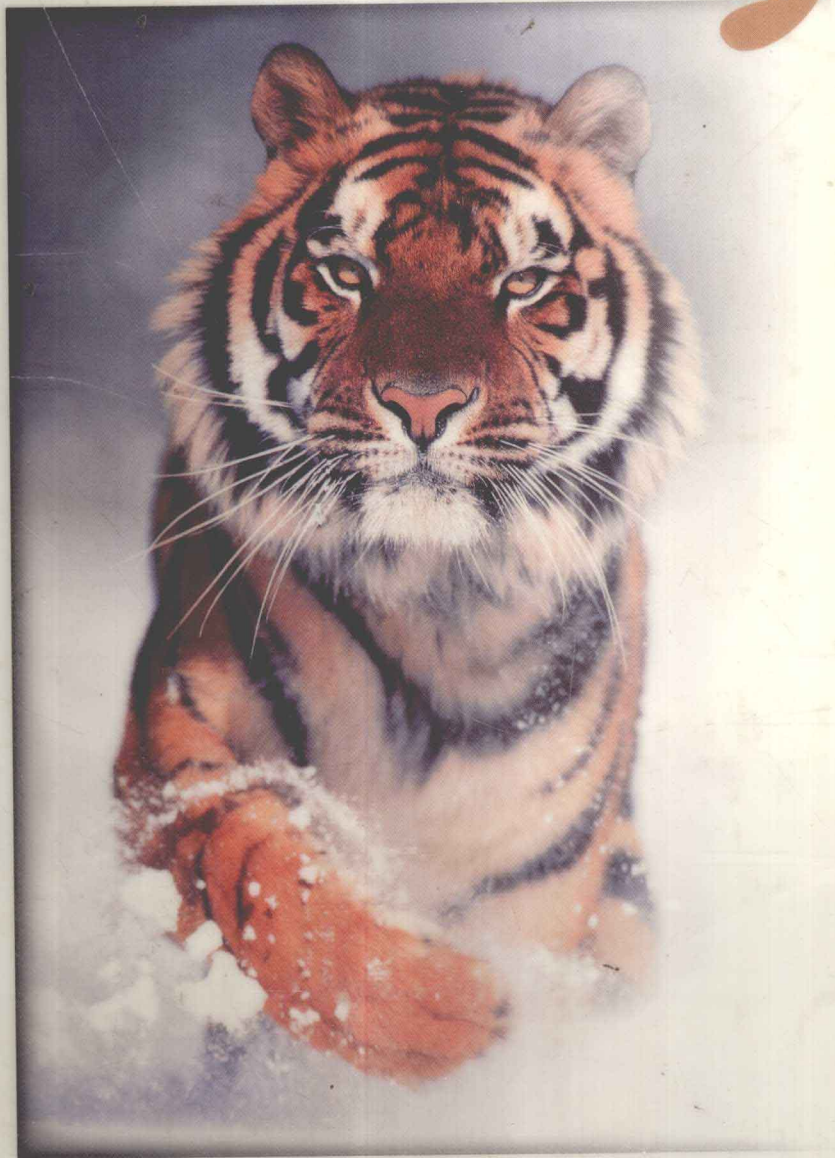


Biology

sixth edition



sylvia s. mader

Biology

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INTERNATIONAL EDITION

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Preface

Biology is an introductory 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.

Scientific Process

Biology emphasizes the scientific process. Notable contributions to biology, including significant experiments, are discussed throughout the text. Chapter 1 explains the scientific method and also illustrates this method by walking students through experiments in the current literature. The text has numerous *Doing Science* readings, many written by contemporary biologists who tell how they go about doing their research and how their findings can be applied to human beings.

Every chapter of *Biology* has been revised and thoroughly updated; however, this edition has not grown significantly in page length. Every chapter has been skillfully revised and rewritten. All illustrations have been carefully correlated to the textual material to ensure that each illustration is on the same or facing page as its textual reference. This direct correlation aids in learning and studying.

Concepts

In this edition the major topics are numbered, and the concepts, which have replaced learning objectives, are grouped according to these topics. This numbering system is used in the textual material, and in the summary, which reviews the concepts according to each major topic. This system allows instructors to assign just certain portions of the chapter and it also allows students to study the chapter in terms of the concepts presented.

New Chapters

Chapter six, "Metabolism: Energy and Enzymes," is new to this edition. This chapter, which explains the laws of thermodynamics, how the cell makes use of ATP, and how enzymes function, lays a foundation for the revised photosynthesis and cellular respiration chapters that follow.

