

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 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* 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 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 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 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



Virginia Borden and **Colleen Belk** 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 they needed to find a better way. 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 Throughout *Biology: Science for Life*

Helping nonmajors to appreciate the importance of learning biology can be a tremendously rewarding job—and a challenging one as well. We sometimes struggled to actively engage students in lectures and to raise their scientific literacy and critical thinking skills, and we knew we were not alone. In fact, when we asked instructors from around the country what challenges they faced while teaching the nonmajors introductory biology course, these dedicated teachers echoed our concerns. This book was written to help biology instructors 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 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, 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 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 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 50). 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, this text also strives to engage the nonmajor 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 type of jacket (see p. 144 and pp. 201–202). 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, 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.

Improvements in the Second Edition

Bringing the first edition of *Biology: Science for Life* to instructors around the country was extremely gratifying to us. The success of the first edition and the positive feedback that it garnered assured us that this approach works for students and instructors alike. We also received feedback from users and reviewers on how to enhance the second edition to most closely meet the needs of biology instructors in diverse settings.

- To make your transition to teaching from this text as simple as possible, we have reorganized the sequence of topics to more closely resemble the traditional topical order found in most biology courses.
- To better meet the needs of instructors teaching a wide diversity of nonmajors biology courses who employed the first edition of *Biology: Science for Life*, we have created two versions of the book. The shorter version provides a thorough overview of the four pillars of modern biological science: cell biology, genetics, evolution, and ecology. We have increased coverage of basic chemistry and metabolism so that students develop a more solid understanding of the basic process that support and constrain much of life on Earth. The longer version includes an expanded animal physiology section, including coverage of all major animal organ systems, as well as additional chapters on plant structure and function.
- We have increased coverage of non-human biology, often providing examples of how the biology of other organisms differs from that of humans. For example, while the storyline of the natural selection chapter is the evolution and control of the HIV virus in an infected person, the chapter is peppered with non-human examples of the effects of natural selection—from the evolution of bill size in Galapagos finches to the adaptations for wind pollination in grasses. Likewise, we have included additional photos to provide more vivid illustrations of the wonderful variety of life on Earth, from amoebas reproducing asexually (Chapter 5) to peacocks demonstrating the effects of sexual selection (Chapter 11).
- The overall goal of the text remains providing a thorough overview of the essentials of biological science while trying to avoid overloading students with information. We worked closely with instructors using the first edition, as well as other reviewers, to pinpoint essential content to include in the second edition. When necessary, we judiciously added more detailed content where the students’ understanding of the material would be enhanced by additional information. Chapter 2:

Are We Alone in the Universe? and Chapter 4: Is the Earth Warming? provide examples of where coverage was expanded (in this case, of chemistry and metabolism), while staying true to the book's philosophy of teaching essential information in a story format.

The development of the second edition has truly been a collaborative process among ourselves, the students and instructors who used the first edition, and the many thoughtful reviewers of these chapters. We look forward to learning about your experience with *Biology: Science for Life*, 2e.

Supplements

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. The student resources offer several ways of reviewing and reinforcing the concepts and facts covered in this textbook. The instructor resources provide a thoroughly revised collection of test questions, an updated and expanded suite of lecture presentation materials, and a valuable source of ideas for educators to enrich their instruction 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.