

Preface

by Jane Reece

Much has changed in the world since the completion of the previous edition of *BIOLOGY*. In the realm of the biological sciences, the sequencing of the genomes of many more species has had deep ramifications in diverse areas of research, providing new insights, for example, into the evolutionary histories of numerous species. There has been an explosion of discovery about small RNA molecules and their roles in gene regulation and, at the other end of the size spectrum, our knowledge of Earth's biodiversity has expanded to encompass hundreds of new species, including parrots, monkeys, and orchids. And during the same period, biology has become more prominent than ever in our daily lives. The news is filled with stories about the promise of personalized medicine, novel cancer treatments, the possibility of producing biofuels with the help of genetic engineering, and the use of genetic profiling in solving crimes. Other news stories report climate change and ecological disasters, new drug-resistant strains of the pathogens that cause tuberculosis and parasitic infections, and famine—crises in the world around us that are posing new challenges for biologists and their allies in the other sciences. On a personal level, many colleagues and I have missed our inspiring friend, the late Neil Campbell, even as our commitment to leadership in biological education has grown. Our changing world needs biologists and a scientifically literate citizenry as never before, and we are committed to working toward that goal.

The New Coauthors

The Seventh Edition of *BIOLOGY* has been used by more students and instructors than any previous edition, remaining the most widely used college textbook in the sciences. With the privilege of sharing biology with so many students comes the responsibility of improving the book to serve the biology community even better. For that reason, Neil would have been delighted to see that this Eighth Edition fulfills our decade-long goal of expanding the author team. As biological discoveries proliferated, Neil and I realized that it was becoming harder than ever to make judicious decisions about which biological concepts are most important to develop in depth in an introductory textbook. We needed an author team with first-hand expertise across the biological spectrum, and we wanted coauthors who had honed their teaching values in the classroom. Our new coauthors—Lisa Urry, Michael Cain, Steve Wasserman, Peter Minorsky, and Rob Jackson—represent the highest standards of scientific scholarship across a broad range of disciplines and a deep commitment to undergraduate teaching. As described on pages iv–v, their scientific

expertise ranges from molecules to ecosystems, and the schools where they teach range from small liberal arts colleges to large universities. In addition, both Lisa and Peter, as major contributors to earlier editions, had prior experience working on the book. The six of us have collaborated unusually closely, starting with book-wide planning meetings and continuing with frequent exchanges of questions and advice as we worked on our chapters. For each chapter, the revising author, editors, and I together formulated a detailed plan; subsequently, my own role involved commenting on early drafts and polishing the final version. Together, we have strived to extend the book's effectiveness for today's students and instructors, while maintaining its core values.

Our Core Values

What are the core values of this book? They start with getting the science right but then focus on helping students make sense of the science. Below I highlight our longtime values and describe how they've been put into practice in the Eighth Edition. You can see examples of many of the book's features in "To the Student: How to Use This Book" (pp. xiv–xix).

Accuracy and Currency

Getting the science right goes beyond making sure that the facts are accurate and up-to-date. Equally important is ensuring that our chapters reflect how scientists in the various subdisciplines of biology, from cell biology to ecology, currently view their area. Changes in the basic paradigms in various biological fields may call for us to reorganize some chapters and even create new ones in a new edition. For example, a new Chapter 21 discusses genomes and their evolution, and neurobiology is now covered in two chapters (Chapters 48 and 49), one focused on the cellular level and one at the organ system level. On pages ix–x, you can read more about new content and organizational improvements in the Eighth Edition.

A Framework of Key Concepts

The explosion of discoveries that makes biology so exciting today also threatens to suffocate students under an avalanche of information. Our primary pedagogical goal is to help students build a framework for learning biology by organizing each chapter around a small number of "Key Concepts," typically three to six. Each chapter begins with a list of its Key Concepts, a photograph that raises an intriguing question, and an Overview section that addresses the question and introduces the chapter. In the body of the chapter, each Key Concept serves as a numbered heading for

a major section, in which the prose and pictures tell a more detailed story. At the end of each concept section, Concept Check questions enable students to assess their understanding of that concept before going on to the next concept. Students encounter the Key Concepts one last time when they reach the Chapter Review at the end of the chapter; the Summary of Key Concepts restates them and offers succinct explanatory support in both words and summary diagrams—new to this edition.

