

Preface

To the Student

As you attended your classes in 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 it 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 challenging 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 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 knowledge 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 with Physiology* around a compelling story in which biology plays an integral role. Through the story you not only will learn the relevant biological principles but also will 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 finish this book, you should have a clear understanding of many important biological principles. You will also be able to critically evaluate which information is most reliable instead of simply accepting all the information you hear or read about. 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 to take nutritional supplements, and decisions that affect the lives of others,

such as whether 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 watching the news or surfing the web, 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

By now you are probably all too aware that teaching non-majors 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 health care 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. To help your efforts toward this end, this text is structured around several themes.

Themes Throughout *Biology: Science for Life with Physiology*

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 basic chemistry, 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, but also this approach allows students both to connect the science to their everyday lives and to integrate the principles and concepts for

later application to other situations. The story 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 also, 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 with Physiology* 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 focused on an evolutionary question. For example, when discussing infectious diseases, the evolution of antibiotic-resistant strains of bacteria is addressed. The physiology unit includes an essay on evolution in each chapter. These essays illustrate the importance of natural selection in the development of various organs and organ systems across a wide range of organisms. 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. Most important, 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 p. 14). 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 ideas and concepts instead of being overwhelmed before they even get started.

In addition to lively illustrations of conventional biology concepts, this text also uses analogies to help students understand difficult topics. For example, the process of

translation is likened to baking a cake (see p. 199). These analogies and 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, 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 in 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.

In an effort to accommodate the wide range of teaching and learning styles of those using our book, each chapter includes a section entitled **A Closer Look**. Preceding each A Closer Look section is a general overview of the topic sufficient to provide nonmajors students with a basic understanding. A Closer Look then provides details that add depth to this understanding. This feature provides instructors with teaching flexibility; for example, some instructors are satisfied with a general overview of cellular respiration, including the reactants and products, and similar basics of metabolism. Others want to teach electron transport and oxidative phosphorylation. **Our format** facilitates both approaches; one can use the overview only or the overview and the Closer Look section. The Closer Look section is differentiated from the rest of the text, making it easy to include or omit from students' assigned reading.

Each chapter contains several **Stop and Stretch** questions designed to provide rest stops where students can assess whether they have understood the material they just completed reading. These questions require students to synthesize material they have read and apply their knowledge in a new situation. Many of these questions are designed to familiarize students with data analysis and help them develop skill at interpreting and understanding scientific data. Answers to these questions are provided in the appendix.

Another feature that aids in student learning is **Visualize This**, which consists of questions in figure captions that test a student's understanding of the concepts contained in the art. These questions are designed to encourage students to spend extra time with complex figures and develop a more sophisticated understanding of the concepts they present. Visualize This questions are included with three or more figures in each chapter and answers to these questions can be found in the appendix.

Each chapter ends with a feature called **Savvy Reader**. We developed this feature in response to the desire of so many of the professors teaching this course to help students learn to critically evaluate science presented in the media. We all want our students to become better, more informed consumers of science. Each Savvy Reader offers an excerpt or a summary of an article or advertisement taken from any of a variety of media sources. After reading the excerpt, the student then answers a series of questions

written with the goal of helping them critically evaluate the scientific information presented in the article. Students learn to evaluate claims made in the popular press about issues ranging from the benefits of particular health care products to whether our friendships are based on similarities in genetic makeup.

Improvements in the Fourth Edition

The positive feedback garnered by previous editions assured us that presenting science alongside a story works for students and instructors alike. In the fourth edition, we have rearranged some of the content and added a new chapter and story line. Chapter 3 addresses the question of dietary supplementation while covering the essential content of nutrients and membrane transport. Chapter 4 revisits the question of body fat and health and now includes the content of cellular respiration. Chapter 5 reviews the latest information regarding the science of global warming and continues to cover the basics of photosynthesis. Story lines have been updated or replaced in other chapters compared to previous editions. Chapter 12 on Species and Races now examines the use of DNA to determine genealogy.

With the previous editions, we focused on improving flexibility for instructors via **A Closer Look** chapter subsections, helping students assess their understanding via **Stop and Stretch** and **Visualize This** questions, and providing students with opportunities to be better consumers of popular media with the **Savvy Reader**. In this edition, we have provided instructors and students with guidance in the form of **Learning Outcomes**. These outcomes describe the knowledge or skills that students should have upon completing the reading and associated activities in the text and ancillary materials. The chapter summary is organized around the Learning Outcomes, and all questions and exercises are tagged to a Learning Outcome. Exercises in the Mastering Biology platform are also tagged to these Learning Outcomes, providing students ample opportunity to master these important concepts.

Finally, users of earlier editions will notice a new style for phylogenetic trees in the text—horizontal rather than vertical, to match the standard presentation in the field of evolutionary biology.