

Preface

This eighth edition of Solomon, Berg, Martin *Biology* continues to convey our vision of the dynamic science of biology and how it affects every aspect of our lives, from our health and behavior to the challenging environmental issues that confront us. Recent discoveries in the biological sciences have increased our understanding of both the unity and diversity of life's processes and adaptations. With this understanding, we have become more aware of our interdependence with the vast diversity of organisms with which we share planet Earth.

BIOLOGY IS A BOOK FOR STUDENTS

The study of biology can be an exciting journey of discovery for beginning biology students. To that end, we seek to help students better appreciate Earth's diverse organisms, their remarkable adaptations to the environment, and their evolutionary and ecological relationships. We also want students to appreciate the workings of science and the contributions of scientists whose discoveries not only expand our knowledge of biology but also help shape and protect the future of our planet. *Biology* provides insight into what science is, how scientists work, what the roles are of the many scientists who have contributed to our current understanding of biology, and how scientific knowledge affects daily life.

Since the first edition of *Biology*, we have tried to present the principles of biology in an integrated way that is accurate, interesting, and conceptually accessible to students. In this eighth edition of *Biology*, we continue this tradition. We also continue to present biology in an inquiry-based framework. Many professors interpret inquiry as a learning method that takes place in the laboratory as students perform experiments. Laboratory research is certainly an integral part of inquiry-based learning. But inquiry is also a way of learning in which the student actively pursues some line of knowledge outside the laboratory. In *Biology*, we have always presented the history of scientific advances, including scientific debates, to help students understand that science is a process (that is, a field of investigative inquiry) as well as a body of knowledge (the product of inquiry). **NEW** In *Biology*, Eighth Edition, we make a concerted effort to further integrate inquiry-based learning into the textbook with the inclusion of two new features: **Key Experiment figures** and **Analyzing Data questions**. **Key Experiment figures** encourage students to evaluate investigative approaches that real scientists have taken.

Analyzing Data questions require students to actively interpret experimental data presented in the text.

Throughout the text, we stimulate interest by relating concepts to experiences within the student's frame of reference. By helping students make such connections, we facilitate their mastery of general concepts. We hope the combined effect of an engaging writing style and interesting features will fascinate students and encourage them to continue their study of biology.

THE SOLOMON/BERG/MARTIN LEARNING SYSTEM

In the eighth edition we have refined our highly successful Learning System, which concentrates on learning objectives and outcomes. Mastering biology is challenging, particularly because the subject of biology is filled with so many facts that must be integrated into the framework of general biological principles. To help students, we provide Learning Objectives both for the course and for each major section of every chapter. At the end of each section, we provide Review questions based on the learning objectives so students can assess their mastery of the material presented in the section.

Throughout the book, students are directed to ThomsonNOW, a powerful online diagnostic tool that helps students assess their study needs and master the chapter objectives. After taking a pretest on ThomsonNOW, students receive feedback based on their answers as well as a Personalized Study plan with links to animations and other resources keyed to their specific learning needs. Selected illustrations in the text are also keyed to *Animated figures* in ThomsonNOW.

Course Learning Objectives

At the end of a successful study of introductory biology, the student can demonstrate mastery of the subject by responding accurately to the following Course Learning Objectives, or Outcomes:

- Design an experiment to test a given hypothesis, using the procedure and terminology of the scientific method.
- Cite the cell theory, and relate structure to function in both prokaryotic and eukaryotic cells.

- Describe the theory of evolution, explain why it is the principal unifying concept in biology, and discuss natural selection as the primary agent of evolutionary change.
- Explain the role of genetic information in all species, and discuss applications of genetics that affect society.
- Describe several mechanisms by which cells and organisms transfer information, including the use of nucleic acids, chemical signals (such as hormones and pheromones), electrical signals (for example, neural transmission), signal transduction, sounds, and visual displays.
- Argue for or against the classification of organisms in three domains and six kingdoms, characterizing each of these clades; based on your knowledge of genetics and evolution, give specific examples of the unity and diversity of these organisms.
- Compare the structural adaptations, life processes, and life cycles of a prokaryote, protist, fungus, plant, and animal.
- Define *homeostasis*, and give examples of regulatory mechanisms, including feedback systems.
- Trace the flow of matter and energy through a photosynthetic cell and a nonphotosynthetic cell, and through the biosphere, comparing the roles of producers, consumers, and decomposers.
- Describe the study of ecology at the levels of an individual organism, a population, a community, and an ecosystem.

