

BIOLOGY

Science for Life

Colleen Belk

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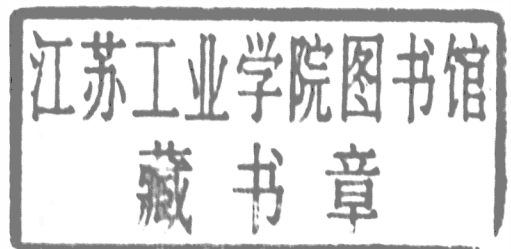
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Supporting Science for Life

For the Student

The goal of the student resource package is to provide opportunities to exercise scientific reasoning skills and apply biological knowledge to real problems. The items listed here offer students many tools for review that are compatible with a wide variety of learning styles.

Student Companion Web Site (www.prenhall.com/belk)

The Student Companion Web Site to *Biology: Science for Life* provides students with the opportunity to review biological concepts and practice problem-solving skills. The focus of the questions and activities is on application, critical thinking, problem solving, analysis, and synthesis. All of the questions and activities provide students with valuable feedback in the form of hints and coaching that identify their areas of weakness and provide them with guidance on how to improve and where to find additional information about these areas. The Student Companion Web Site features:

- **Chapter Outlines:** Available on the Web site, this feature provides a brief overview of the book's chapter contents and major concepts addressed.
- **Learning Objectives:** These objectives address what the students should be able to understand after reading and completing the activities for each chapter.
- **Media Activities:** These activities offer students a visual view of concepts and test their knowledge using a wide variety of activities integrated into each chapter.

Animations: These activities demonstrate dynamic concepts and processes to better show changes over time and complex interactions. Each animation is followed by interactive activities designed to help students achieve mastery of chapter-specific learning objectives.

Explore the Issue and Explore the Science: These activities offer in-depth exploration of each chapter's major issue and scientific concepts through Web sites, articles, and essay questions. Each activity reinforces the student's need to apply biological knowledge and scientific reasoning to real-world issues.

- **Self Test:** The self-test questions allow students to test both their mastery of the major concepts in the

chapter as well as their understanding of the connections these biological concepts have to their lives. Divided into two different types—Analyzing and Applying the Basics, and Connecting the Science—these questions contain helpful hints and coaching that provide students with valuable feedback to help focus their time most effectively.

- **Essay Challenge:** These high-level essay questions focus on Analyzing and Applying the Basics, and Connecting the Science. Hints and suggested answers accompany every question.
- **Issues Update:** This tool links to on-line articles and Web sites that address the major issues and science introduced in a chapter. Links are updated each semester to keep current with recent research and writings.
- **Research Navigator:** This tool equips students with the means to start a research assignment or research paper or to access full text articles. It is complete with extensive help on the research process and three exclusive databases of credible and reliable source material, including the EBSCO Academic Journal and Abstract Database, *The New York Times* Search by Subject Archive, and "Best of the Web" Link Library, Research Navigator™, and enables students to efficiently and effectively make the most of their research time and stay up-to-date on the issues.
- **Science Skills:** This resource features Chemistry and Math Review to help students recap basic knowledge in these areas. It also provides an extensive collection of links and articles on evaluating information and avoiding misinformation.
- **Student Study Tips:** This tool offers extensive resources on how to prepare for tests, get the most out of lectures, and make the best use of study time.

Student Study Guide (0-13141505-0)

The Student Study Guide serves as the print version of many of the resources found on the Student Companion Web Site, including chapter outlines, learning objectives, self tests, Essay Challenge, Explore the Science, and Explore the Issues. For the student who is always on the go, this guide offers a portable alternative to our media resources.

Laboratory Program

***Biology: Science for Life* Laboratory Manual**

This inquiry-driven laboratory manual, designed specifically for the non-science major, reinforces and extends the key biological concepts from *Biology: Science for Life*. These fifteen exercises take a process-oriented approach and often lead to open-ended results. As with the text, the laboratory exercises are connected to compelling stories and provide instructors with an excellent springboard for discussion on the role of biological research in contemporary society.

Symbiosis: The Prentice Hall Custom Laboratory Program for Biology ([www.pearsoncustom.com/ database/symbiosis/ph.com](http://www.pearsoncustom.com/database/symbiosis/ph.com))

With *Symbiosis: The Prentice Hall Custom Laboratory Program for Biology*, instructors can select from a wide variety of biology, microbiology, or anatomy and physiology labs to build a custom lab manual that exactly matches their content needs and course organization. By visiting the Web site, instructors can select from an extensive list of Prentice Hall laboratory publications or from Pearson Custom Publishing's established library of biology labs. Using the tools provided in our *Lab Ordering and Authoring Kit*, instructors have the ability to develop the best possible lab manual for their courses.

