

Preface

This is a wonderful time to teach and learn biology. Opportunities to marvel at the natural world and the life within it abound. It's difficult to view a news website without finding stories that touch on biology and its intersection with society. In addition, the world of pop culture is rich with books, movies, TV shows, comic strips, and video games that feature biological wonders and challenge us to think about important biological concepts and their implications. Although some people say that they don't like biology (or, more often, science in general), nearly everyone will admit to an inborn biophilia. After all, most of us keep pets, tend a garden, enjoy zoos and aquariums, or appreciate time spent outdoors. Furthermore, nearly everyone realizes that the subject of biology has a significant impact on his or her own life through its connections to medicine, biotechnology, agriculture, environmental issues, forensics, and myriad other areas. But despite the inborn affinity that nearly everyone has for biology, it can be a struggle for nonscientists to delve into the subject. Our primary goal in writing *Campbell Essential Biology* is to help teachers motivate and educate the next generation of citizens by tapping into the inherent curiosity about life that we all share.

Goals of the Book

Although our world is rich with “teachable moments” and learning opportunities, the explosion of knowledge we have already witnessed in the 21st century threatens to bury a curious person under an avalanche of information. “So much biology, so little time” is the universal lament of biology educators. Neil Campbell conceived of *Campbell Essential Biology* as a tool to help teachers and students focus on the most important areas of biology. To that end, the book is organized into four core areas: cells, genes, evolution, and ecology. Dr. Campbell's vision, which we carry on and extend in this edition, has enabled us to keep *Campbell Essential Biology* manageable in size and thoughtful in the development of the concepts that are most fundamental to understanding life. We've aligned this new edition with today's “less is more” approach in biology education for nonscience majors—where the emphasis is on fewer topics and more focused explanations—and we never allow the content we do include to be diluted. Toward that end, in this new edition we removed some of the most technical details and terminology, which we hope will help nonscience major students to focus on the key topics in biology.

We formulated our approach after countless conversations with teachers and students in which we noticed some important trends in how biology is taught. In particular, many teachers identify three goals: (1) to engage students by relating the core content to their lives and the greater society, (2) to clarify the process of science by showing how it is applied in the real world and to give students practice in

applying scientific and critical thinking skills themselves; and (3) to demonstrate how evolution serves as biology's unifying theme. To help achieve these goals, every chapter of this book includes three important features. First, a chapter-opening essay called Biology and Society highlights a connection between the chapter's core content and students' lives. Second, an essay called The Process of Science (found in the body of the chapter) describes how the scientific process has illuminated the topic at hand, using a classic or modern experiment as an example. Third, a chapter-closing Evolution Connection essay relates the chapter to biology's unifying theme of evolution. To maintain a cohesive narrative throughout each chapter, the content is tied together with a unifying chapter thread, a relevant high-interest topic that is woven throughout the three chapter essays and is touched on several additional times in the chapter. Thus, this unifying chapter thread ties together the three pedagogical goals of the course using a topic that is compelling and relevant to students.

New to This Edition

We hope that this latest edition of *Campbell Essential Biology* goes even further in helping students relate the material to their lives, understand the process of science, and appreciate how evolution is the unifying theme of biology. To this end, we've added significant new features and content to this edition:

- **Clarifying the importance of biology to students' lives.** Every student taking an introductory biology course should be made keenly aware of the myriad ways that biology affects his or her own life. To help put such issues front and center, and to “prime the learning pump” before diving into the content, we have included a new feature at the start of each chapter called Why It Matters. Every chapter begins with this new feature, which presents a series of attention-grabbing facts, in conjunction with compelling photographs that illustrate the importance of that chapter's topic to students' lives. These high-interest facts appear again in the chapter narrative, typeset in a design meant to capture students' attention and placed adjacent to the science discussion that explains the fact. Examples include: Why Macromolecules Matter (“A long-distance runner who carbo-loads the night before a race is banking glycogen to be used the next day”) and Why Ecology Matters (“Producing the beef for a hamburger requires eight times as much land as producing the soybeans for a soyburger”).
- **Major themes in biology incorporated throughout the book.** In 2009, the American Association for the Advancement of Science published a document that

served as a call to action in undergraduate biology education. The principles of this document, which is titled "Vision and Change," are becoming widely accepted throughout the biology education community. "Vision and Change" presents five core concepts that serve as the foundation of undergraduate biology. In this edition of *Campbell Essential Biology*, we repeatedly and explicitly link book content to each of the five themes. For example, the first theme, the relationship of structure to function, is illustrated in Chapter 2 in the discussion of how the unique chemistry of water accounts for its biological properties. The second theme, information flow, is explored in Chapter 10 in the discussion on how genes control traits. The third theme, interconnections within systems, is illustrated in Chapter 18 in the discussion on the global water cycle. The fourth theme, evolution, is called out in Chapter 17 in the discussion on the phylogeny of animals. The fifth theme, energy transformations, is explored in Chapter 6 in the discussion on the flow of energy through ecosystems. Readers will find at least one major theme called out in this way per chapter, which will help students see

the connections between these major themes and the course content and instructors will have myriad easy-to-reference examples to help underscore these five themes. These specific examples are supplemented by many others throughout the text.

