metabolism, and Genetics*:

1. How Proteins Function: Hemoglobin (figs. 16.2, 36.2, 39.8, 39.9)
2. Cell Size (figs. 5.3–5.5)
3. Active Transport (figs. 6.10–6.12)
4. Cell-Cell Interactions (figs. 6.5, 6.13, 17.11)
5. Mitosis: Regulating the Cell Cycle (figs. 10.3–10.8, 10.10, 11.6, 11.7)
6. Cell Chemistry: Thermodynamics (figs. 7.3–7.6)
7. Enzymes in Action: Kinetics
8. Oxidative Respiration (figs. 7.10, 9.2, 9.4, 9.6–9.9)
9. Photosynthesis (figs. 8.2, 8.3, 8.5–8.7)
10. Exploring Meiosis (figs. 11.2, 11.3, 11.5, 11.7)
11. Three-Point Genetic Cross (figs. 12.7, 13.5)
12. Heredity in Families (figs. 14.6, 14.7, 14.9, 14.12, 14.13, 14B)
13. Gene Segregation Within Families (figs. 14.6, 14.7)
14. DNA Fingerprinting: You Be the Judge (fig. 18.4)
15. Reading DNA (figs. 15.6, 15.7, 16.5)
16. Gene Regulation (figs. 16.5, 16.6, 16.11, 17.1, 17.2, 17.5)
17. Making a Restriction Map (p. 205, figs. 18.3, 18.4, 18.9)

PREFACE

Biology is an introductory college text that covers the concepts and principles of biology from the structure and function of the cell to the organization of the biosphere. It draws upon the entire world of living things to bring out an evolutionary theme that is introduced from the start.

The writing style and clarity of the text make it appropriate for use by the liberal arts student but it is also comprehensive enough for the science major.

Biology demonstrates and in addition has the reader participate in the scientific process. Not only are notable contributors mentioned, significant experiments in the history of science are fully explained. Chapter 2, which discusses the scientific method, also illustrates this method by walking students through experiments in the current literature. As before, each part ends with a case study which encourages students to use scientific methodology in order to think critically. New to this edition are the Research Reports written by contemporary biologists who tell us how they go about doing their research and how their findings can be applied to human beings.

TEXT AND ILLUSTRATION COORDINATION

In this edition, you will find that all major topics begin at the top of a page and that each illustration is on the same or facing page with its text. Just glancing through the text verifies that the illustrations are on the same two page layout as their reference. This was achieved because the author was involved in deciding the layout of the book from the writing of the very first word! Coordination of text and illustration goes beyond simple placement, however. It also means making sure that the text and illustration together teach the concept under discussion. Contributors have helped improve the text and an excellent team of artists have assisted in creating the very best illustrations.

CHAPTERS NEW TO THIS EDITION

Evolution, which is the topic of Part III, includes two new chapters. The "Origin and History of Life" gives an overview of major evolutionary events since life evolved. "Human Evolution" is a chapter that includes the very latest information about recent discoveries.

Classification of plants and animals has been greatly influenced by cladistics, the most widely accepted school of systematics today. The various schools of systematics, including cladistics, are reviewed in the first of the diversity chapters. The diversity chapters received special attention and there is now a separate chapter for each of the kingdoms. New illustrations appear on nearly every page.

The part devoted to botany was expanded for this edition and recent research, especially concerning growth and development, is emphasized. These chapters have been carefully addressed. A new reading is devoted to the use of plants by human beings.

READINGS FOR THIS EDITION

The readings for this edition have been organized into several different types. We have already mentioned the "Research Reports," in which research biologists invite us to share in the excitement of their current findings. The "Of Human Interest" readings show how biology is applicable to the concerns of human beings. "A Closer Look" expands in an interesting way on the core information presented in the text. Some of these are about the research done by well-known biologists. Many chapters end with a section called "Biological Relationships" because students need to see how the various biological concepts are interrelated.

CLARITY IN WRITING AND NEW PEDAGOGY

Biology is as up to date as it possibly can be but is still retains its clarity and readability. The goal, as always, is to explain each concept without the use of jargon and in a way that is understandable to the beginning student.