Print and Media Resources

For the Instructor

The goal of the instructor's resource package is to provide you with a valuable source of ideas and resources to enrich your instruction and assessment efforts. The items listed here serve not only as a source of images, questions, and activities but as a springboard for your own ideas.

Instructor's Resource CD-ROM (0-13141021-0) and Instructor's Resource Library (www.prenhall.com/belk)

The Instructor's Resource CD-ROM and the Instructor's Resource Library provide a fully searchable and integrated collection of resources (available in two locations) to help you make efficient and effective use of your lecture preparation time, as well as to enhance your classroom presentations and assessment efforts. In short, you have everything you need at your fingertips. Both resources feature:

- *Presentation Gallery*: Designed to make the preparation of your lecture presentation faster and easier. Presentation resources include over 1000 jpeg files of illustrations, tables, and photos from the text; PowerPoint slides with all labeled and unlabeled images embedded; and animations of major concepts in .swf and .mov format.
- *Assessment Gallery*: Contains a wealth of new ideas to help you determine your students' level of understanding throughout the course. This reservoir of ideas and resources includes projects, group and collaborative activities, discussion topics and questions, demonstrations, worksheets, and a test bank complete with two types of questions for each chapter: Analyzing and Applying the Basics and Connecting the Science. All are in easy-to-use, editable Word documents.
- *Course Management Resources Gallery*: Supplies WebCT- and BlackBoard-ready resources to help you manage your course. These resources are easy to incorporate into any existing course or can be

used to construct a new one. In addition, a prepared Prentice Hall CourseCompass management system is available with flexible customization.

- *Research Navigator™*: Another powerful tool designed to make your lecture and assessment preparation easier. Research Navigator includes three extensive databases of credible and reliable source material including EBSCO Academic Journal and Abstract Database, *The New York Times* Search by Subject Archive, and "Best of the Web" Link Library.
- *Student Study Gallery*: Provides all of the questions and activities found on the Student Companion Web site and in the Student Study Guide as editable Word documents. This resource allows you access to the review materials available to students.
- *Search Engine*: A tool that lets you find relevant resources via a number of different parameters, such as key terms, learning objectives, figure number, and resource type (e.g., Media Activities).