The science of ecology is undergoing fundamental changes, and the ecology chapters have been rewritten to have a modern approach. Four chapters (23–26) are devoted to reviewing the ecological principles that explain how the

natural world works. These chapters make frequent reference to how humans impact the environment, and chapter 27 is concerned with this topic alone. Ecological problems of our day are considered.

Ecology is further emphasized in this edition because *Ecology Focus* readings appear in each part, and the part entitled "Behavior and Ecology" has been moved to follow Part III, "Evolution." This sequence is logical because evolution and ecology are intertwined.

Like ecology, systematics is now undergoing changes that promise to revolutionize the science. Cladistics is now challenging the traditional school and has been well received by many. Therefore, students need to be exposed to how cladists go about determining evolutionary relationships. More and more reliance is being placed on molecular data, which suggests there are three domains of life: bacteria, archaea, and eukarya. All of these topics are considered in Part V, including a thorough examination of each kingdom.

New Pedagogy

Consistent with accepted educational methodology, this edition of *Biology* features an introduction and a closing that emphasize the concepts of the chapter. The introduction, which appears on the chapter opening page, sparks student interest and highlights the overall themes for the chapter. *Connecting Concepts*, which closes the text portion of the chapter, stimulates critical thinking and shows how the concepts in the chapter are related to the concepts in other chapters.

Readings

The readings have now been organized into four types. The *Doing Science* readings are often written by contemporary scientists who tell us about their particular type of research and how they became interested in this field of biology. Some of the *Doing Science* readings feature the work of minority researchers such as Barbara McClintock's work regarding "jumping genes" and Susumu Tonegawa's work in antibody diversity. The *Health Focus* readings give practical information concerning some particular topic of interest, such as proper nutrition and how to prevent cancer. The *Ecology Focus* readings draw attention to some particular environmental problem such as the need to preserve

tropical rain forests and the relationship between ozone holes and skin cancer. *A Closer Look* readings are designed to expand, in an interesting way, on the core information presented in each chapter.

New Appearance

There are many new illustrations in *Biology*, but special attention was given to Part I in which all art pieces are color consistent with new animal and plant cells in chapter four, "Cell Structure and Function." Location icons are now a part of all organelle illustrations.

The appearance of this edition is completely new and improved. Color has been used more effectively, and all text art is now screened in one or two colors. And, the summary statements no longer have a color screen. The end result is a book whose appearance will be pleasing to all.

Technology

Many technology aids are available for use with *Biology*, and each chapter now has its own listing of these. For the student, the Mader Home Page offers exercises to aid learning and resources that expand on the text's content and applica-

tions. *Explorations in Human Biology* and *Explorations in Cell Biology and Genetics* are interactive CD-ROMs that bring biology to life. *The Life Science Animations* videotapes include fifty-three additional topics that can be studied in a visually appealing way. *The Dynamic Human* CD-ROM offers three-dimensional visuals that facilitate an understanding of human anatomy and physiology. Other aids are also available, and all of these are listed on the technology page (see page xviii of the preface).

For the Instructor, the *Extended Lecture Outline* makes the contents of the book available in a way that facilitates lecture preparation. The outline is available on the Mader Home Page and on disk by request. *The Visual Resource Library* on CD-ROM makes the text illustrations available for classroom use. The images and their labels can even be manipulated. To help with the mechanics of teaching there is a computerized version of the *Test Item File* available in Windows and Macintosh formats.

Aids to the Reader

Biology includes a number of aids that have helped students study biology successfully and enjoyably.

► new to this edition

► Part IV: Ecology was thoroughly updated for this edition and all chapters have been completely rewritten. *Ecology Focus* readings occur throughout the text.

A new chapter (6) entitled "Metabolism: Energy and Enzymes," the first of three energetics chapters, was rewritten, and the other two chapters (7 and 8) have been revised.

Systematics received special attention and the three domains of life are discussed. Cladistics has been revised and made clearer for the student.

► New art appears throughout the text, and in Part I the colors used are consistent with new plant and animal cells. Color is more effectively used

throughout the text, giving the book a completely new appearance.

► Four types of readings are featured:

Doing Science
Ecology Focus
Health Focus
A Closer Look

► The chapter opening page has an integrated outline of the major topics and chapter concepts. The major topics are numbered in the chapter outlines, in the text, and in the Summary. The introduction, which sparks student interest and highlights certain themes, is on the chapter opening page. Each chapter ends with *Con-*

necting Concepts, which emphasizes how the concepts of the chapter are related to concepts in other chapters.