Although the pedagogy in *Biology* has been praised by many, we have been able to make improvements. The micrographs are accompanied by a magnification bar that allows one to better judge the size of an organism. The use of these bars is explained in a reading entitled "The Microscopic Scale" found in chapter 5. Greek and Latin derivatives now accompany many boldfaced terms in order to give students a basis for learning and understanding scientific terminology. These are also included in the end-of-chapter glossary, which in this edition includes a full definition for each key term listed.

Even more significant, perhaps, are the new part introductions that review the central concepts of that part and how they relate to biology in general. At the start of each chapter, the chapter outline and learning objectives have been integrated so that learning objectives are listed under, and page referenced to, the major topics within that chapter. Students will appreciate that the heads for each chapter have been rewritten in an interesting way that highlights the significance of the material that follows. We continued to include the useful in-chapter summary statements that provide a synopsis of these same topics.

ORGANIZATION OF THE TEXT

The text has the following parts, which have been revised as discussed.

Introduction

An essay written by J. William Schopf, University of California—Los Angeles, which introduces the introductory chapter, shows how the unity and diversity of life is rooted in the evolutionary process. The chapter itself discusses the characteristics of life and at the same time introduces biological concepts that serve as an overview for the rest of the book.

Chapter 2, as mentioned, explains the scientific method and gives examples of both experimental and observational biological research.

Part I: The Cell

Cell structure and function and energy metabolism are presented in this part. Human applications are stressed throughout; for example, there is a reading about the new nutrition labels in the organic chemistry chapter. Cellular metabolism has been simplified, and there are many new illustrations to clarify cellular processes.

Part II: Genetic Basis of Life

This part is given a strong historical approach but practical aspects are not neglected. Students are given an opportunity to test their ability to do problems as they proceed. The cell cycle, human genetics, cancer coverage, and biotechnology have all been updated.

Part III: Evolution

This new part presents evolutionary tenets and serves as a springboard for the diversity chapters that follow. New chapters are provided on the process of evolution, the history of life, and human evolution. Many new findings have been included.

Part IV: Diversity of Life

The diversity chapters have been placed in a new part which begins with a chapter on systematics and classification of organisms. Special care was taken to introduce and explain the cladistic school of systematics. Each kingdom is assigned its own chapter which has been written anew. Almost every illustration in this part has been reworked and redrawn.

Part V: Plant Structure and Function

Four chapters are devoted to flowering plant anatomy and physiology. The first chapter provides a foundation for the others that discuss nutrition and transport, growth and development, and reproduction. The chapters in this part were expanded, rewritten and updated. Many new and interesting topics, illustrating the vitality of this area of biology, have been added.

Part VI: Animal Structure and Function.

This part, which begins with a chapter on animal organization and homeostasis, contains separate chapters on the various animal systems. The comparative approach has been strengthened and as requested by adopters, there is additional material on the reproductive methods of various animals.

Part VII: Behavior and Ecology

A behavior chapter precedes those devoted to ecology because behavior pertains to the interactions of organisms within ecosystems. The behavior chapter was completely rewritten and it now has an experimental approach. The ecology chapters balance traditional ecology with environmental concerns. Some instructors may wish to begin the year's work with this part, which is certainly a workable alternative.

AIDS TO THE READER

Biology was written to provide students with the opportunity to enjoy, appreciate, and come to understand the concepts of biology and the scientific process. The following text features are especially designed to assist student learning.

I Part Introduction and Technology Correlation Lists

An introduction for each part highlights the central ideas of that part and specifically tells the student how the topics within each part contribute to biological knowledge.

At the beginning of each part are listings from *Explorations in Human Biology* and *Explorations in Cell Biology, Metabolism, and Genetics*, and from the *Life Science Animations* videotapes. The CD-ROM modules and the animations have been carefully correlated to figures in the chapters.

