

BIOLOGY TODAY

An Issues Approach

Third Edition

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ELI C. MINKOFF · PAMELA J. BAKER

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Preface

Our book takes an issues-oriented approach to the teaching of biology, one that covers all of the major biological concepts. Our approach aims to educate citizens, biologists and nonbiologists alike, with an understanding that will enable them to evaluate scientific arguments and make informed decisions affecting their own lives and the well-being of society. We are committed to teaching science as a human activity that impinges upon other aspects of society and gives rise to social issues that require discussion. Individuals are increasingly called upon to deal with science-based issues throughout their lives. Each of us makes food choices daily and medical decisions nearly as often. DNA evidence is used more and more in solving crimes and in predicting susceptibility to disease. Stem cell technologies confront us with real possibilities only imagined a few years ago. Our waste disposal habits affect the environment in which we live, and our transportation and manufacturing choices affect the very air we breathe. Citizens, legislators, juries, and corporate managers need to make important decisions, affecting many lives, based in part on the findings of science. Everyone needs to be aware of science, the way that scientists work, and how science can be used and misused.

The issues themselves are not our focus, however; instead, they form a context in which to teach basic biology. This is very different from teaching the biology specific to a particular issue, which often leaves students thinking that the biological concept applies only to that case. Some other texts are now using current issues, but our approach is unique because in our text the issues are central to the pedagogy, not “add-ons” presented as case studies or in side-bars, boxes or separate pamphlets. Consequently, we have selected issues that are not only of current importance, but that also lend themselves as vehicles for teaching the major concepts of biology. For example, we use the chapter on the population explosion as a vehicle to teach the biology of reproduction; also osmosis and photosynthesis are covered in a chapter called Plants to Feed the World. Wherever possible, we have presented a concept in more than one part of the book, developing the concept in more than one context. Prokaryotic biology and asexual reproduction, for example, are introduced in a chapter called Classifying Nature and then are further developed in a new chapter called New Infectious Threats.

Years ago, a group of educators called the Biological Sciences Curriculum Study developed a list of key concepts in biology. Each of these concepts is covered in our book. In the years since the Biological Sciences Curriculum Study list was developed, biology itself has evolved, so we have added new concepts as they have risen in importance (see our Web site under Resources: Key biological concepts, for both the list of concepts and where they are covered). In this third edition, we have brought the text up-to-date by expanding certain topics and adding new concepts. Three new chapters have been added. Chapter 4, Genomics and Genetic Engineering, covers concepts flowing from the Human Genome Project, including genomics, proteomics and bioinformatics. Chapter 17, New Infectious Threats, discusses the microbiology and ecology of emerging infections and the issue of bioterrorism. Chapter 19, Protecting the Biosphere, covers the continuing evolution of our atmosphere and the effects of acid rain, ozone depletion and global warming.

Other chapters have been reorganized to incorporate new concepts. Evolution and Classification are now covered in separate chapters and we have expanded the discussion of each. Intelligent design is now included in Chapter 5, and Chapter 6 now includes cladistics, comparative genomics, and other taxonomic methods, as well as the three-domain classification system. We have expanded the section on reproductive anatomy and physiology as well as reproductive technologies in Chapter 9, and, obesity as well as cellular respiration is

covered in Chapter 10. Stem cells and cloning are added to Chapter 12 as are the ethical considerations surrounding these controversial topics. A greater emphasis on the diversity of sensory systems in various animals is found in Chapter 13 and the human effects on biomes are detailed in Chapter 18.

The issues have also been adjusted to stay current. Students (especially those not majoring in biology) are more likely to be interested in and develop an understanding of material if it is meaningfully related to issues of concern to them, and these change over time. Infectious diseases are much in the news, and these form the basis for the new Chapter 17. More on obesity and on newly recognized micronutrients have been added to Chapter 10. For issues of continuing interest, such as AIDS or cancer or drugs, we have incorporated the latest statistics as well as the latest biological advances. We recognize that the average undergraduate student is now older than twenty-two; therefore, we have picked issues with a wide age-appeal. We have also attempted to use geographically diverse examples. We know our readers, regardless of where they attend college, are from around the world. By the combination of text and Thought Questions, we encourage students to think beyond themselves, both globally and locally.