Active Learning

Increasingly, instructors tell us that they want their students to take a more active role in learning biology and to think about biological questions at a higher level. In the Eighth Edition, we provide several new ways for students to engage in active learning. First, the Concept Check questions in this edition build in difficulty, and each set now ends with a new “What if?” question that challenges students to integrate what they have learned and to think analytically. There are also questions accompanying selected figures within the text; each of these questions encourages students to delve into the figure and assess their understanding of its underlying ideas. And new “Draw It” exercises in every chapter ask students to put pencil to paper and draw a structure, annotate a figure, or graph experimental data. In addition to appearing regularly in the Chapter Review, a “Draw It” question may show up in a Concept Check or figure legend. Finally, the website that accompanies the book features two especially exciting new student tools, both of which focus on biology’s toughest topics: MasteringBiology tutorials and BioFlix 3-D animations and tutorials. These are described on page xx.

Evolution and Other Unifying Themes

Together with *BIOLOGY*’s emphasis on key concepts, a thematic approach has always distinguished our book from an encyclopedia of biology. In the Eighth Edition, as previously, the central theme is evolution. Evolution unifies all of biology by accounting for both the unity and diversity of life and for the remarkable adaptations of organisms to their environments. The evolutionary theme is woven into every chapter of *BIOLOGY*, and Unit Four, Mechanisms of Evolution, has undergone a major revision. In Chapter 1, the other unifying themes have been streamlined from ten to six. And throughout the book, these themes are now referenced more explicitly in Key Concepts and subheadings. The former themes of “scientific inquiry” and “science, technology, and society” continue to be highlighted throughout the book, not as biological themes but as aspects of how science is done and the role of science in our lives.

Integration of Text and Illustrations

We regard text and illustrations as equal in importance, and starting with the First Edition, have always developed them simultaneously. The Eighth Edition has a number of new and

improved figures, with the increased use of a more three-dimensional art style where it can enhance understanding of biological structure. At the same time, we avoid excess detail, which can obscure the main point of the figure. We have also improved our popular “Exploring” Figures and have added more (see the list on p. xii). Each of these large figures is a learning unit that brings together a set of related illustrations and the text that describes them. The Exploring Figures enable students to access dozens of complex topics very efficiently. They are core chapter content, not to be confused with some textbooks’ “boxes,” which have content peripheral to the flow of a chapter. Modern biology is challenging enough without diverting students’ attention from a chapter’s conceptual storyline.

Telling the Story at the Right Level

Whether in pictures or prose, we are committed to explaining biology at just the right level, and we’ve continued to use Neil’s “quantum theory of teaching biology” as a touchstone. According to this idea, there are discrete levels at which a concept can be successfully explained, and a successful explanation must avoid getting “stuck between levels.” Of course, most seasoned instructors have independently recognized this issue, also known as the “too much–too little” problem. The author team has drawn upon both scientific expertise and teaching experience to tell the story of biology at an appropriate level.

The Importance of Scientific Inquiry

Another of our core values is our belief in the importance of introducing students to the scientific way of thinking. In both lecture hall and laboratory, the authors and many of our colleagues are experimenting with diverse approaches for involving students in scientific inquiry, the process by which questions about nature are posed and explored. Special features in the textbook and in inquiry-based supplements make this edition of *BIOLOGY* more effective than ever in helping instructors convey the process of science in their courses.

Modeling Inquiry by Example

Every edition of *BIOLOGY* has traced the history of many research questions and scientific debates to help students appreciate not just “what we know,” but “how we know,” and “what we do not yet know.” In *BIOLOGY*, Seventh Edition, we strengthened this aspect of the book by introducing “Inquiry” Figures, which showcase examples of experiments and field studies in a format that is consistent throughout the book. Each of these inquiry cases begins with a research question, followed by sections describing the experiment, results, and conclusion. Complementing the Inquiry Figures are “Research Method” Figures, which walk students through the techniques and tools of modern biology.

In the Eighth Edition, we have added many more Inquiry Figures; there is now at least one in every chapter and often more (see the list of Inquiry Figures on pp. xii–xiii). Each

Inquiry Figure now ends with a "What if?" question that requires students to demonstrate their understanding of the experiment described. We have also expanded the usefulness of the Inquiry Figures in another important way: In response to feedback from many instructors, we now cite the journal article that is the source of the research, providing a gateway to the primary literature. And the full papers for nine of the Inquiry Figures are reprinted in *Inquiry in Action: Interpreting Scientific Papers*, by Ruth Buskirk and Christopher Gillen. This new supplement, which can be ordered with the book for no additional charge, provides background information on how to read scientific papers plus specific questions that guide students through the nine featured articles.

