

Preface

Inspired by the thousands of students in our own classes over the years and by enthusiastic feedback from the many instructors who have used or reviewed our book, we are delighted to present this new, Ninth Edition. We authors have worked together closely to ensure that both the book and the supplementary material online reflect the changing needs of today's courses and students, as well as current progress in biology. Titled *Campbell Biology: Concepts & Connections* to honor Neil Campbell's founding role and his many contributions to biology education, this book continues to have a dual purpose: to engage students from a wide variety of majors in the wonders of the living world and to show them how biology relates to their own existence and the world they inhabit. Most of these students will not become biologists themselves, but their lives will be touched by biology every day. Understanding the concepts of biology and their connections to our lives is more important than ever. Whether we're concerned with our own health or the health of our planet, a familiarity with biology is essential. This basic knowledge and an appreciation for how science works have become elements of good citizenship in an era when informed evaluations of health issues, environmental problems, and applications of new technology are critical.

Concepts and Connections

Concepts Biology is a vast subject that gets bigger every year, but an introductory biology course is still only one or two semesters long. This book was the first introductory biology textbook to use concept modules to help students recognize and focus on the main ideas of each chapter. The heading of each module is a carefully crafted statement of a key concept. For example, "Helper T cells stimulate the humoral and cell-mediated immune responses" announces a key concept about the role of helper T cells in adaptive immunity (Module 24.12). Such a concept heading serves as a focal point, and the module's text and illustrations converge on that concept with explanation and, often, analogies. The module text walks the student through the illustrations, just as an instructor might do in class. And in teaching a sequential process, such as the one diagrammed in Figure 24.12A, we number the steps in the text to correspond to numbered steps in the figure. The synergy between a module's narrative and graphic components transforms the concept heading into an idea with meaning to the student. The checkpoint question at the end of each module encourages students to test their understanding as they proceed through a chapter. Finally, in the Chapter Review, all the key concept statements are listed and briefly summarized under the overarching section titles, explicitly reminding students of what they've learned.

Connections Students are more motivated to study biology when they can connect it to their own lives and interests—for example, when they are able to relate science to health issues, economic problems, environmental quality, ethical controversies, and social responsibility. In this edition, purple Connection icons mark the numerous application modules that go beyond the core biological concepts. For example, the new Connection Module 32.6 describes how humans tap into plant transport mechanisms for harvesting such materials as maple syrup and latex. In addition, our Evolution Connection modules, identified by green icons, connect the content of each chapter to the grand unifying theme of evolution, without which the study of life has no coherence. For example, a new Evolution Connection in Chapter 14 uses data from studies by Rosemary and Peter Grant and their students to demonstrate the continuing effects of natural selection on Darwin's finches. Explicit connections are also made between the chapter introduction and either the Evolution Connection module or the Scientific Thinking module in each chapter; high-interest questions introduce each chapter, drawing students into the topic and encouraging a curiosity to explore the question further when it appears again later in the chapter. And, connections are made in every chapter between key concepts and the core concepts of biology.

New to This Edition

New Focus on Five Underlying Themes of Biology

A major goal of this Ninth Edition is to provide students with an explicit framework for understanding and organizing the broad expanse of biological information presented in Concepts and Connections. This framework is based on the five major themes outlined in *Vision and Change in Undergraduate Biology Education: A Call to Action* published by the American Academy for the Advancement of Science. These major themes extend across all areas of biology: evolution, the flow of information, the correlation of structure and function, the exchange of energy and matter, and the interactions and interconnections of biological systems. Chapter 1 introduces each of these themes in a separate module. Specific examples of the themes are then called out in each chapter by green icons: **INFORMATION**, **STRUCTURE AND FUNCTION**, **ENERGY AND MATTER**, **INTERACTIONS**, and **EVOLUTION CONNECTION** (always in module form).

Expanded Coverage of the Process of Science

Chapter 1 also includes an enhanced focus on the nature of science and the process of scientific inquiry, setting the stage for both the content of the text and the process by which our biological knowledge has been built and continues to grow. We continue this emphasis on the process of scientific inquiry through our Scientific Thinking modules

in every chapter, which are called out with an orange icon. New concept check questions for these modules focus on aspects of the process of science: the forming and testing of hypotheses; experimental design; variables and controls; the analysis of data; and the evaluation and communication of scientific results.

Additional Visualizing the Concept Modules These modules, which were new to the Eighth Edition, have raised our hallmark art-text integration to a new level. Visualizing the Concept modules take challenging concepts or processes and walk students through them in a highly visual manner, using engaging, attractive art; clear and concise labels; and instructor “hints” called out in light blue bubbles. These short hints emulate the one-on-one coaching an instructor might provide to a student during office hours and help students make key connections within the figure. Examples of the eight new Visualizing the Concept modules include Module 6.9, Most ATP production occurs by oxidative phosphorylation; Module 8.17, Crossing over further increases genetic variability; Module 13.14, Natural selection can alter variation in a population in three ways; Module 28.6, Neurons communicate at synapses, and Module 34.18, The global water cycle connects aquatic and terrestrial biomes.