In addition to its real-life appeal, the issues approach allows for a more comprehensive view of biology. As a discipline biology has become fragmented to the extent that different perspectives on the same problem, for example, molecular perspectives and environmental perspectives, are often taught in separate courses with no reference to each other. The current understanding of each issue is covered from different perspectives, which often include cellular and molecular perspectives, organismal or individual perspectives, and global or population perspectives, combined as appropriate. Our approach accordingly helps students to experience the interdisciplinary nature of today's biology. Each chapter ends with a section called "Connections to Other Chapters" that further emphasizes this point.

Our approach also examines the intimate connections between biological and social issues. We have chosen to teach 'facts' in a context that emphasizes how they are produced, organized, and used to solve problems. Other books often expose students to the results of biology without gaining understanding of biology as a process of discovery. Instead, we hope to instill in students an understanding and appreciation of this process. To help students, we have presented multiple interpretations or points of view as much as possible. Societal and ethical issues are mentioned wherever relevant, and part of the initial chapter is devoted to an examination of ethical principles. We encourage teachers to set aside time for class discussions to further stimulate student thought, or for students to set up such discussions among themselves informally. With *Biology Today* we aim to stimulate critical thinking and questioning rather than memorization. Thought Questions, suitable for class discussions are provided at the end of each section, and, in this new edition, new Thought Questions have been added.

As *Biology Today* goes into its third edition, we have continued to benefit from the input of many people in producing a book that remains scientifically accurate and is optimally organized for student understanding. We would like to take this opportunity to thank the many people who reviewed portions of our text and provided us with helpful suggestions. In alphabetical order; they were: Lee Abrahamsen, Bates College; Paul Biersuck, Nassau Community College; Robert Benda, Prince William Sound Community College; Virginia L. Bliss, Framingham State College; Neil Buckley, SUNY Plattsburgh; Craig Coleman, Brigham Young University; Patricia Flower, University of San Diego; Wendy Jean Garrison, University of Mississippi; Denis Goulet, University of Mississippi; Tamar L. Goulet, University of Mississippi; Eric G. Haenni, Hendrix College; Heidi Hawkins, College of Southern Idaho; Joseph Hawkins, College of Southern Idaho; Bernard Hauser, University of Florida; Pat Hauslein, St. Cloud State University; Melissa Ishler, Mansfield University; Eric Jellen, Brigham Young University; Walter Johnson, Merritt College; Charles D. Kay, Wofford College; Nancy Kleckner, Bates College; Michael E. Kovach, Baldwin-Wallace College; Glen Lawson, Bates College; Mary Lehman, Longwood College; Marilyn Mathis, Howard

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Eli C. Minkoff
Pamela J. Baker

Biology Today Web Site

Biology Today offers two complementary Web sites that serve as a complete teaching and learning resource—an essential supplement to an issues-oriented biology course.

Where the Web site icon is featured in the book, students are encouraged to go to the *Biology Today* Web site to find additional content. We have indicated the names of these resources in the text itself and each resource is organized by chapter on the Web site. Also organized by chapter are notes and outlines, and a selection of ethical discussion topics. These are completely new to this edition, and designed to invite in-class discussions. In addition, you can find a bibliography, the glossary, a table of biological concepts, a list of useful Web links and sample term papers. Please visit this Web site at:

<http://www.garlandscience.com/biologytoday>

The Garland Science Classwire Web site offers extensive instructional resources. In addition to containing all materials on the first site, it provides a testbank, and curriculum advice and assistance for those teaching an issues-oriented biology course for the first time. It also contains a sample syllabus, advice about laboratory manuals, and all the answers to the practice questions from the textbook. All the images from the textbook are also available in a downloadable, Web-ready, as well as Power Point-ready, format. Instructors can choose whether they wish to make these resources available to students.

Garland Science Classwire also does much more than offer supplementary teaching resources. It is a flexible and easy to use course management tool that allows instructors to build Web sites for their classes. It offers features such as a syllabus builder, a course calendar, a message center, a course planner, virtual office hours and a resource manager. No programming or technical skills are needed. Garland Science Classwire is offered free of charge to all instructors who adopt *Biology Today* for their course. Resources for all other Garland textbooks are also available.