BIOLOGY AND TECHNOLOGY			
<p>Many of the figures and concepts discussed in <i>Biology</i>, fifth edition are further explored in technology products. The following is a list of figures in part II that correlate to technology products.</p> <p> A set of five videotapes contains over 50 animations of physiological processes integral to the study of biology. These videotapes, entitled <i>Life Science Animations</i> (LSA), cover such topics as chemistry, genetics, and reproduction. A videotape icon appears in appropriate figure legends to alert the reader to these animations.</p> <p> <i>Explorations in Human Biology</i> and <i>Explorations: Cell Biology, Metabolism & Genetics</i> by George B. Johnson are interactive CD-ROMS with activities that can be used by an instructor in lecture and/or placed in a lab or resource center for student use. This interactive software consists of modules that cover key topics discussed in a biology course. The CD-ROMS are available for use with Macintosh and IBM Windows computers. A CD-ROM icon appears in appropriate figure legends to alert the reader of these activities.</p>			
Corresponding Figures	Videotape Concepts	CD-ROM Modules	
10.3 Cell cycle	12. Mitosis	Mitosis: Regulation the Cell Cycle	
10.4 Control of the cell cycle	12. Mitosis	Mitosis: Regulation the Cell Cycle	
10.5 Prophase	12. Mitosis	Mitosis: Regulation the Cell Cycle	
10.6 Metaphase	12. Mitosis	Mitosis: Regulation the Cell Cycle	
10.7 Anaphase	12. Mitosis	Mitosis: Regulation the Cell Cycle	
10.8 Telophase	12. Mitosis	Mitosis: Regulation the Cell Cycle	
10.10 Plant cell mitosis	12. Mitosis; 50. Mitosis and Cell Division in Plants	Mitosis: Regulation the Cell Cycle	
11.2 Overview of meiosis	13. Meiosis	Exploring Meiosis	
11.3 Crossing-over occurs during meiosis I	14. Crossing Over	Exploring Meiosis	
11.4 Chiasmata of chromosomal bivalent	14. Crossing Over	Exploring Meiosis	
11.5 Phases of meiosis	13. Meiosis	Exploring Meiosis	
11.6 Life cycle of humans	12. Mitosis; 13. Meiosis	Mitosis: Regulation the Cell Cycle	

2 Learning Objectives

The Learning Objectives provide a framework for the content of each chapter. Note that the objectives are listed under the appropriate A-heads and are page referenced for student study.

3

BASIC CHEMISTRY

Learning Objectives

Matter Is Composed of Elements

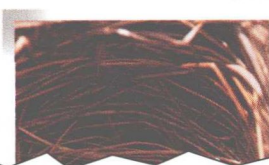
- Explain the difference between an element and an atom. 24–25
- Name and describe the subatomic particles of an atom, indicating which one accounts for the occurrence of isotopes. 25–26
- Describe and discuss the energy levels (electron shells) of an atom, including the orbitals of the first two levels. 27–29
- Draw a simplified atomic structure of any atom with an atomic number less than 20. 29

Atoms Form Compounds and Molecules

- Draw representative atomic structures for ionic and covalent molecules, and distinguish between ionic and covalent reactions. 30–32
- Note which atom has been reduced and which has been oxidized in a particular reaction. 33

Water Is Essential to Life

- Describe the chemical properties of water, and explain how these properties affect their importance for living things. 34–36
- Define an acid and a base; describe the pH scale, and state the significance of buffers. 36–37



3 Internal Summary Statements

Internal summaries are highlighted and enlarged to illustrate the chapter's key concepts. These appear at the ends of major sections and help students focus their study efforts on the basics.

The chemical properties of atoms differ because the number and the arrangement of their electrons are different.

4 Illustrations and Tables

The illustrations and tables in *Biology* have been designed to help students learn basic biological concepts as well as the specific content of the chapters, and are consistent with multicultural educational goals. Often it is easier to understand a given process by studying a drawing, especially when it is carefully coordinated with the text, as is the case here. New to this edition are integrative illustrations where both a photograph and a drawing are combined. Several new illustrations include information formerly found in tables.



5 Customization Option

The pages are double-numbered for full-color customization. An instructor can order a customized textbook to suit their course needs.

6 Figures Referenced On-page

Textual references and figures are found on the same page spread in the fifth edition. That means a student never has to turn the page to see the referenced figure.

7 Figures Correlated to Technology

Figures are correlated to the *Explorations* CD-ROMs and the *Life Science Animations* videotapes. Two icons,  and , are placed by figures that can be further enhanced with the multimedia products.

8 Boxed Features

Each chapter contains one or more readings. *Research Reports* are written by contemporary scientists and tell us about a particular aspect of their field of study. *Of Human Interest* highlights topics of special interest and ties biological principals to student concerns. *A Closer Look* expands on the core information presented in each chapter.