Pedagogical Features

We use numerous learning strategies to increase the student's success:

- **NEW** A list of **Key Concepts** at the beginning of each chapter provides a chapter overview.
- **Learning Objectives** at the beginning of each major section in the chapter indicate, in behavioral terms, what the student must do to demonstrate mastery of the material in that section.
- Each major section of the chapter is followed by a series of **Review questions** that assess comprehension by asking the student to describe, explain, compare, contrast, or illustrate important concepts. The Review questions are based on the section Learning Objectives.
- **Concept Statement Subheads** introduce sections, previewing and summarizing the key idea or ideas to be discussed in that section.
- **Sequence Summaries** within the text simplify and summarize information presented in paragraph form. For example, paragraphs describing blood circulation through the body or the steps by which cells take in certain materials are followed by a Sequence Summary listing the structures or steps.
- **Focus On boxes** explore issues of special relevance to students, such as the effects of smoking or alcohol abuse. These boxes also provide a forum for discussing certain topics of current interest in more detail, such as the smallest ancient humans (*Homo floresiensis*), worldwide declining amphibian populations, and Alzheimer's disease.
- Numerous **Tables**, many illustrated, help the student organize and summarize material presented in the text.
- A **Summary with Key Terms** at the end of each chapter is organized around the chapter Learning Objectives. This summary provides a review of the material, and because selected key terms are boldface in the summary, students are provided the opportunity to study vocabulary words within the context of related concepts.
- End-of-chapter questions provide students with the opportunity to evaluate their understanding of the material in the chapter. **Test Your Understanding** consists of multiple-choice questions, some of which are based on the recall of important terms, whereas others challenge students to integrate their knowledge. Answers to the Test Your Understanding questions are provided in Appendix E. A series of thought-provoking **Critical Thinking questions** encourages the student to apply the concepts just learned to new situations or to make connections among important concepts.
- **NEW** Every chapter has one or more **Evolution Link questions** in the Critical Thinking section. **NEW** Many chapters contain one or more **Analyzing Data questions** based on data presented in the chapter.
- The **Glossary** at the end of the book, the most comprehensive glossary found in any biology text, provides precise definitions of terms. The Glossary is especially useful because it is extensively cross-referenced and includes pronunciations. The vertical blue bar along the margin facilitates rapid access to the Glossary. The companion website also includes glossary flash cards with audio pronunciations.
- **NEW** An updated and expanded **art program** brings to life, reinforces, and expands concepts discussed in the text. This edition includes **Key Experiment figures**, which emphasize the scientific process in both classic and modern research; examples include Figures 9-7, 17-2, 36-7, and 50-8. Also new to this edition are **Key Points** stated in process diagrams of complex topics; examples include Figures 28-19 and 54-2. Many of these figures have numbered parts that show sequences of events in biological processes or life cycles. Numerous photographs, both alone and combined with line art, help students grasp concepts by connecting the "real" to the "ideal." The line art uses devices such as **orientation icons** to help the student put the detailed figures into the broad context. We use symbols and colors consistently throughout the book to help students connect concepts. For example, the same four colors and shapes are used throughout the book to identify guanine, cytosine, adenine, and thymine.

WHAT'S NEW: AN OVERVIEW OF BIOLOGY, EIGHTH EDITION

Three themes are interwoven throughout *Biology*: the evolution of life, the transmission of biological information, and the flow of energy through living systems. As we introduce the concepts

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of modern biology, we explain how these themes are connected and how life depends on them.

Educators present the major topics of an introductory biology course in a variety of orders. For this reason, we carefully designed the eight parts of this book so that they do not depend heavily on preceding chapters and parts. This flexible organization means that an instructor can present the 56 chapters in any number of sequences with pedagogical success. Chapter 1, which introduces the student to the major principles of biology, provides a good springboard for future discussions, whether the professor prefers a “top-down” or “bottom-up” approach.

In this edition, as in previous editions, we examined every line of every chapter for accuracy and currency, and we made a serious attempt to update every topic and verify all new material. The following brief survey provides a general overview of the organization of *Biology* and some changes made to the eighth edition.

Part 1: The Organization of Life

The six chapters that make up Part 1 provide basic background knowledge. We begin Chapter 1 with a new discussion of research on heart repair and then introduce the main themes of the book—evolution, energy transfer, and information transfer. Chapter 1 then examines several fundamental concepts in biology and the nature of the scientific process, including a discussion of systems biology. Chapters 2 and 3, which focus on the molecular level of organization, establish the foundations in chemistry necessary for understanding biological processes. Chapters 4 and 5 focus on the cell level of organization. Chapter 4 contains additional information on microtubules, microfilaments, and motor proteins; Chapter 5 has expanded coverage of transport proteins and a new section on uniporters, symporters, and antiporters.

NEW In the eighth edition we have added a new chapter, Chapter 6, on cell communication, because recent studies of cell signaling, including receptor function and signal transduction, are providing new understanding of many life processes, particularly at the cell level.