► Technology Aids are correlated to the text. *Explorations in Human Biology* and *Explorations in Cell Biology and Genetics* CD-ROMs offer exciting new ways to understand biological concepts. *The Dynamic Human* on CD-ROM is an interactive three-dimensional visual guide to human anatomy and physiology.

► Explore the Mader Home Page for even more information:

<http://www.mhhe.com/sciencemath/biology/mader/>

The inside cover lists major contributions to the field of biology in a concise, chronological manner. Students may refer to these whenever it is appropriate.

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.

The chapter begins with an integrated outline that numbers the major topics of the chapter and lists the concepts for each topic.

Each chapter has an introduction on the chapter opening page that sparks student interest in the themes for the chapter.

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

CHAPTER

4

4.1 Cells Make Up Living Things

- All organisms are composed of cells, which arise from preexisting cells. 58
- A microscope is usually needed to see a cell because most cells are quite small. 59
- Cell-volume-to-surface relationships explain why cells are so very small. 59

4.2 Prokaryotic Cells Are Less Complex

- Prokaryotic cells do not have a membrane-bounded nucleus nor other organelles of eukaryotic cells. 62

4.3 Eukaryotic Cells Are More Complex

- Eukaryotic cells have a membrane-bounded nucleus that contains DNA within chromosomes. 63, 66
- Organelles are membrane-bounded compartments specialized to carry out specific functions. 63, 69
- Chloroplasts use solar energy to produce organic molecules that are broken down, releasing energy in mitochondria. 70
- The cytoskeleton, a complex system of filaments and tubules, gives the cell its shape and accounts for the movement of the cell and its organelles. 72

4.4 How the Eukaryotic Cell Evolved

- The endosymbiotic hypothesis states that certain eukaryotic organelles were originally prokaryotes taken up by a larger cell. 76

Onion root tip, *Allium*

20 μm

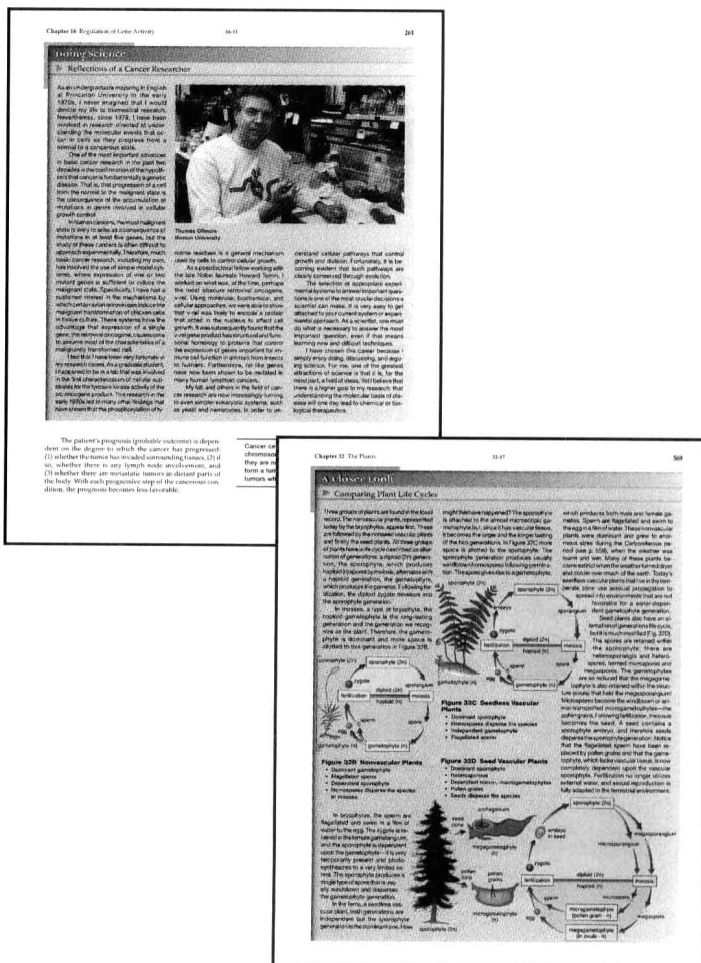
Today we are accustomed to thinking of living things as being constructed of cells. But the word cell didn't come into use until the seventeenth century. Antonie van Leeuwenhoek of Holland is famous for observing tiny, unicellular living things that no one had seen before. Leeuwenhoek sent his findings to an organization of scientists called the Royal Society in London. Robert Hooke, an Englishman, confirmed Leeuwenhoek's observations and was the first to use the term cell. The tiny chambers he observed in the honeycomb structure of cork reminded him of cells in a monastery. Naturally, he referred to the boundaries of these chambers as cell walls.