RESEARCH REPORT

Life After Photosynthesis

Carbon dioxide (CO_2) from the atmosphere is the primary source for almost all of the organic carbon in the tissues of plants, animals, fungi, bacteria, and other organisms on earth. Plants fix CO_2 during photosynthesis, and other organisms get along by eating or absorbing plant material. It has long been known that the amount of CO_2 in the atmosphere influences how fast photosynthesis can occur. Generally, the more CO_2 available to a plant, the faster it photosynthesizes. These observations are becoming more important because it is predicted that the concentration of CO_2 in the atmosphere, which is currently about 0.04%, will double within the coming century.

My research is concerned primarily with "life after photosynthesis," meaning the metabolism of plants after CO_2 is incorporated into organic molecules. Such metabolism is often referred to as secondary metabolism, partly because it begins several steps after the primary process of photosynthesis.

Plants metabolize in general increases when photosynthetic rates increase. This is because the plant has more energy available to use in the metabolism of the products of photosynthesis.

W. Dennis Clark
Arizona State University



the buildup of secondary metabolites? It has been several years since I first asked this question, and the jury is still out. However, the verdict appears to be yes, in some cases. In other cases, altered plant-herbivore interactions may have little to do with secondary metabolism. Recent studies show that for grasshoppers the digestibility of enriched- CO_2 sagebrush (*Artemisia tridentata*) is improved, probably because of high starch content. Flavonoids, my favorite plant chemicals, are UV-absorbing pigments that may play a significant role in defending plants against damaging UV radiation. More UV radiation is reaching the earth from the sun because pollutants are causing our protective ozone (O_3) shield, which ordinarily absorbs UV radiation, to develop holes. Experiments in 1991 showed that the concentrations of flavonoids in rice leaves were highest in plants that were grown in a combination of high CO_2 and high UV radiation. Work in 1993 showed that UV radiation and UV-B radiation harm-

9 Chapter Summaries

The summary is a numbered list of statements that follow the organization of the chapter and helps students to identify the concepts and focus on important topics discussed in each chapter.

10 Chapter Questions

Three kinds of questions—study questions, objective questions, and critical thinking questions—appear at the close of each chapter. They allow students to test their ability to fulfill the study objectives. The study questions review the chapter, and their sequence follows that of the chapter. The critical thinking questions are based on biological concepts found in the chapter. They verify that knowledge of a biological concept allows one to reason about some particular aspect of biology. The objective questions allow students to test their ability to answer recall-based questions. The types of objective questions have been expanded in this edition to include questions that require the completing or labeling of diagrams. Answers to the objective questions and critical thinking questions appear in appendix D.

Writing across the curriculum recognizes that students need an opportunity to practice writing in all courses. When students write out the answers to the study questions, they are writing while studying biology. Writing out the answers to the critical thinking questions also fulfills writing across the curriculum requirements.

11 Selected Key Terms

Each chapter ends with a selected key term list. Key terms are boldfaced in the chapter, defined in context, and also appear in the end-of-text glossary. Especially significant key terms appear in the selected key term list. Each term is accompanied by its phonetic spelling, if needed, a definition, and in many cases, the Greek or Latin derivation.

12 Suggested Readings

The list of readings at the end of each part suggests references that can be used for further study of the topics covered in the chapters of that part. The references listed in this section were carefully chosen for readability and accessibility. New to this edition, references are followed by a short description and an indication of their level of rigor.

13 Critical Thinking Case Studies

Each part ends with a case study designed by Dr. Robert D. Allen, Victor Valley College, to help students think critically by participating in the process of science. At many institutions, instructors are encouraged to develop the writing skills of their students. In such cases, instructors could require students to write out their answers to the questions in each case study. Suggested answers for each of these questions appear in the Instructor's Manual.

14 Appendices and Glossary

The appendices contain optional information. Appendix A is an expanded table for classification of organisms; appendix B is an expanded table of chemical elements; appendix C is a new presentation of the metric system; and appendix D gives the answers to the objective questions and critical thinking questions found at the end of each chapter.

The glossary defines all the boldface terms in the text. These terms are the ones most necessary for the successful study of biology. Terms that are difficult to pronounce have a phonetic spelling.

ADDITIONAL AIDS

Instructor's Manual/Test Item File

The *Instructor's Manual*, revised by the author, is designed to assist instructors as they plan and prepare for classes using *Biology*. An expanded chapter outline which could be used as a lecture outline, is also available on disk. The outline includes the learning objectives and bold faced terms for each major section of the chapter. Lecture enrichment ideas are given and there is a listing of the transparencies and micrograph slides available for lecture hall use. A listing of videotape and CD-ROM ancillaries available from the publisher is followed by a listing of other audiovisual and computer software.

