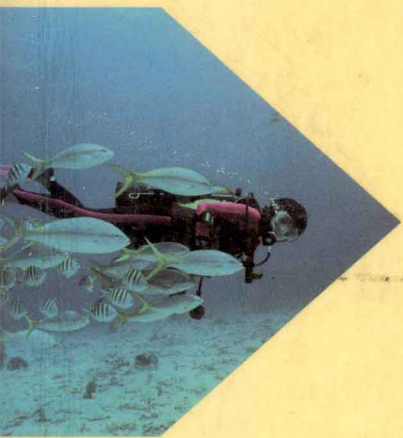




Biology

SANDRA S. GOTTFRIED



Today



Biology Today

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Assistant Professor of Biology and Education
Departments of Biology and Educational Studies
University of Missouri—St. Louis

with 777 illustrations



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Preface

Is human papilloma virus #16 a threat to your health? The answer is on p. 486. Why are anabolic steroids a health risk? Find out on p. 315. How is the AIDS epidemic affecting college students today? If you want to know, see pp. 344-345. If these questions intrigue you, then reading *Biology Today* may be more than a “textbook” experience. These topics and others, such as genetic engineering, the global population crisis, rain forest destruction, and the ozone hole, link the concepts of biology today to the students of today in a context of becoming an informed citizen of the world. Providing students with information that is vital to their health, well-being, and general education, *Biology Today* explores traditional biological content within societal, technological, and personal contexts.

I wrote *Biology Today* for the introductory biology student at a community college or university. Of my 20-plus year career in biology education, I spent 5 years teaching at a community college and have spent the last 4 years teaching introductory students at a university. I feel I am well-aware of my audience and their needs. My training in scientific research, biology, and education and experience as a science writer and teacher enabled me to write this book in a way that truly embodies the philosophy of educating introductory students to become better-informed citizens at personal, local, national, and international levels. To accomplish this task, I first assumed that my audience of students had no prior knowledge of biology. Therefore I used a writing style that is easy and direct, developing concepts within a context of rich description to provide a scaffold for learning and to make concepts more concrete. Today’s introductory students need explanation, not simply a list of vocabulary terms.

In addition, *Biology Today* places traditional biology in a context both relevant and important to the student. This is done in two ways. First, everyday situations or concerns that students have encountered in the media are used as

examples wherever possible. Second, the text has a strong human focus, with the human body serving as the focal point for the physiology section (Part Four, Human Biology: The Structure and Function of the Body). Students are interested in how their bodies function. They also need accurate information about their own physiology to make informed choices about activities that will affect their bodies, such as making decisions regarding birth control and choosing what foods to eat.

In summary, *Biology Today* portrays biology as a process rather than a product, helping students better understand how scientists do their work and develop theories about the natural world. Introductory students need a broad understanding and an appreciation of how the biological world affects their lives. *Biology Today* attempts to fill this need.

Organization

Biology Today is organized into eight parts. Chapters were designed to stand alone so that the professor may use the text in the order in which it was written or in an alternative order. The chapter opening pedagogy provides “Highlights” for each chapter that serve as a “menu” to the chapter content. These Highlights will help professors determine the chapter order that best suits the organization of their course. Page references to concepts previously defined and explained are sprinkled throughout the chapters.

In general, the book is organized in a traditional fashion. Basic biological concepts are presented in the first chapter with chemistry, cell biology, metabolism, physiology, and genetics composing the first five parts of the text. The last three parts present evolution, diversity, and ecology.

Part One

An introduction to biology and chemistry

This part begins with Chapter 1 (The Themes of Biology Today), which provides an overview of the scientific method and an introduction to biological themes such as unity and diversity that are emphasized throughout the book. In addition, other introductory concepts, such as the kingdoms of life, are introduced and explained. Chapter 2 (The Chemistry of Life) presents basic chemistry, with an emphasis on biologically relevant chemical principles.

Part Two

Cells: The basic unit of life

Part Two contains information about all aspects of cells: their basic structure and function (Chapter 3, Cell Structure and Function), the cell membrane and its function (Chapter 4, Cell Membranes), and the processes of mitosis and meiosis (Chapter 5, Cell Division).