An examination of the cell in the light micrograph shown here may not be overly impressive. You can see a darkened nucleus near the cell's center and tiny dark specks spread throughout the cell like specks of dust. Now we know, however, that the nucleus contains numerous chromosomes and thousands of genes! The dots surrounding the nucleus are actually organelles, tiny specialized structures performing specific functions in the cell. Cells may seem simple but they are really quite complex.

The illustrations and tables in *Biology* 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. Every illustration appears on the same or facing page to its reference.

Four types of readings are included in the text. *Doing Science* readings invite the reader to share in the excitement of past and current research projects. *Ecology Focus* readings draw attention to some environmental problem. *Health Focus* readings review measures to keep healthy. *A Closer Look* reading is designed to expand in an interesting way on the core information presented in the chapter.

These appear at the close of the text portion of the chapter, and they stimulate critical thinking by showing how the concepts of the chapter are related to others in the text.



End of Chapter Pedagogy

The numbered major topics are repeated in the *Summary*, which reviews the concepts for each topic. *Reviewing the Chapter* are a series of study questions that follow the sequence of the chapter. *Testing Yourself* consists of objective questions that allow students to test their ability to answer recall-based questions. Answers to *Testing Yourself* questions are given in Appendix A. *Applying the Concepts* are critical thinking questions based on biological concepts. *Using Technology* lists the available technology, including the Mader Home Page address, for the chapter. *Understanding the Terms* provides a page reference for boldfaced terms in the chapter. A matching exercise allows students to test their knowledge of the terms.

Further 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 ac-

cessibility. References are followed by a short description and an indication of their level of rigor.

Appendices and Glossary

The appendices contain optional information. *Appendix A* is the answer key to the objective questions found at the end of each chapter; *Appendix B* is an expanded table of chemical elements; *Appendix C* explains the metric system; *Appendix D* is a classification of organisms; and *Appendix E* is a listing of acronyms used in the text along with the complete term. The glossary defines 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, and the Greek and Latin derivation is given for selected terms.

402
23-28
Part IV Behavior and Ecology

connecting concepts

Modern ecology began with descriptive studies by nineteenth-century naturalists. In fact, an early definition of the field was "scientific natural history." However, modern ecology has grown to be much more than a simple descriptive field. Ecology is now very much an experimental, predictive science.

Much of the success in the development of ecology as a predictive science has come from studies of populations and the development of models that examine how populations change over time. The simplest models are based on population growth when there are unlimited resources. This results in exponential growth, a type of population growth that is only rarely seen in nature. Pest species may exhibit exponential growth until they run out of resources. Because so few natural populations exhibit exponential growth, population ecologists realized they must incorporate resource limitation in their models. The simplest models that account for limited resources result in sigmoidal or logistic growth. Populations which exhibit logistic growth will cease growth when they reach the environmental carrying capacity.

Many modern ecological studies are concerned with identifying the factors that place limits on population growth and that set the environmental carrying capacity. A combination of careful descriptive studies, experiments done in nature, and sophisticated models has allowed ecologists to make good predictions about which factors have the greatest influence on population growth. The example of the winter moth is a good case in point.

The next step in the development of modern ecology has been to try to understand how populations of different species affect each other. This is known as community ecology. Because each population in a community responds to environmental changes in slightly different ways, developing predictive models that explain how communities change has been challenging. However, ecologists are beginning to be able to predict how communities will change through time and to understand what factors influence community properties such as species number, abundance of individuals, and species interactions.

Individuals are at different stages of their life span in a population. Mortality (deaths per capita) within a population can be recorded in a life table and illustrated by a survivorship curve. The pattern of population growth is reflected in the age distribution of a population, which consists of prereproductive, reproductive, and postreproductive segments. Populations that are growing exponentially have a pyramid-shaped age distribution pattern.