Please visit Garland Science Classwire at:

<http://www.classwire.com/garlandscience>

About the Book

This third edition of *Biology Today* has undergone considerable revision and reorganization. The basic biology content has been expanded on several topics while current issues and recent science have been both expanded and updated.

Here is an overview of the study aids and features included in this edition. Each chapter opens with a page containing three lists: Issues, Biological Concepts and a Chapter Outline.

Issues: Every chapter raises a number of critical issues, and asks the student to consider a number of important, pivotal questions. These are presented as a bulleted list. Most will be of personal interest to the students regardless of their age. They encourage students to think beyond themselves and to consider their place in the world. Most are issues that students will have encountered in the news. By raising questions, we prompt students to think beyond what they have seen or heard in the news, to question how and by whom “facts” are produced, and to recognize when information is incomplete. These underlying questions are linked with other critical thinking sections within the chapter; thought questions, and the linkage is indicated by the “perspectives” icon.

Biological Concepts: Our main purpose is to cover key biological concepts. This list summarizes the biology that is covered within the chapter. The list is nested so that it can serve as a concept map to guide student’s analysis. For example in Chapter 8, one of the entries on the list is: Population ecology (populations, regulating population size). The Biological Concepts headings are taken primarily from the lists of key biological concepts developed by the Biological Sciences Curriculum Study. A complete table of the biological concepts recommended by this group as being key to a basic understanding of biology can be found on our Web site (under Resources: Key biological concepts). This table is fully cross-referenced to indicate where the material is covered in the book. As can be seen by reference to this table, all of the concepts are covered somewhere in the book, and many are covered in more than one context.

Chapter Outline: Chapters begin with an outline listing the first and second level section headings. The first level section headings are sentences stating the main theme of that section. The second level headings are short summary phrases of the main content topic of that section. Thus, these section headings can serve as a study guide for the student to the biological and issue-related content covered within the chapter.

Opening Narrative: The opening narrative scenario immediately introduces the science covered in the chapter by placing it within an interesting and relevant societal context.

Thought Questions: Sets of thought questions appear at the end of each chapter section. They are linked to the

chapter opening issues list by the perspectives icon. Although a few thought questions have factual ‘right’ answers, most do not. Some questions require students to do further reading and many encourage students to think about the limitations of available data or the applications and implications of science. We encourage students with differing viewpoints to discuss these questions among themselves and to ask, “What further information would help us resolve our differences or reach decisions?” These questions can form the basis for discussion either in class or in informal study groups.

Illustrations: Since many of the concepts of biology can be understood and remembered visually, the book is well illustrated with photographs and drawings. Many of the illustrations are new since the second edition and many are visually simplified. The captions to these illustrations often provide another important avenue to understanding. All figures from the book are available on *Art of Biology Today* CD-ROM in two convenient formats: PowerPoint and JPEG. In addition, they are available on our Classwire Web site.

Tables: Throughout the book are numerous tables; these summarize important sections of text or provide specific examples. Several new summary tables are included.

Boxes: Interspersed throughout the text are boxes some of which supplement the text while others review key principles.

Important Vocabulary: Important vocabulary is highlighted in bold type in the text. Each of these terms is defined in the glossary at the end of the book and on our Web site. The terms that are most important conceptually are used in sentences at the end of each chapter in the chapter summary.

Chapter Summary: A bulleted list of the most important ideas from the chapter, with the key vocabulary in bold. This format is useful as a study guide.

Connections to Other Chapters: *Biology Today* aims for an integrated view of biology. The connections section at the end of each chapter helps reinforce this integrated view, with related material presented in different contexts at other places in the text. In addition, “connections” icons placed throughout the book indicate cross-references to different contexts for the same content. Pedagogically this serves to discourage students from compartmentalizing their new knowledge, developing the critical thinking level of generalizing concepts from a variety of contexts.

Practice Questions: Learning biological concepts still requires some memorization of the facts. End-of-chapter practice questions are review questions for students to answer.

Glossary: Each of the bolded terms is defined in an alphabetically arranged glossary at the end of the book and on the *Biology Today* Web site.

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