Part Three

How living things transform energy

Cellular metabolism is the focus of this unit. A chapter on chemical reactions introduces this unit (Chapter 6, The Flow of Energy within Organisms) and prepares the students to study cellular respiration (Chapter 7, Cellular Respiration: How Cells Release Stored Energy from Food Molecules) and photosynthesis (Chapter 8, Photosynthesis: How Plants Capture and Store Energy from the Sun).

Part Four

Human biology: The structure and function of the body

This unit covers aspects of the structure and function of the human body. The chapters focus on homeostasis and how structure is related to function. The numerous boxed essays in this unit were designed to interest students. Boxes include such relevant issues “How to Avoid Heart Disease” in Chapter 12 (Circulation), “AIDS on the College Campus” in Chapter 13 (Defense Against Disease), and “Solving the Mystery of Alzheimer’s Disease” in Chapter 16 (The Nervous System).

Part Five

How humans reproduce and pass on biological information

This unit covers human reproduction and genetics, beginning with Chapter 20 (Sex and Reproduction) and moving on to Chapter 21 (Human Development Before Birth). Mendelian genetics (Chapter 22, Patterns of Inheritance), human genetics (Chapter 23, Human Genetics), and molecular genetics (Chapter 24, The Molecular Basis of In-

heritance) follow. Again, emphasis is placed on student-oriented information. In this unit, students learn about how they inherited their particular blood type, how color-blindness is passed along in the genes, and how genetic engineering is helping those with diabetes.

Part Six

Evolution: How living things change over time

Current information about evolution is presented in this unit. Chapter 25 (The Scientific Evidence for Evolution) presents the evidence contained in fossils, the geological record, and the molecular record that support the theory of evolution. Chapter 26 (The Evolution of the Five Kingdoms of Life) follows scientists’ thinking as they attempt to construct scenarios of how life began. A separate, complete chapter on human evolution, including vertebrate evolution (Chapter 27), is a hallmark of this section.

Part Seven

The diversity and unity of living things

Structure, function, and evolutionary position of the five kingdoms of life are covered in this unit. The first two chapters describe the Kingdoms Monera, Protista, and Fungi (Chapter 28, viruses, bacteria, and genetic engineering and Chapter 29, protists and fungi). The reproductive patterns of plants are described and followed by their patterns of structure and function (Chapter 30, Plants: Reproductive Patterns and Diversity and Chapter 31, Plants: Patterns of Structure and Function). Chapters on invertebrates (Chapter 32, Invertebrate Animals: Patterns of Structure, Function and Reproduction) and vertebrates (Chapter 33, Vertebrate Animals: Patterns of Structure, Function, and Reproduction) describe patterns of body symmetry, body cavity structure, and embryological development, linking these concepts to the evolutionary history of these animal groups. Characteristics of animal phyla and vertebrate classes are discussed with a comparative approach.

Part Eight

How living things interact with each other and with their environment

These seven chapters discuss the interaction of organisms with the environment. The unit begins with two chapters on animal behavior: Chapter 34 (Innate Behavior and Learning in Animals) and Chapter 35 (Social Behavior in Animals). Chapter 36 (Population Ecology), Chapter 37 (Interactions within Communities of Organisms), and Chapter 38 (Ecosystems) present an overview of ecology. Chapter 39 (Biomes and Life Zones of the World) describes the large climatic areas of the world along with their distinctive plant and animal populations. This chapter includes a discussion of fresh water and saltwater environments. The unit ends with the ecological problems facing the world today in Chapter 40 (The Biosphere: Today and Tomorrow).

Features

Biology Today boasts several pedagogical features that make the book easy to use. Students should find these features a great help when reading their assignments for class and reviewing for exams and quizzes.

Each chapter opens with a short “vignette” that is designed to spark student interest. Sometimes these vignettes explain something that may already be familiar to the student in a context that relates to the chapter material. For example, Chapter 19 (Hormones) opens with a vignette about the dangers of anabolic steroids. Other vignettes focus on unusual phenomena that nevertheless have a biological explanation. Chapter 14 (Excretion) opens with a discussion about why some species of turtles “cry” and how this crying is related to salt and water balance.