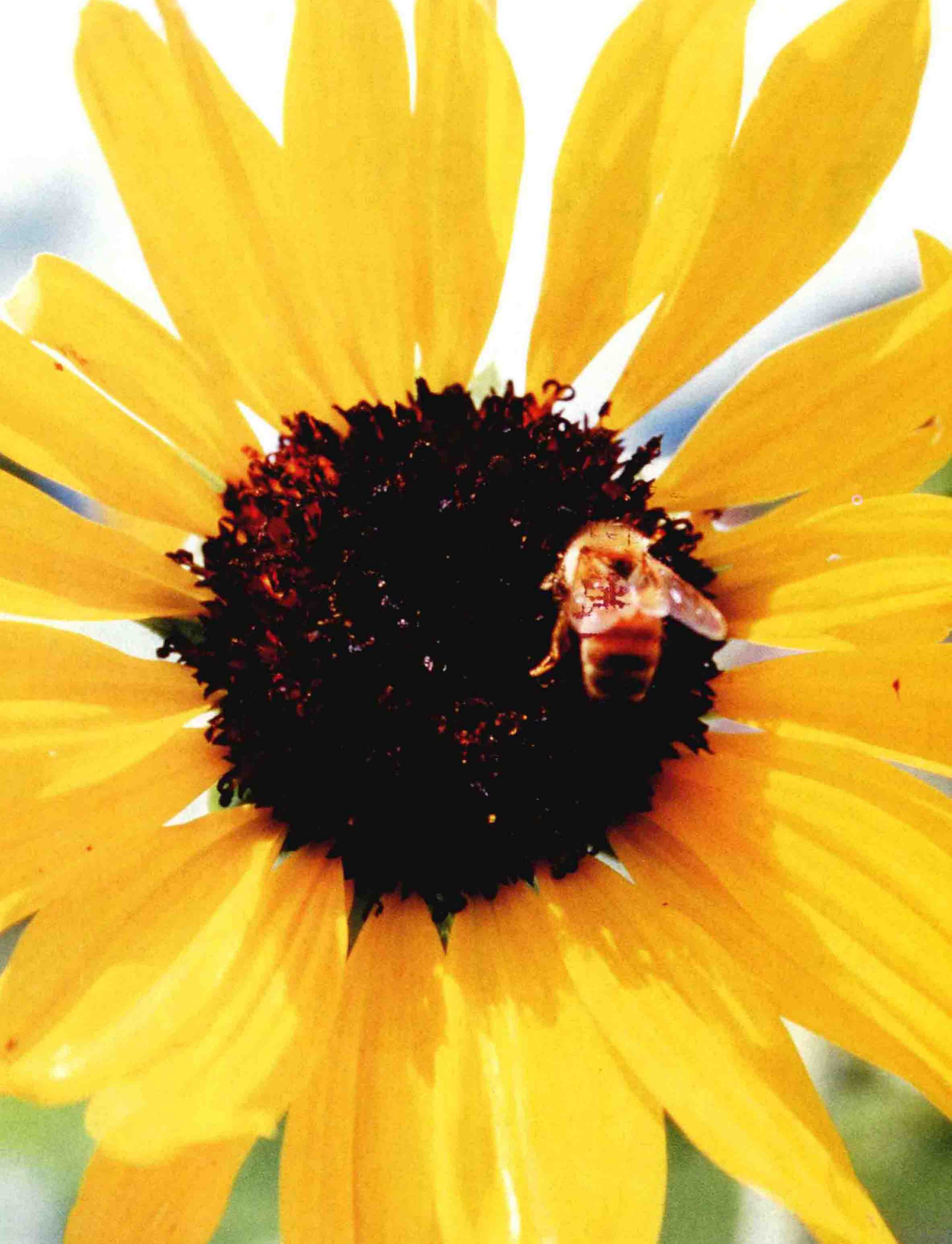
Instructor's Resource Guide (0-13141022-9)

The printed Instructor's Resource Guide offers a portable alternative to the resources on the Instructor's Resource CD-ROM and the Instructor's Resource Library. It includes assessment ideas and resources ranging from discussion questions, to demonstrations, to group and collaborative activities. The Instructor's Resource Guide also features a list of the digital resources available with *Biology: Science for Life*.

Transparency Pack (0-13141025-3)

Even in this digital age, transparencies are still an efficient and effective way to visually reinforce your lecture. The pack includes 250 four-color transparencies that have been selected from the text, including all of the illustrations, and have been enlarged for large lecture-hall viewing. These images enhance your classroom presentations with enlarged labels and increased color saturation.

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“Because science,

*told as a story, can intrigue and inform the
non-scientific minds among us, it has the
potential to bridge the two cultures into
which civilization is split—the sciences
and the humanities. For educators, stories
are an exciting way to draw young minds
into the scientific culture.”*

E. O. Wilson

Preface

To the Student

As you worked your way through high school, or otherwise worked to prepare yourself for college, you were probably unaware that an information explosion was taking place in the field of biology. This explosion, brought on by advances in biotechnology and communicated by faster, more powerful computers, has allowed scientists to gather data more quickly and disseminate data to colleagues in the global scientific community with the click of a mouse. Every discipline of biology has benefited from these advances, and today's scientists collectively know more than any individual could ever hope to understand.

Paradoxically, as it becomes more and more difficult to synthesize huge amounts of information from disparate disciplines within the broad field of biology, it becomes more vital that we do so. The very same technologies that led to the information boom, coupled with expanding human populations, present us with complex ethical questions. These questions include whether or not it is acceptable to clone humans, when human life begins and ends, who owns living organisms, what our responsibilities toward endangered species are, and many more. No amount of conceptual understanding alone will provide satisfactory answers to these questions. Addressing these kinds of questions requires the development of a scientific literacy that surpasses the rote memorization of facts. To make decisions that are individually, socially, and ecologically responsible, you must not only understand some fundamental principles of biology but also be able to use this knowledge as a tool to help you analyze ethical and moral issues involving biology.

To help you understand biology and apply your knowledge to an ever-expanding suite of issues, we have structured each chapter of *Biology: Science for Life* around a compelling story in which biology plays an integral role. Through the story you will not only learn the relevant biological principles but you will also see how science can be used to help answer complex questions. As you learn to apply the strategies modeled by the text, you will begin developing your critical thinking skills.