Suggested answers for the critical thinking case studies that appear at the end of each part in the text are placed at the end of the corresponding parts in the *Instructor's Manual*.

The Test Item File was revised by Dr. John Richard Schrock, Emporia State University, and now also includes higher level objective questions. The test item file questions are sequenced

according to the learning objectives, and include objective, true/false, and critical thinking essay questions. Microtest III, a computerized test bank of the test items, is available in Dos, Windows, and Macintosh formats.

Study Guide

To ensure close coordination with the text, the author has written the *Study Guide* that accompanies the text. Each text chapter has a corresponding *Study Guide* chapter that includes a listing of learning objectives, study questions, puzzles and games, and a chapter test. Answers to the study questions and the chapter test are provided to give students immediate feedback. New to this edition is the KeyWord Crossword puzzle, an intriguing, new way to study glossary terms.

The learning objectives in the *Study Guide* are the same as those in the *Instructor's Manual*, and the study questions in the *Study Guide* are sequenced to these objectives. Instructors who make their choice of learning objectives known to the students can thereby direct student learning in an efficient manner. Instructors and students who make use of the *Study Guide* should find that student performance increases dramatically.

Microguide, a computerized study guide, is also available for students. This electronic study guide features chapter objectives, quiz questions, chapter summaries, and selected key terms. The questions are page referenced to the text.

Laboratory Manual

The author has also written the *Laboratory Manual to accompany Biology*. Most chapters in the text have an accompanying laboratory exercise in the manual (some chapters have more than one accompanying exercise). In this way, instructors are better able to emphasize particular portions of the curriculum. Every laboratory has been rewritten to further help students appreciate the scientific method and to learn the fundamental concepts of biology and the specific content of each chapter.

Customized Laboratory Manual-Full Color

All thirty-five exercises are now available as individual "lab separates" in full color, so instructors can order a customized manual to suit their particular course needs.

Laboratory Resource Guide

More extensive information regarding preparation is found in the *Laboratory Resource Guide*. The guide includes suggested sources for materials and supplies, directions for making up solutions and otherwise setting up the laboratory, expected results for the exercises, and suggested answers to all questions in the laboratory manual. It is available for free to all adopters of the laboratory manual.

Student Study Art Notebook

A full-color, lecture-time notepad containing all transparency images with space for notes, so students can spend more time paying attention and less time scrambling to sketch images. Packaged free with each new text.

Electronic Image Bank

Nearly all text illustrations will be available on CD-ROM with a presentation software that allows the user to manipulate the images and the labels.

Micrograph Slides

A boxed set of 100 slides of photo micrographs and electron-micrographs is available to adopters.

Transparencies

A set of 300 transparency acetates features key illustrations from the text in two- and full-color and now have upsized labels. A boxed set of slides containing the transparency images is also available.

Art Masters

A set of 250 art masters consisting of one-color line art with labels can be used for additional transparencies or can be copied and used for student hand-outs.

NEW TECHNOLOGY

Several new state-of-the-art technology products are available that are correlated to this textbook. These useful and enticing supplements can assist you in teaching and can improve student learning.

Explorations in Human Biology and Explorations in Cell Biology, Genetics, and Metabolism CD-ROMs

Each of these interactive CDs by Dr. George B. Johnson comprise sixteen modules, featuring fascinating topics in biology. These interactive investigations are correlated to appropriate topical material in *Biology*. The multimedia figures are identified with a CD-ROM icon (). Each text part opens with a list of *Explorations* topics correlated to those chapters.

Life Science Animations Videotapes

Fifty-three animations of key physiological processes are available on videotapes. The animations, correlated to this text by a videotape icon, bring visual movement to biological processes that are difficult to understand on the text page. The figures correlated to these videotapes are identified with a videotape icon ().

Life Science Living Lexicon CD-ROM

This new interactive CD-ROM, by Will Marchuk of Red Deer College, offers students a glossary of over 1,200 key science terms and definitions; word construction through the use of prefixes, root words, and suffixes; descriptions of eponyms; more than 1,000 full-color images for selected terms; and over 200 questions for student quizzing.