23.3 Regulation of Population Size

Population growth is limited by density-independent (e.g., weather) and density-dependent factors (predation, competition, and resource availability). Do some populations have an intrinsic means of regulating population growth as opposed to density-independent and density-dependent factors, which are extrinsic means? Territoriality is given as an example of a possible intrinsic means of regulation.

23.4 Life History Patterns

The logistic growth model has been used to suggest that the environment promotes either *r*-selection or *K*-selection. So-called *r*-selection occurs in unpredictable environments where density-independent factors affect population size. Energy is allocated to producing as many small offspring as possible. Adults remain small and do not invest in parental care of offspring. *K*-selection occurs in environments that remain relatively stable, where density-dependent factors affect population size. Energy is allocated to survival and repeated reproductive events. The adults are large and invest in parental care of offspring. Actual life histories contain trade-offs between these two patterns.

23.5 Human Population Growth

The human population is expanding exponentially, and it is unknown when the population size will level off. Most of the expected increase will occur in certain LDCs (less-developed countries) of Africa, Asia, and Latin America. Support for family planning, human development, and delayed child bearing could help prevent an expected increase.

Summary

23.1 Scope of Ecology

Ecology is the study of the interactions of organisms with other organisms and with the physical environment. Ecology encompasses several levels of study: organism, population, community, ecosystem, and finally the biosphere. Ecologists are particularly interested in how interactions affect the distribution and abundance of organisms.

Population density is simply the number of individuals per unit area or volume. Distribution of these individuals can be uniform, random, or clumped. A population's distribution is often determined by limiting factors; that is, abiotic factors like water, temperature, and availability of nutrients.

23.2 Characteristics of Populations

Population size is dependent upon natality (number of births), mortality (number of deaths), immigration, and emigration. The number of births minus the number of deaths results in the net reproductive rate (symbolized as r) per capita per unit time.

One model for population growth assumes that the environment offers unlimited resources. In the example given, the members of the population have discrete reproductive events, and therefore the size of next year's population is given by the equation: $N_t = N_0 e^{rt}$. Under these conditions, exponential growth results in a J-shaped curve.

Most environments restrict growth, and exponential growth cannot continue indefinitely. Under these circumstances an S-shaped or logistic growth curve results. The growth of the population is given by the equation $dN/dt = rN(K-N)/K$ for populations in which individuals have repeated reproductive events. The term $(K-N)/K$ represents the unused portion of the carrying capacity (K). When the population reaches carrying capacity, the population stops growing because environmental resistance opposes biotic potential, the maximum net reproductive rate for a population.

892
49-28
Part VII Animal Structure and Function

Applying the Concepts

- Hormone levels are maintained by feedback control. Contrast control of neurotransmitter levels in the nervous system with control of hormone levels in the endocrine system.
- The nervous system is fast acting, and the endocrine system is fairly slow moving. Contrast message delivery in the nervous system with that in the endocrine system.
- Hormone levels greatly affect the phenotype. Use the effect of sex hormones to substantiate this concept.

Using Technology

Your study of hormones and endocrine systems is supported by these available technologies:

- Exploring the Internet
The Mader Home Page provides resources for and help with studying this chapter.
<http://www.mhhe.com/sciencemath/biology/mader/>
(Click on Biology.)
- The Dynamic Human CD-ROM
Endocrine System
- Explorations in Cell Biology & Genetics CD-ROM
Cell-Cell Interactions (K4)
- Explorations in Human Biology CD-ROM
Hormone Action (H11)
- Life Science Animations Video
Video #3: Animal Biology I
Rapidly Hormone Action (cAMP) (K28)

Understanding the Terms

| | |
|---|--|
| Addison disease 883 | hypothalamus 878 |
| adrenal cortex 882 | insulin 885 |
| adrenal gland 882 | melanocyte-stimulating hormone (MSH) 880 |
| adrenal medulla 882 | nonsteroid hormone 875 |
| adrenocorticotrophic hormone (ACTH) 880 | norepinephrine 882 |
| aldosterone 882 | oxytocin 878 |
| anabolic steroid 887 | pancreas 885 |
| androgen 887 | pancreatic islet 885 |
| antidiuretic hormone (ADH) 878 | parathyroid gland 881 |
| circadian rhythm 888 | parathyroid hormone (PTH) 881 |
| Cushing syndrome 883 | pineal gland 888 |
| cyclic AMP 875 | pituitary gland 878 |
| diabetes mellitus 885 | progesterone 887 |
| endocrine system 873 | prolactin (PRL) 880 |
| epinephrine 882 | prostaglandin 888 |
| estrogen 887 | renin 882 |
| glucagon 885 | second messenger 875 |
| goiter 880 | steroid hormone 874 |
| gonad 877 | thymus 888 |
| gonadotropin hormone 880 | thyroid gland 880 |
| growth hormone (GH) 879 | thyroid-stimulating hormone (TSH) 880 |
| hormone 874 | thyroxine 880 |