In addition to the vignettes, the chapter openers contain a list of chapter “Highlights” that detail in short statements the chapter content. These highlights will help students condense the chapter material and provide a quick review. An “outline” of the chapter accompanies the highlights and also assists students with organizing and segmenting the chapter concepts.

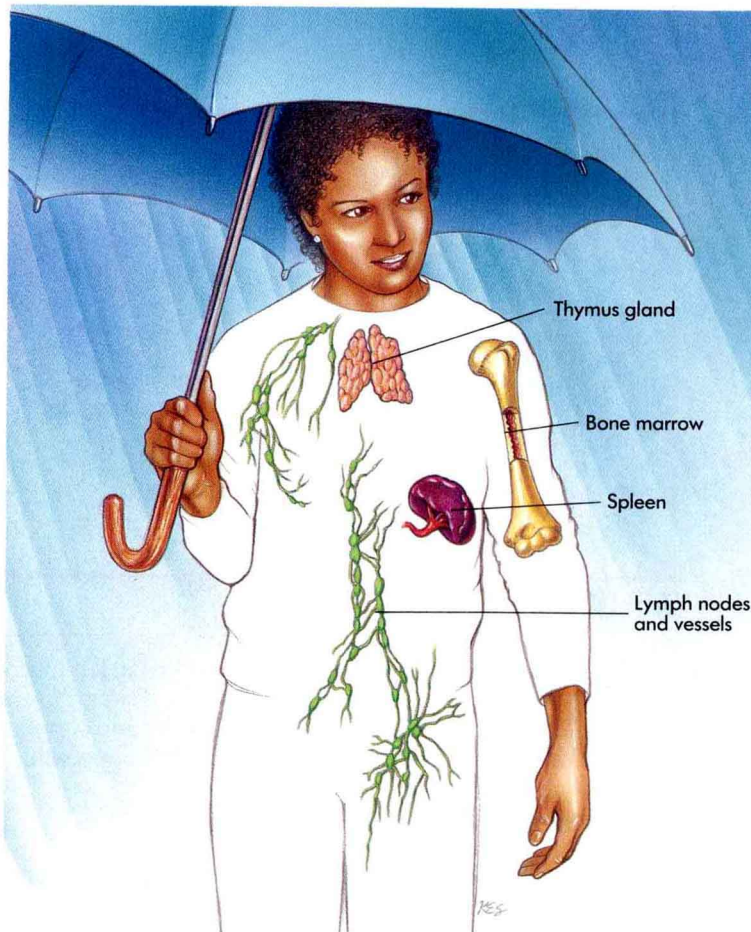
Within each chapter are “Concept summaries” that provide spot summaries at key points in the chapter. They are short (usually no more than three sentences long) and effectively review the preceding material. Students will find them invaluable when reviewing for examinations.

“Boxed essays” are found throughout each chapter. The four themes of the boxed essays were specially designed with our students in mind. The “Biology and You” boxes link biology to students’ everyday lives, highlighting the personal relevance of many biological concepts. “Biology, Technology, and Society” boxes highlight the links among biology, the fast-paced technology of today’s world, and societal issues. “Biology in Focus” describes the work of the scientist in detail, often answering the question, “How do we know that?” And lastly, “Biology and Evolution” boxes emphasize the change of organisms over time and their evolutionary relationships to one another.

Each chapter closes with a “Summary” that lists all the key concepts in the chapter, a list of “Key terms” with the page number on which the term appears, a list of “Review questions” that tests student comprehension of the chapter content, and a few “Thought questions” that are designed to initiate class discussion and debate. Each chapter also has a short list of “Further Readings,” chosen with the introductory student in mind. In addition to the usual *Scientific American* and *Science* articles, there are articles from *Smithsonian*, *National Wildlife*, and *National Geographic*.

Two appendixes provide additional support for the student. Appendix A provides answers to the review questions. Appendix B is a table of classification of the five kingdoms of life. Because of the human focus of this book, animals are classified through class, and the vertebrates are classified through order.

The glossary provides the pronunciation, definition, and derivation for each key term in the book and also gives the page reference for each term. This glossary is complete and easy to use and will help students immeasurably as they make their way through the text.