Other Technology Products that are Excellent Complements to *Biology*

BioSource videodisc, by Wm. C. Brown and Sandpiper Multimedia, Inc., features twenty minutes of moving animations and nearly ten thousand full-color illustrations and photos, many from leading WCB biology textbooks.

Biology StartUp, a five-disk set of Macintosh tutorials by Myles C. Robinson and Kathleen Hakola Pace, Grays Harbor College, is designed to help nonmajor students master challenging biological processes like chemistry and cell biology. This set can be a valuable addition to a resource center and is especially helpful to students enrolled in developmental education courses or those who need additional assistance to succeed in an introductory biology course.

OTHER TITLES OF RELATED INTEREST FROM WM. C. BROWN PUBLISHERS

You Can Make a Difference

Judith Getis

This short, inexpensive supplement offers students practical guidelines for recycling, conserving energy, disposing of hazardous wastes, and other pollution controls. It can be shrink-wrapped with the text at minimal additional cost. (ISBN 0-697-13923-9)

How to Study Science

Fred Drewes, Suffolk County Community College

This useful workbook offers students helpful suggestions for meeting the challenges of a college science course. It offers tips on how to take notes, how to get the most out of laboratories, and how to overcome science anxiety. The book's unique design helps students develop critical thinking skills while facilitating careful note taking. (ISBN 0-697-14474-7)

The Life Science Lexicon

William N. Marchuk, Red Deer College

This portable, inexpensive reference helps introductory-level students quickly master the vocabulary of the life sciences. Not only a dictionary, it carefully explains the rules of word construction and derivation, in addition to giving complete definitions of all important terms. (ISBN 0-697-12133-X)

Biology Study Cards

Kent Van De Graaff, R. Ward Rhees, and
Christopher H. Creek, Brigham Young University

This boxed set of 300 two-sided study cards provides a quick yet thorough visual synopsis of all key biological terms and concepts in the general biology curriculum. Each card features a masterful illustration, pronunciation guide, definition, and description in context. (ISBN 0-697-03069-5)

The Gundy-Weber Knowledge Map of the Human Body

G. Craig Gundy, Weber State University

The 13-disk Mac-Hypercard program is for use by instructors and students alike. It features carefully prepared computer graphics, animations, labeling exercises, self-tests, and practice questions to help students examine the systems of the human body. Contact your local Wm. C. Brown representative or call 1-800-351-7671.

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Critical Thinking Case Study Workbook

Written by Robert Allen, this ancillary includes 34 additional critical thinking case studies of the type found in the text. Like the text case studies, they are designed to immerse students in the “process of science” and challenge them to solve problems in the same way biologists do. The case studies here are divided into 3 levels of difficulty (introductory, intermediate, and advanced) to afford instructors greater choice and flexibility. An answer key accompanies this workbook.

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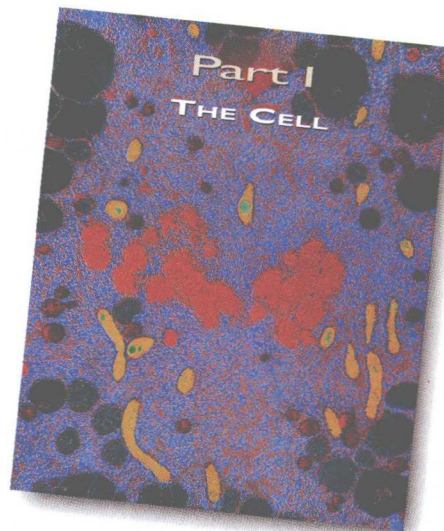
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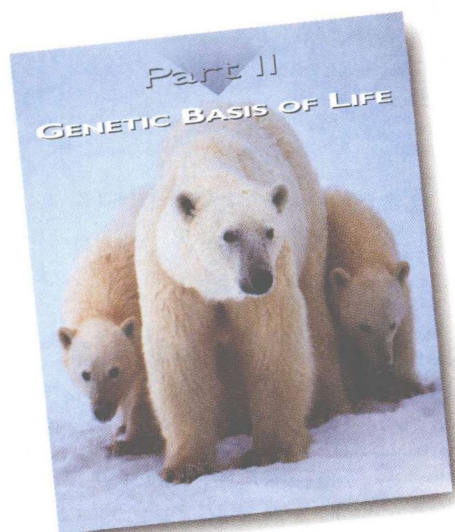
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