Match the terms to these definitions:

- Hormone secreted by the adrenal cortex that regulates the sodium and potassium ion balance of the blood.
- Chemical messengers produced in one part of the body that controls the activity of other parts.
- Hormone secreted by the posterior pituitary that increases the permeability of the collecting ducts in a kidney.
- Gland—either at the skin surface (fish, amphibians) or in the third ventricle of the brain, (mammals)—that produces melatonin.
- Hormone secreted by the anterior lobe of the pituitary gland that stimulates activity in the adrenal cortex.
- Large gland in the neck that produces several important hormones, including thyroxine and calcitonin.
- Hormone, secreted by the pancreas, which causes the liver to break down glycogen and raises the blood glucose level.
- Substance secreted by the anterior pituitary; it promotes cell division, protein synthesis, and bone growth.

► technology

Several 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.

Exploring the Internet

<http://www.mhhe.com/sciencemath/biology/mader/>

The Mader Home Page allows students and teachers from all over the world to communicate. *Biology* has a complete text-specific site developed exclusively for users of the sixth edition. By visiting this site, students can access additional study aids, explore links to other relevant biology sites, catch up on current information, and pursue other activities.

The Internet Primer

by Fritz J. Erickson &
John A. Vonk

This short, concise primer shows students and instructors how to access and use the Internet. The guide provides enough information to get started by describing the most critical elements of using the Internet.

The Dynamic Human CD-ROM

This guide to anatomy and physiology interactively illustrates the complex relationships between anatomical structures and their functions in the human body. Realistic, three-dimensional visuals are the premier feature of this exciting learning tool. The program covers each body system, demonstrating to the viewer the anatomy, physiology, histology, and clinical applications of each system. *The Dynamic Human* is listed in the Using Technology section at the end of each systems chapter.

Explorations in Human Biology CD-ROM; Explorations in Cell Biology and Genetics CD-ROM

These interactive CDs, by Dr. George B. Johnson, feature fascinating topics in biology. *Explorations in Human Biology* and *Explorations in Cell Biology and Genetics* have 33 different modules that allow stu-

dents to study a high-interest biological topic in an interactive way. In this edition of *Biology*, the Explorations that correlate to the chapter are listed in the Using Technology section, which appears at the end of each chapter. The modules are briefly described in the Instructor's Manual.

Life Science Animations Videotapes

Fifty-three animations of key physiological processes are available on videotapes. The animations bring visual movement to biological processes that are difficult to understand on the text page. In this edition of *Biology*, the Explorations that correlate to the chapter are listed in the Using Technology section, which appears at the end of each chapter.

BioSource Videodisc

BioSource Videodisc, by WCB/McGraw-Hill and Sandpiper Multimedia, Inc., features 20 minutes of animations and nearly 10,000 full-color illustrations and photos, many from leading WCB/McGraw-Hill biology textbooks.

Bioethics Forums Videodisc

Bioethics Forums is an interactive program that explores societal dilemmas arising from recent breakthroughs in biology, genetics, and biomedical technology. The scenarios are fictional, but the underlying science and social issues are real. *Bioethics Forums* encourages students to explore the science behind decisions as well as the processes of ethical reasoning and decision-making.

Visual Resource Library

Our electronic art image bank is a CD-ROM that contains hundreds of biological images from *Biology*, Sixth Edition. The CD-ROM contains an easy-to-use program that enables you quickly to view images, and you may easily import the images into PowerPoint to create your own multimedia presentations or use the already prepared PowerPoint presentations. The CD-ROM also includes several video clips featuring key animated biological processes.

Virtual Biology Laboratory CD-ROM

by John T. Beneski and Jack Waber, West Chester University

This CD-ROM is designed primarily for nonscience major students. The exercises are designed to expose students to the types of tools used by biologists, allow students to perform experiments without the use of wet lab setups, and support and illustrate topics and concepts from a traditional biology course.