Part 2: Energy Transfer through Living Systems

Because all living cells need energy for life processes, the flow of energy through living systems—that is, capturing energy and converting it to usable forms—is a basic theme of *Biology*. Chapter 7 examines how cells capture, transfer, store, and use energy. Chapters 8 and 9 discuss the metabolic adaptations by which organisms obtain and use energy through cellular respiration and photosynthesis. New to Chapter 9 is a summary section on the importance of photosynthesis to plants and other organisms.

Part 3: The Continuity of Life: Genetics

We have updated and expanded the eight chapters of Part 3 for the eighth edition. We begin this unit by discussing mitosis and meiosis in Chapter 10, which includes new sections on binary fission and prometaphase in mitosis. Chapter 11, which consid-

ers Mendelian genetics and related patterns of inheritance, has a new section on recognition of Mendel's work, including discussion of the chromosome theory of inheritance. We then turn our attention to the structure and replication of DNA in Chapter 12, including a new section on proofreading and repair of errors in DNA. Chapter 13 has a discussion of RNA and protein synthesis, including a new section and summary table on the different kinds of eukaryotic RNA. Gene regulation is discussed in Chapter 14, which includes new paragraphs on genomic imprinting and epigenetic inheritance. In Chapter 15, we focus on DNA technology and genomics, including new material on DNA analysis, genomics, expressed sequence tags, RNAi, and the importance of GM crops to U.S. agriculture. These chapters build the necessary foundation for exploring the human genome in Chapter 16, which has expanded discussion of abnormalities in chromosome structure and on X-linked genes affecting intelligence. In Chapter 17, we introduce the role of genes in development, emphasizing studies on specific model organisms that have led to spectacular advances in this field; changes include new material on RNAi as a powerful tool in developmental genetics and discussion of cancer as a stem cell disease.

NEW The art program in the genetics section includes many new pieces, such as Figures 10-8 (cohesins), 10-11 (binary fission), 12-14 (DNA repair), 13-11 (linkage of amino acid to its specific RNA), 13-18 (photo of plants with altered miRNA), 14-1 (lean pig with *IGF2* mutation), 14-13 (protein degradation by ubiquitin-proteasomes), 15-9 (Southern blotting technique), 15-15 (DNA fingerprinting), 16-5 (common abnormalities in chromosome structure), 16-10 (gene therapy in mouse bone marrow cells), and 17-6 (six model organisms).

Part 4: The Continuity of Life: Evolution

Although we explore evolution as the cornerstone of biology throughout the book, Part 4 delves into the subject in depth. We provide the history behind the discovery of the theory of evolution, the mechanisms by which it occurs, and the methods by which it is studied and tested. Chapter 18 introduces the Darwinian concept of evolution and presents several kinds of evidence that support the theory of evolution. In Chapter 19, we examine evolution at the population level. Chapter 20 describes the evolution of new species and discusses aspects of macroevolution. Chapter 21 summarizes the evolutionary history of life on Earth. In Chapter 22, we recount the evolution of the primates, including humans. Many topics and examples have been added to the eighth edition, such as new material on developmental biology as evidence for evolution in Galápagos finches, the founder effect and genetic drift with respect to Finns and Icelanders, ways of defining a species, the Archaean and Proterozoic eons, and a new *Focus On* box on *Homo floresiensis*.

Part 5: The Diversity of Life

In this edition of *Biology*, we continue to emphasize the cladistic approach. We use an evolutionary framework to discuss each group of organisms, presenting current hypotheses of how groups of organisms are related. Chapter 23 discusses why organ-

isms are classified and provides insight into the scientific process of deciding *how* they are classified. New advances have enabled us to further clarify the connection between evolutionary history and systematics in the eighth edition. Chapter 24, which focuses on the viruses and prokaryotes, contains a major revision of prokaryote classification and new sections on evolution in bacteria and on biofilms. Chapter 25 reflects the developing consensus among the eight major eukaryote groups. Chapter 26 describes the fungi and includes an updated phylogeny with a discussion of members of phylum Glomeromycota and their role as mycorrhizal fungi. Chapters 27 and 28 present the members of the plant kingdom; Chapter 28 includes new material that updates the evolution of the angiosperms. In Chapters 29 through 31, which cover the diversity of animals, we place more emphasis on molecular systematics. We have also added new sections on animal origins and the evolution of development.

Part 6: Structure and Life Processes in Plants

Part 6 introduces students to the fascinating plant world. It stresses relationships between structure and function in plant cells, tissues, organs, and individual organisms. In Chapter 32, we introduce plant structure, growth, and differentiation. Chapters 33 through 35 discuss the structural and physiological adaptations of leaves, stems, and roots. Chapter 36 describes reproduction in flowering plants, including asexual reproduction, flowers, fruits, and seeds. Chapter 37 focuses on growth responses and regulation of growth. In the eighth edition, we present the latest findings generated by the continuing explosion of knowledge in plant biology, particularly at the molecular level. New topics include the molecular basis of mycorrhizal and rhizobial symbioses, molecular aspects of floral initiation at apical meristems, self-incompatibility, and the way that auxin acts by signal transduction. Chapter 36 also discusses a new experiment figure on the evolutionary implications of a single mutation in a gene for flower color that resulted in a shift in animal pollinators.