Learning Inquiry by Practice

BIOLOGY, Eighth Edition, encourages students to practice thinking as scientists by tackling the "What if?" questions in the Concept Checks and Inquiry Figures (and occasional figure legends), as well as the "Scientific Inquiry" questions in the Chapter Review. Many of those in the Chapter Reviews ask students to analyze data or to design an experiment.

The supplements for the Eighth Edition build on the textbook to provide diverse opportunities for students to practice scientific inquiry in more depth. In addition to *Inquiry in Action: Interpreting Scientific Papers*, these include new editions of several other supplements that can be made available without cost. One is *Biological Inquiry: A Workbook of Investigative Cases*, Second Edition, by Margaret Waterman and Ethel Stanley; another is *Practicing Biology: A Student Workbook*, Third Edition, by Jean Heitz and Cynthia Giffen. You can find out more about these and other student supplements, both print and electronic, on pages xx–xxiii.

The *BIOLOGY* Interviews: A Continuing Tradition

Scientific inquiry is a social process catalyzed by communication among people who share a curiosity about nature. One of the many joys of authoring *BIOLOGY* is the privilege of interviewing some of the world's most influential biologists. Eight new interviews, one opening each unit of the textbook, introduce students to eight of the fascinating individuals who are driving progress in biology and connecting science to society. And in this edition, each unit of the text includes an Inquiry Figure based upon the research of the unit's interviewee; for example, see Inquiry Figure 2.2, on page 31. The interviewees for this edition are listed on page xi.

A Versatile Book

Our book is intended to serve students as a textbook in their general biology course and also later as a useful tool for review and reference. *BIOLOGY*'s breadth, depth, and versatile organization enable the book to meet these dual goals. Even by limiting our scope to a few Key Concepts per chapter, *BIOLOGY* spans more biological territory than most introductory

courses could or should attempt to cover. But given the great diversity of course syllabi, we have opted for a survey broad enough and deep enough to support each instructor's particular emphases. Students also seem to appreciate *BIOLOGY*'s breadth and depth; in this era when students sell many of their textbooks back to the bookstore, more than 75% of students who have used *BIOLOGY* have kept it after their introductory course. In fact, we are delighted to receive mail from upper division students and graduate students, including medical students, expressing their appreciation for the long-term value of *BIOLOGY* as a general resource for their continuing education.

Just as we recognize that few courses will cover all 56 chapters of the textbook, we also understand that there is no single correct sequence of topics for a general biology course. Though a biology textbook's table of contents must be linear, biology itself is more like a web of related concepts without a fixed starting point or a prescribed path. Diverse courses can navigate this network of concepts starting with molecules and cells, or with evolution and the diversity of organisms, or with the big-picture ideas of ecology. We have built *BIOLOGY* to be versatile enough to support these different syllabi. The eight units of the book are largely self-contained, and, for most of the units, the chapters can be assigned in a different sequence without substantial loss of coherence. For example, instructors who integrate plant and animal physiology can merge chapters from Unit Six (Plant Form and Function) and Unit Seven (Animal Form and Function) to fit their courses. As another option, instructors who begin their course with ecology and continue with this top-down approach can assign Unit Eight (Ecology) right after Chapter 1, which introduces the unifying themes that provide students with a panoramic view of biology no matter what the topic order of the course syllabus.

Our Partnership with Instructors

A core value underlying all our work as authors is our belief in the importance of our partnership with instructors. Our primary way of serving instructors, of course, is providing a textbook that serves their students well. In addition, Benjamin Cummings makes available a wealth of instructor resources, in both print and electronic form (see pp. xx–xxiii). However, our relationship with instructors is not a one-way street. In our continuing efforts to improve the book and its supplements, we benefit tremendously from instructor feedback, not only in formal reviews from hundreds of scientists, but also via informal communication in person and by phone and e-mail. Neil Campbell built a vast network of colleagues throughout the world, and my new coauthors and I are fully committed to continuing that tradition.

The real test of any textbook is how well it helps instructors teach and students learn. We welcome comments from the students and professors who use *BIOLOGY*. Please address your suggestions to me:

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