Virtual Physiology Laboratory CD-ROM

This CD-ROM features ten simulations of the most common and important animal-based experiments ordinarily performed in the physiology component of your laboratory. This revolutionary program allows students to repeat laboratory experiments until they adeptly master the principles involved. The program contains video, audio, and text to clarify complex physiological functions.

The Secret of Life Video Modules

WGBH, Boston and BBC-TV

WGBH has produced eight 15-minute video modules that illuminate the biological universe with unique stories and animation. Each module concludes with a series of stimulating questions for class discussion.

The Secret of Life Videodisc

WGBH, Boston

A two-sided videodisc is available as a companion to *Biology*, Sixth Edition. Topic coverage includes biotechnology, human reproduction, portraits of modern science and research, and human genetics.

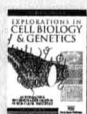
Our CD-ROM products may be packaged with the text at a cost savings. Contact your WCB/McGraw-Hill sales representative for details.

Technology Correlations

The Sixth Edition of *Biology* has three technology learning tools that are correlated to the chapters. The Using Technology section at the end of the chapter lists those that are appropriate to that chapter.¹



The Dynamic Human is an interactive CD-ROM with three-dimensional visuals demonstrating the anatomy, physiology, and histology, along with clinical applications, of each body system.



Explorations in Human Biology and Explorations in Cell Biology and Genetics are interactive CD-ROMs consisting of 33 different modules that cover key topics in biology.



Life Science Animations is a set of five videotapes containing 53 animations of processes integral to the study of biology.



Chapter 1 A View of Life

Life Science Animations 52 (Tape 5)

Chapter 2 Basic Chemistry

Life Science Animations 1 (Tape 1)

Chapter 4 Cell Structure and Function

Life Science Animations 2, 3, 4 (Tape 1)

Chapter 5 Membrane Structure and Function

Explorations in Cell Biology 2, 3
Life Science Animations 2, 3 (Tape 1)

Chapter 6 Metabolism: Energy and Enzymes

Explorations in Cell Biology 6, 8
Life Science Animations 7, 11 (Tape 2)

Chapter 7 Photosynthesis

Explorations in Cell Biology 9
Life Science Animations 8, 9, 10 (Tape 1)

Chapter 8 Cellular Respiration

Explorations in Cell Biology 8
Life Science Animations 5, 6, 7, 11 (Tape 1)

Chapter 9 Cell Division

Explorations in Cell Biology 5
Life Science Animations 12, 50 (Tapes 1 and 5)

Chapter 10 Meiosis and Sexual Reproduction

Explorations in Cell Biology 10
Life Science Animations 13, 14, 19, 20 (Tape 2)

Chapter 12 Chromosomes and Genes

Explorations in Cell Biology 11

Chapter 13 Human Genetics

Explorations in Cell Biology 1, 12, 13
Explorations in Human Biology 1

Chapter 14 DNA: The Genetic Material

Life Science Animations 15 (Tape 2)

Chapter 15 Gene Activity

Explorations in Cell Biology 1, 15
Life Science Animations 16, 17 (Tape 2)

Chapter 16 Regulation of Gene Activity

Explorations in Cell Biology 15, 16
Life Science Animations 18 (Tape 2)

Chapter 17 Recombinant DNA and Biotechnology

Explorations in Cell Biology 14, 17

Chapter 20 Origin and History of Life

Life Science Animations 53 (Tape 5)

Chapter 25 Ecosystems

Life Science Animations 51, 52 (Tape 5)

Chapter 27 Human Impact on the Global Environment

Explorations in Human Biology 16

Chapter 30 The Protists

Life Science Animations 45 (Tape 4)

Chapter 32 The Plants

Life Science Animations 46, 47

Chapter 36 Plant Structure

Life Science Animations 46
(Tape 5)

Chapter 37 Nutrition and Transport in Plants

Life Science Animations 47, 48 (Tape 5)

Chapter 38 Growth and Development in Plants

Life Science Animations 49 (Tape 5)

Chapter 40 Animal Organization and Homeostasis

Dynamic Human, Anatomical Orientation

Chapter 41 Circulation

Explorations in Human Biology 5
Life Science Animations 37, 38, 39, 40 (Tape 4)
Dynamic Human, Cardiovascular System

Chapter 42 Lymph Transport and Immunity

Explorations in Human Biology 12, 13
Life Science Animations 41, 42, 43, 44 (Tape 4)
Dynamic Human, Lymphatic System

Chapter 43 Digestion and Nutrition

Explorations in Human Biology 7
Life Science Animations 33 (Tape 4)
Dynamic Human, Digestive System