By the time you have read the last chapter, you should have a clear understanding of many important biological principles. You will also be able to think like a scientist and critically evaluate which information is most reliable instead of simply accepting all the information you read in the paper or hear on the radio or television. Even though you may not be planning to be a practicing biologist, well-developed critical thinking skills will enable you to make decisions that affect your own life, such as whether or not to take nutritional supplements, and decisions that affect the lives of others, such as whether or not to believe the DNA evidence presented to you as a juror in a criminal case.

It is our sincere hope that understanding how biology applies to important personal, social, and ecological issues will convince you to stay informed about such issues. On the job, in your community, at the doctor's office, in the voting booth, and at home reading the paper, your knowledge of the basic biology underlying so many of the challenges that we as individuals and as a society face will enable you to make well-informed decisions for your home, your nation, and your world.

To the Instructor



Colleen Belk and Virginia Borden have collaborated on teaching the nonmajors biology course at the University of Minnesota–Duluth for over a decade. This collaboration has been enhanced by their differing but complementary areas of expertise. In addition to the nonmajors course, Colleen Belk teaches General Biology for majors, Genetics, Cell Biology, and Molecular Biology courses. Virginia Borden teaches General Biology for majors, Evolutionary Biology, Plant Biology, Ecology, and Conservation Biology courses.

After several somewhat painful attempts at teaching all of biology in a single semester, the two authors came to the conclusion that this strategy was not effective. They realized that their students were more engaged when they understood how biology directly affected their lives. Colleen and Virginia began to structure their lectures around stories they knew would interest students. When they began letting the story drive the science, they immediately noticed a difference in student interest, energy, and willingness to work harder at learning biology. Not only has this approach increased student understanding, it has increased the authors' enjoyment in teaching the course—presenting students with fascinating stories infused with biological concepts is simply a lot more fun. This approach served to invigorate their teaching. Knowing that their students are learning the biology that they will need now and in the future gives the authors a deep and abiding satisfaction.

By now you are probably all too aware that teaching nonmajor students is very different from teaching biology majors. You know that most of these students will never take another formal biology course, therefore your course may be the last chance for these students to see the relevance of science in their everyday lives and the last chance to appreciate how biology is woven throughout the fabric of their lives. You recognize the importance of engaging these students because you know that these students will one day be voting on issues of scientific importance, holding positions of power in the community, serving on juries, and making healthcare decisions for themselves and their families. You know that your students' lives will be enhanced if they have a thorough grounding in basic biological principles and scientific literacy.

Themes in *Science for Life*

Helping nonmajors to appreciate the importance of learning biology is a difficult job. We have experienced the struggle to actively engage students in lectures and to raise their scientific literacy and critical thinking skills, and it seems that we were not alone. When we asked instructors from around the country what challenges they faced while teaching the nonmajors introductory biology course, they echoed our concerns. This book was written to help you meet these challenges.

The Story Drives the Science. We have found that students are much more likely to be engaged in the learning process when the textbook and lectures capitalize on their natural curiosity. This text accomplishes this by using a story to drive the science in every chapter. Students get caught up in the story and become interested in learning the biology so they can see how the story is resolved. This approach allows us to cover the key areas of biology, including the unity and diversity of life, cell structure and function, classical and molecular genetics, evolution, and ecology, in a manner that makes students want to learn. Not only do students want to learn, this approach allows students to both connect the science to their everyday lives and integrate the principles and concepts for later application to other situations. This approach will give you flexibility in teaching and will support you in developing students' critical thinking skills.

The Process of Science. This book also uses another novel approach in the way that the process of science is modeled. The first chapter is dedicated to the scientific method and hypothesis testing, and each subsequent chapter weaves the scientific method and hypothesis testing throughout the story. The development of students' critical thinking skills is thus reinforced for the duration of the course. Students will see that the application of the scientific method is often the best way to answer questions raised in the story. This practice not only allows students to develop their critical thinking skills but, as they begin to think like scientists, helps them understand why and how scientists do what they do.

Integration of Evolution. Another aspect of *Biology: Science for Life* that sets it apart from many other texts is the manner in which evolutionary principles are integrated throughout the text. The role of evolutionary processes is highlighted in every chapter, even when the chapter is not specifically focussed on an evolutionary question. For example, when discussing infectious diseases, the evolution of antibiotic-resistant strains of bacteria is addressed. With evolution serving as an overarching theme, students are better able to see that all of life is connected through this process.