New Visualizing the Data Figures Also new to this edition are figures that present data in an infographic form, marked by Visualizing the Data icons. These 19 eye-catching figures provide students with a fresh approach to understanding the concepts illustrated by graphs and numerical data. Figure 10.19 maps emergent virus outbreaks, showing that they originate throughout the world. Figure 12.17 summarizes a wealth of bioinformatics data on genome sizes versus the number of genes found in various species. Figure 13.16 illustrates the growing threat of antibiotic resistant bacteria. Figure 21.14 allows students to directly compare caloric intake (via food) with caloric expenditure (via exercise). Figure 30.5B shows changes in bone mass during the human life span. Figure 36.11 offers an illuminating visual comparison of the per capita and national ecological footprints of several countries with world average and “fair share” footprints. Figure 38.3 shows graphic evidence of global warming by tracking annual global temperatures since 1880.

New Unit Openers That Feature Careers Related to the Content of the Unit Expanding our emphasis on the connections of biology to students’ lives, each unit opener page now includes photos of individuals whose professions relate to the content of the unit. For instance, Unit I features a brewery owner and a solar energy engineer. Unit IV portrays a hatchery manager and a paleoanthropologist. These examples are intended to help students see how their biology course relates to the world outside the classroom and to their own career paths.

New Design and Improved Art The fresh new design used throughout the chapters and the extensive reconceptualization of many figures make the book even more appealing and accessible to visual learners. Much of the art in Chapter 6, How Cells Harvest Chemical Energy, for example, has been revised to help students work through the complex reactions of cellular respiration. Other examples of improved art are found in Figures 5.15B, 10.11A, and 37.22B.

The Latest Science Biology is a dynamic field of study, and we take pride in our book’s currency and scientific accuracy. For this edition, as in previous editions, we have integrated the results of the latest scientific research throughout the book. We have done this carefully and thoughtfully, recognizing that research advances can lead to new ways of looking at biological topics; such changes in perspective can necessitate organizational changes in our textbook to better reflect the current state of a field. For example, Chapter 12 uses both text and art to present the innovative CRISPR-Cas9 system for gene editing. You will find a unit-by-unit account of new content and organizational improvements in the “New Content” section on pages xix–xx following this Preface.

MasteringBiology® MasteringBiology, the most widely used online tutorial and assessment program for biology, continues to accompany *Campbell Biology: Concepts & Connections*. In addition to 170 author-created activities that help students learn vocabulary, extend the book’s emphasis on visual learning, demonstrate the connections among key concepts (helping students grasp the big ideas), and coach students on how to interpret data, the Ninth Edition features new assignable videos. These videos bring this text’s Visualizing the Concept modules to life, help students learn how to evaluate sources of scientific information for reliability, and include short news videos that engage students in the many ways course concepts connect to the world outside the classroom. MasteringBiology® for *Campbell Biology: Concepts & Connections*, Ninth Edition, will help students to see strong connections through their text, and the additional practice available online allows instructors to capture powerful data on student performance, thereby making the most of class time.

This Book’s Flexibility

Although a biology textbook’s table of contents is by design linear, biology itself is more like a web of related concepts without a single starting point or prescribed path. Courses can navigate this network by starting with molecules, with ecology, or somewhere in-between, and courses can omit topics. *Campbell Biology: Concepts & Connections* is uniquely suited to offer flexibility and thus serve a variety of courses. The seven units of the book are largely self-contained, and in a number of the units, chapters can be assigned in a different order without much loss of coherence. The use of numbered modules makes it easy to skip topics or reorder the presentation of material.



For many students, introductory biology is the only science course that they will take during their college years. Long after today's students have forgotten most of the specific content of their biology course, they will be left with general impressions and attitudes about science and scientists. We hope that this new edition of *Campbell Biology: Concepts & Connections* helps make those impressions positive and supports instructors' goals for sharing the fun of biology. In our continuing efforts to improve the book and its supporting materials, we benefit tremendously from instructor and student feedback, not only in formal reviews but also via informal communication. Please let us know how we are doing and how we can improve the next edition of the book.

Martha Taylor

(Chapter 1 and Unit I),
mrt2@cornell.edu

Eric Simon

(Units II and VI and Chapters 21 and 27),
SimonBiology@gmail.com

Jean Dickey

(Units III, IV, and VII and Chapters 22 and 30),
dickeyj@clemson.edu

Kelly Hogan

(Chapters 20, 23–26, 28, and 29),
leek@email.unc.edu

Jane Reece

janereece@cal.berkeley.edu