Part 7: Structure and Life Processes in Animals

In Part 7, we provide a strong emphasis on comparative animal physiology, showing the structural, functional, and behavioral adaptations that help animals meet environmental challenges. We use a comparative approach to examine how various animal groups have solved similar and diverse problems. In Chapter 38, we discuss the basic tissues and organ systems of the animal body, homeostasis, and the ways that animals regulate their body temperature. Chapter 39 focuses on body coverings, skeletons, and muscles. In Chapters 40 through 42, we discuss neural signaling, neural regulation, and sensory reception. In Chapters 43 through 50, we compare how different animal groups carry on specific life processes, such as internal transport, internal defense, gas exchange, digestion, reproduction, and development. Each chapter in this part considers the human adaptations for the life processes being discussed. Part 7 ends with a discussion of

behavioral adaptations in Chapter 51. Reflecting recent research findings, we have added new material on homeostasis and the process of contraction in whole muscle. We have also updated and added new material on neurotransmitters, information processing, thermoreceptors, electroreceptors and magnetoreception, endocrine regulation of blood pressure, Toll-like receptors, cytokines, cancer treatment, HIV and autoimmune diseases, new nutrition guidelines, obesity, maintenance of fluid and electrolyte balance, steroid action that allows rapid signaling, melanocyte-stimulating hormones (MSH), diabetes, anabolic steroids, menopause, the estrous cycle, contraception, and STDs. In Chapter 51, we have added new information on cognition, communication, interspecific and intraspecific selection, parental care, and helping behavior.

Part 8: The Interactions of Life: Ecology

Part 8 focuses on the dynamics of populations, communities, and ecosystems and on the application of ecological principles to disciplines such as conservation biology. Chapters 52 through 55 give the student an understanding of the ecology of populations, communities, ecosystems, and the biosphere, whereas Chapter 56 focuses on global environmental issues. Among the many changes in this unit are new material on secondary productivity, top-down and bottom-up processes, characteristics of endangered species, deforestation, and a greatly expanded section on conservation biology.

A COMPREHENSIVE PACKAGE FOR LEARNING AND TEACHING

A carefully designed supplement package is available to further facilitate learning. In addition to the usual print resources, we are pleased to present student multimedia tools that have been developed in conjunction with the text.

Resources for Students

Study Guide to Accompany Biology, Eighth Edition, by Ronald S. Daniel of California State Polytechnic University, Pomona; Sharon C. Daniel of Orange Coast College; and Ronald L. Taylor. Extensively updated for this edition, the study guide provides the student with many opportunities to review chapter concepts. Multiple-choice study questions, coloring-book exercises, vocabulary-building exercises, and many other types of active-learning tools are provided to suit different cognitive learning styles.

A Problem-Based Guide to Basic Genetics by Donald Cronkite of Hope College. This brief guide provides students with a systematic approach to solving genetics problems, along with numerous solved problems and practice problems.

Spanish Glossary. NEW This Spanish glossary of biology terms is available to Spanish-speaking students.

Website. The content-rich companion website that accompanies *Biology*, Eighth Edition, gives students access to high-quality resources, including focused quizzing, a Glossary complete with pronunciations, InfoTrac® College Edition readings and exercises, Internet activities, and annotated web links. For these and other resources, visit www.thomsonedu.com/biology/solomon.

ThomsonNOW. NEW This updated and expanded online learning tool helps assess students' personal study needs and focus their time. By taking a pretest, they are provided with a Personalized Study plan that directs them to text sections and narrated animations—many of which are new to this edition—that they need to review. If they need to brush up on basic skills, the **How Do I Prepare?** feature walks them through tutorials on basic math, chemistry, study skills, and word roots.

Audio. NEW This edition of *Biology* is accompanied by a range of "mobile content" resources, including downloadable study skill tips and concept reviews in MP3 format for use on a portable MP3 player.

Virtual Biology Laboratory 3.0 by Beneski and Waber. **NEW** These 14 online laboratory experiments, designed within a simulation format, allow students to "do" science by acquiring data, performing experiments, and using data to explain biological concepts. Assigned activities automatically flow to the instructor's grade book. New self-designed activities ask students to plan their procedures around an experimental question and write up their results.

Additional Resources for Instructors

The instructors' Examination Copy for this edition lists a comprehensive package of print and multimedia supplements, including online resources, available to qualified adopters. Please ask your local sales representative for details.

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