- **New unifying chapter threads.** As discussed earlier, every chapter in *Campbell Essential Biology* has a unique unifying chapter thread—a high-interest topic that helps to demonstrate the relevance of the chapter content. The chapter thread is incorporated into the three main essays of each chapter (Biology and Society, The Process of Science, and Evolution Connection) and appears throughout the chapter text. This sixth edition features many new chapter threads and essays, each of which highlights a current topic that applies biology to students' lives and to the greater society. For example, Chapter 2 presents a new thread on radioactivity, including discussions of its use in health care and as a tool to test evolutionary hypotheses. Chapter 15 features a new thread on human microbiota, including a recent investigation into the possible role of microbiota in obesity and an exploration of how the change from a hunter-gatherer lifestyle to a diet heavy in processed starch and sugar selected for oral bacteria that cause tooth decay.
- **Developing data literacy.** Many nonscience-major students express anxiety when faced with numerical data, yet the ability to interpret data can help with many important decisions we all face. To help foster critical thinking skills, we have incorporated a new feature called

Interpreting Data into the end-of-chapter assessments. These questions, one per chapter, offer students the opportunity to practice their science literacy skills. For example, in Chapter 10, students are asked to examine historical data of flu mortality, and in Chapter 15, students are tasked with calculating how quickly bacteria can multiply on unrefrigerated food. We hope that practice examining these simple yet relevant data sets will help students be more comfortable when they must confront numerical data in their own lives.

- **Updated content and figures.** As we do in every edition, we have made many significant updates to the content presented in the book. Examples of new or updated material include new discussions on epigenetics, metagenomics, and RNA interference; an examination of new genomic information on Neanderthals; updated climate change statistics; a discussion of advances in fetal genetic testing; and an updated discussion of new threats to biodiversity. We have also included nearly a dozen new examples of DNA profiling and a cutting-edge exploration of genetically modified foods. We also strive with each new edition to update our photos and illustrations. New figures include examples that show how a prion protein can cause brain damage (Figure 3.20) and how real data from DNA profiling can exonerate wrongly accused individuals (Figure 12.16).
- **New analogies.** As part of our continuing effort to help students visualize and relate to biology concepts, we have included numerous new analogies in this edition. For example, in Chapter 4, we compare the significant differences between prokaryotic and eukaryotic cells to the differences between a bicycle and an SUV. In Chapter 8, we compare the process of DNA winding into chromosomes with the act of winding yarn into a skein. Additional analogies, both narrative and visual, bring biological scale into focus, such as a 4,600-mile road trip that is used to help students imagine the scale of biological evolution on Earth (Figure 15.1).
- **MasteringBiology updates.** New whiteboard-style animated videos provide students with an introduction to key biological concepts so students can arrive to class better prepared to explore applications or dive into any topic more deeply. New Everyday Biology videos, produced by the BBC, promote connections between concepts and biology in everyday life, and Evaluating Science in the Media activities teach students how to be wise consumers of scientific information and coach them through critically evaluating the validity of scientific information on the Internet. New Scientific Thinking activities encourage students to develop scientific

reasoning skills as they explore a current area of research and allows instructors to easily assess student mastery of these skills.

- **Teaching the Issues.** Because many instructors, including the authors, prefer to use current topics to demonstrate the relevance of biology to students' lives, we've expanded our series of Current Topic Instructor PowerPoints® with this edition. New topics include DNA Profiling, Stem Cells and Cloning, Diabetes, Biodiversity, and more. Each PowerPoint® Presentation includes instructor teaching tips and active learning strategies to easily create a high-interest, active lecture.

Attitudes about science and scientists are often shaped by a single required science class—this class. We hope to tap into the innate appreciation of nature we all share and nurture this affection into a genuine love of biology. In this spirit, we

hope that this textbook and its supplements will encourage all readers to make biological perspectives a part of their personal worldviews. Please let us know how we are doing and how we can improve the next edition of *Campbell Essential Biology*.

ERIC SIMON

Department of Biology and
Health Science
New England College
Henniker, NH 03242
SimonBiology@gmail.com

JEAN DICKEY

Department of Biology
Clemson University
Clemson, SC 29634
dickeyj@clemson.edu

KELLY HOGAN

Department of Biology
University of North Carolina
Chapel Hill, NC 27599
leek@email.unc.edu

JANE REECE

C/O Pearson Education
1301 Sansome Street
San Francisco, CA 94111
JaneReece@cal.berkeley.edu