Chapter 44 Respiration

Explorations in Human Biology 3, 6
Dynamic Human, Respiratory System

Chapter 45 Osmotic Regulation and Excretion

Dynamic Human, Urinary System

Chapter 46 Neurons and Nervous Systems

Explorations in Cell Biology 8, 9
Explorations in Human Biology 10
Life Science Animations 22, 23, 24, 25 (Tape 3)
Dynamic Human, Nervous System

Chapter 47 Sense Organs

Life Science Animations 26, 27 (Tape 3)

Chapter 48 Support Systems and Locomotion

Explorations in Human Biology 4, 9
Life Science Animations 30, 31 (Tape 3)
Dynamic Human, Muscular System, Skeletal System

Chapter 49 Hormones and Endocrine Systems

Explorations in Cell Biology 4
Explorations in Human Biology 11
Life Science Animations 28 (Tape 3)
Dynamic Human, Endocrine System

Chapter 50 Reproduction

Explorations in Human Biology 13
Dynamic Human, Reproductive System

Chapter 51 Development

Life Science Animations 21, (Tape 2)

¹Technology aids are described per chapter in the *Instructor's Manual*.

More Teaching and Learning Aids

Instructor's Manual/Test Item File

The Instructor's Manual/Test Item File, prepared by Dr. John Richard Schrock, Emporia State University, is designed to assist instructors as they plan and prepare for classes using *Biology*. The first part of the Instructor's Manual pertains to the text chapters and the second part is the Test Item File.

The Instructor's Manual contains both an extended lecture outline and lecture enrichment ideas, which together review in detail the contents of the text chapter. The technology section lists videos and computer software items that are available from outside sources and also those that are available from WCB/McGraw-Hill. Answers to the Applying the Concepts questions appear in the Instructor's Manual.

The Test Item File for each chapter contains approximately 60 objective test questions and several essay questions. These same questions are found in the computerized version of the test item file.

Study Guide

To ensure close coordination with the text, Sylvia Mader has written the *Student Study Guide* that accompanies the text. Each text chapter has a corresponding study guide chapter that includes a listing of objectives, study questions, and a chapter test. Answers to the study questions and the chapter tests are provided to give students immediate feedback.

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

Laboratory Manual

Sylvia Mader has also written the *Laboratory Manual* to accompany *Biology*. With few exceptions, each chapter in the text has 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, if they wish. The 35 laboratory sessions in the manual are designed to further help students appreciate the scientific method and to learn the fundamental concepts of biology and the specific content of each chapter. All exercises have been tested for student interest, preparation time, and feasibility.

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 setting up the laboratory, expected

results for the exercises, and suggested answers to questions in the laboratory manual. It is free to all adopters of the laboratory manual.

Transparencies

A set of 300 full color transparency acetates accompany the text. These acetates contain key illustrations from the text. This set of transparencies is also available as slides.

Visuals Testbank

This testbank contains black-and-white versions of 250 of the illustrations available as transparencies. The labels are deleted and copies can be run off for student quizzing or practice.

Micrograph Slides

This ancillary provides a boxed set of 100 color slides of photomicrographs and electron micrographs in the text.

From WCB/McGraw-Hill

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A Life Science Living Lexicon

by William N. Marchuk, Red Deer College

This portable, inexpensive reference helps introductory-level students quickly master the vocabulary of the life sciences. Not 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

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Life Science Living Lexicon CD-ROM

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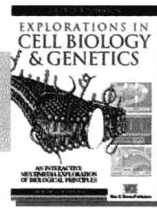
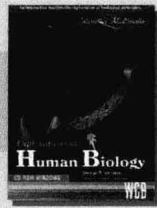
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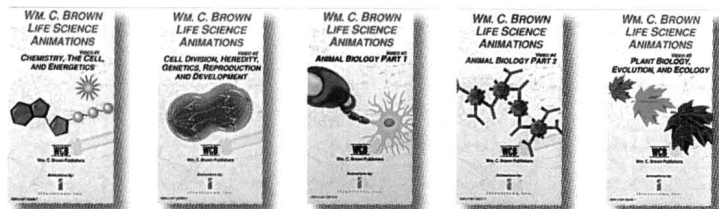
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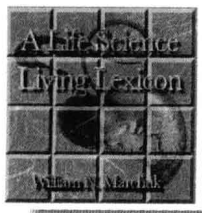
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