Pedagogical Elements

Open the book and flip through a few pages and you will see some of the most inviting, lively, and informative illustrations you have ever seen in a biology text. The illustrations are inviting because they have a warm, hand-drawn quality that is clean and uncluttered. The liveliness of the illustrations is accomplished with vivid colors, three-dimensionality, and playful compositions. Most importantly, the illustrations are informative, not only because they were carefully crafted to enhance concepts in the text but also because they employ techniques like the "pointer" that help draw the students' attention to the important part of the figure (see page 3). Likewise, tables are more than just tools for organizing information; they are illustrated to provide attractive, easy references for the student. We hope that the welcoming nature of the art and tables in this text will encourage nonmajors to explore instead of being overwhelmed before they even get started.

In addition to lively illustrations, this text also strives to engage the non-major student through the use of analogies. For example, the process of translation is likened to baking a cake, and the heterozygote advantage is likened to the advantage conferred by having more than one pair of shoes (see pages 166 and 381). These clever illustrations are peppered throughout the text.

Students can reinforce and assess what they are learning in the classroom by reading the chapter, studying the figures, reviewing the key terms, and answering the end-of-chapter questions. We have written these questions in every format likely to be used by an instructor during an exam so that students have practice answering many different types of questions. We have also included “Connecting the Science” questions that would be appropriate for essay exams, class discussions, or use as topics for term papers.

Supplements

Development of the supplements package that accompanies *Biology: Science for Life* began several years ago. A group of talented and dedicated biology educators teamed up with us to build a set of resources that equip nonmajors with the tools to achieve scientific literacy that will allow them to make informed decisions about the biological issues that affect them daily. In each chapter, a variety of resources are tightly integrated with the text through specific chapter learning objectives. The student resources offer opportunities to exercise scientific reasoning skills and to apply biological knowledge to real problems and issues within the framework of these learning objectives. The instructor resources provide a valuable source of ideas for educators to enrich their instruction and assessment efforts. Available in print and media formats, the *Biology: Science for Life* resources are easy to navigate and support a variety of learning and teaching styles.

We believe you will find that the design and format of this text and its supplements will help you meet the challenge of helping students both succeed in your course and develop science skills—for life.

Acknowledgments

The Reviewers

Each chapter of this book was thoroughly reviewed several times as it moved through the development process. Reviewers were chosen on the basis of their demonstrated talent and dedication in the classroom. Many of these reviewers were already trying various approaches to actively engage students in lectures, and to raise the scientific literacy and critical thinking skills among their students. Their passion for teaching and commitment to their students was evident throughout this process. These devoted individuals scrupulously checked each chapter for scientific accuracy, readability, and coverage level. In addition to general reviewers, we also had a team of expert reviewers evaluate individual chapters to ensure that the content was accurate and that all the necessary concepts were included.

All of these reviewers provided thoughtful, insightful feedback, which improved the text significantly. Their efforts reflect their deep commitment to teaching nonmajors and improving the scientific literacy of all students. We are very thankful for their contributions to *Biology: Science for Life*.

Karen Aguirre	Clarkson University
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Mary Ashley	University of Chicago
Thomas Balgooyen	San Jose State University
Donna Becker	Northern Michigan University
Lesley Blair	Oregon State University
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Supplement Authors

Print and media supplements were prepared by a very creative, energetic, and fun team of nonmajors biology instructors from colleges and universities across the country. Early in the development process we attended a workshop with them in Cambridge, Massachusetts, to discuss the goals of the supplements. We had a great time working with this good-natured group. It was a joy spending time with people who care so much about their students. This very productive workshop led to a truly collaborative effort to address the needs of the instructors and students—their contributions energized the project tremendously. As a result, students will see dynamic animations of many complex processes and will have the opportunity to practice newly learned skills. The work of these instructors helped ensure that the supplements were reinforcing the chapter learning objectives. We cannot thank them enough.

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Michael Rutledge	Middle Tennessee State University

The Book Team

When we set out to write this book, we would not have predicted that we would so thoroughly enjoy the experience. Our enjoyment stems directly from the enthusiasm and talent of the Prentice Hall team. It has been an honor to work with all of these talented, dedicated people.

The book team came together due to the efforts of our editor Teresa R. Chung. Teresa is a woman of tremendous vision, insight, integrity, humor, energy, and style. She has guided every aspect of this project from its inception to its delivery. It was heartening to be in such capable hands and to be