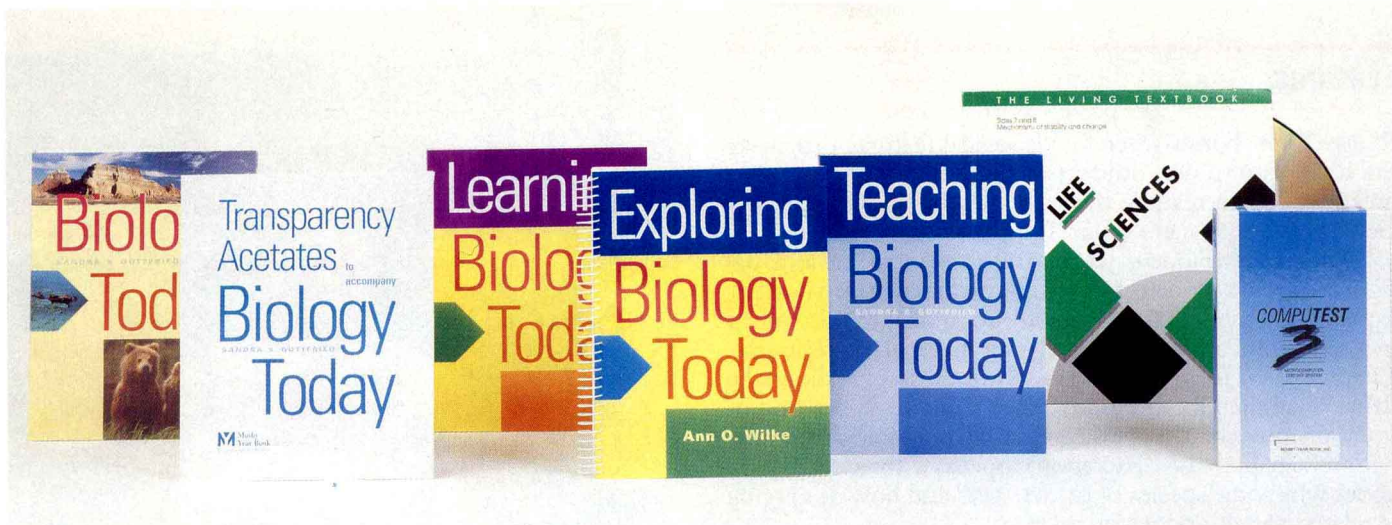


The art program

No biology text today can be a pedagogical success without a top-notch art program. Given the visual orientation of today’s students—the computer graphics that they are bombarded with on television and the special effects that enliven today’s feature films—it makes sense that a biology textbook use visual impact to teach concepts. *Biology Today* accomplishes this task by applying some basic principles to the art program:

- The illustrations and photographs should make abstract concepts more concrete to enhance student understanding.
- The content of text and art should match—there should not be concepts or structures presented in the art that are not discussed in the narrative.
- There should be an emphasis on simple, clear illustrations that teach process using layout and sometimes, for very complex processes, numbered steps.
- Legends should be a helpful guide to the illustration and should not introduce material that is not in the text.
- Art should be visually appealing so that students are prompted to “take a look.”

We have followed these principles to the letter in *Biology Today*, with the result that the art program represents another important focus in the pedagogical program and is an element in itself.



Ancillaries

Biology Today has a full range of ancillary materials that meets the needs of both students and instructors. Carefully designed and executed, the ancillaries supplement and support *Biology Today* and enhance its student-oriented approach.

Instructor's resource manual

For the instructor, *Teaching Biology Today* is an invaluable teaching resource. Written by Dr. Ann Lumsden of Florida State University, each chapter contains a complete synopsis, suggested topics for class discussion, lecture outlines, teaching ideas, and a listing of applicable audiovisual resources. A text bank of over 2000 questions is also included in the manual. In addition, transparency masters of key illustrations in *Biology Today* are included in *Teaching Biology Today* to enhance visual learning.

Computerized test bank

The test questions included in *Teaching Biology Today* are also available as *Computest*, a computerized test generation system. *Computest* is available in MacIntosh and IBM formats. It has many features that make it easy for the instructor to design tests and quizzes. The instructor can browse and select questions for inclusion on an examination using several different criteria, including question type and level of difficulty.

Transparency acetates

Also available for the instructor are 150 full-color transparency acetates that reproduce the important illustrations in *Biology Today*. Labeling is clear, bold, and large enough for even students seated in the back of a large room to see.

Videodisc

Mechanisms of Life: Stability and Change Videodisc is a state-of-the-art instructional medium that combines versatility, compactness, and ease of use. This videodisc contains thou-

sands of still photographs, selected artwork, and film clips on biological processes to provide visual reinforcement in the classroom. Other features include the ability to search and display images or animated sequences and extensive use of full motion along with still images.

Laboratory manual

Exploring Biology Today is a unique laboratory manual written by Ann Wilke, Director of Undergraduate Laboratories at the University of Missouri—St. Louis. This manual responds to the needs of introductory students by guiding both formal and concrete thinkers through a laboratory experience that teaches them biology and how to become more critical thinkers. Based on the learning cycle, each of the 30 2-hour laboratory exercises in *Exploring Biology Today* leads students through their investigation of the biological world using three steps: exploration, in which students develop new understandings by means of hands-on experiences; concept introduction, in which the concepts students explored are articulated and labeled; and concept application, in which the students apply their knowledge and understanding to new situations. *Exploring Biology Today* is accompanied by an instructor's manual that offers support for both the laboratory set-up and the learning cycle approach.

Study guide

The student study guide, *Learning Biology Today*, by Dr. David Cotter of Georgia College, enhances and explores the concepts in the text by building from fact-based knowledge to the use of higher-order thinking skills. In each chapter, students are first tested for their mastery of basic concepts. Subsequent sections then test for deeper understanding of the chapter concepts, with the last section stressing application of these concepts to new situations. This "building block" approach facilitates the critical thinking necessary to solve problems using knowledge acquired from the text, without short-changing the straightforward learning of new concepts and ideas.

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The reviewers of *Biology Today* provided countless suggestions that enhanced the quality of this textbook and ensured its accuracy. Their names are listed and to each one I extend a personal "Thank you." I would like to give special thanks to my colleagues at the University of Missouri—St. Louis who were always available to review manuscript pages and provide instant feedback: Ed Joern, Randy Nolan, Carl Thurman (now at the University of Northern Iowa), and Ann Wilke.

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This book is dedicated to my parents, Evo and Florence Sebastianelli of Farmington, Connecticut, and to my son, Marc Gottfried of St. Louis, Missouri.

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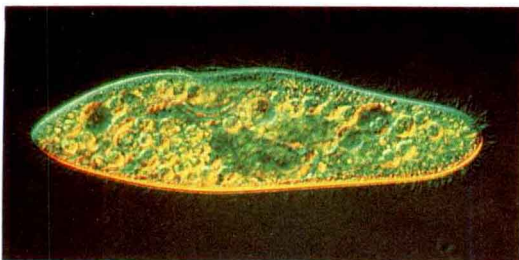
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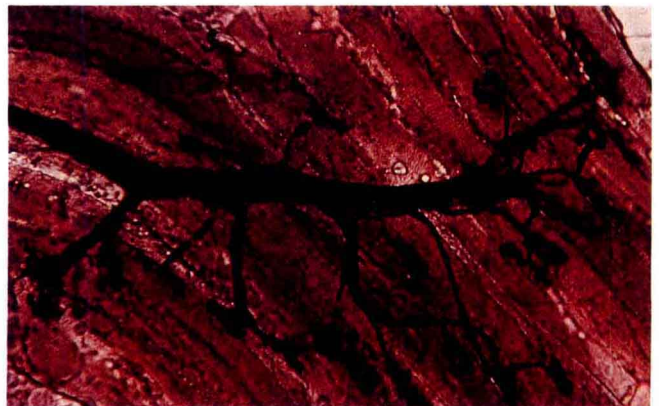
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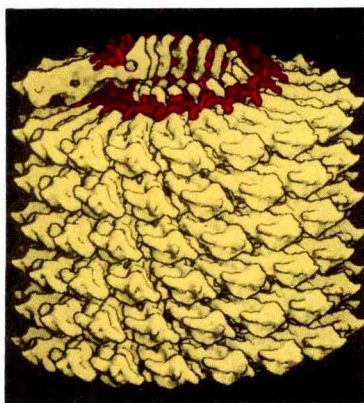
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