

Preface

This edition of *Biology: The Unity and Diversity of Life* includes a wealth of new information about recent discoveries in biology (details can be found in the *Power Bibliography*, which lists journal articles and other references we used in the revision process). Descriptions of current research, along with photos and videos of scientists who carry it out, underscore the concept that science is an ongoing endeavor carried out by a diverse community of people. We discuss not only what was discovered, but also how the discoveries were made, how our understanding has changed over time, and what remains undiscovered.

At the same time, we provide a thorough, accessible introduction to well-established concepts and principles that underpin modern biology. We examine every topic from an evolutionary perspective and emphasize the connections between all forms of life. Throughout the book, we revised text and diagrams to make difficult concepts easier for students to grasp.

We also continue to focus on real world applications of the topics we discuss. This edition provides expanded coverage of human health and diseases. It also covers in more detail the many ways in which human activities can alter the environment and threaten both human health and the biodiversity of our planet.

CHANGES TO THIS EDITION

Learning Road Map Each chapter opens with a *Learning Road Map* that places the chapter in a larger context. It notes which previously discussed material the chapter draws upon, highlights key concepts discussed within the chapter, and looks ahead to later sections that refer back to the chapter's concepts. For added impact, each *Learning Road Map* overlays an intriguing full-page opening photo. The photo reappears within the chapter, together with a caption that explains its content.

Opening Essay/Essay Revisited We now devote the first section of each chapter to an essay about an environmental or health application of that chapter's theme. The final section revisits this topic as a reminder of the chapter's relevance to the real world.

Section-Based Links to Earlier Concepts *Links to Earlier Concepts* appear at the start of most sections. These links emphasize connections between biological topics and facilitate review of material that has not been fully mastered. For example, the heading of the section about membrane potential refers back to earlier coverage of potential energy and of transport proteins.

Section-Based Glossaries In addition to a full glossary of terms at the end of the book, each section now has a *Section-Based Glossary* that includes all boldface terms for that section. A student can simply glance at this glossary for a quick check of a term's meaning.

Step-by-Step Graphics Integrated With Text We have long explained biological processes using figures accompanied by step-by-step captions. In this edition, we've also integrated stepwise descriptions of many

graphics into the text, using colored, numbered balls to make the connections.

Visual Chapter Summary To further enhance visual learning, we've added graphics to each section of the chapter summary. As before, each chapter summary includes all key terms from that chapter in boldface.

Chapter-Specific Changes Every chapter was extensively revised for clarity; this edition has more than 200 new photos and over 250 new or updated figures. A section-by-section guide to content and figures is available upon request, but we summarize the highlights here.

- **Chapter 1, Invitation to Biology** Revised and expanded coverage of critical thinking, scientific process, and philosophy of science. Material on classification systems moved to this chapter.
- **Chapter 2, Life's Chemical Basis** New opening essay discusses mercury toxicity and prevalence; revisions emphasize electron behavior in atoms as it relates to ions and bonding.
- **Chapter 3, Molecules of Life** Importance of protein structure now exemplified with prions.
- **Chapter 4, Cell Structure and Function** Expanded discussion and new photos of archaeans.
- **Chapter 5, Ground Rules of Metabolism** Chapter now includes material on cell membrane function; new section on cofactors, including ATP.
- **Chapter 6, Where It Starts—Photosynthesis** Biofuels essay revised to include food supply debate; revisited section on climate change and CO₂ now includes atmospheric change after photosynthesis evolution.
- **Chapter 7, How Cells Release Chemical Energy** Introductory section now discusses the relationship between the evolution of oxygenic photosynthesis and aerobic respiration. Third stage art revised to connect with summary illustration.
- **Chapter 8, DNA Structure and Function** This chapter was moved forward in book to allow a more complete explanation of genes and inheritance; now includes material on chromosome structure and mutations. New opener essay about cloned 9/11 rescue dog Tracker.
- **Chapter 9, From DNA to Protein** Introductory essay revised to include RIPs other than ricin; material on sickle cell anemia and other effects of beta globin mutations added.
- **Chapter 10, Gene Control** Theme of evolutionary connections strengthened throughout; male sex determination and riboswitches added to existing sections; new epigenetics section added.
- **Chapter 11, How Cells Reproduce** New fluorescence micrograph of HeLa cells shows how defects in cell cycle controls lead to cancer; section on telomeres added.
- **Chapter 12, Meiosis and Sexual Reproduction** Artwork updated; new fluorescence micrograph illustrates checkpoint proteins in meiosis.
- **Chapter 13, Observing Patterns in Inherited Traits** Opening essay is now on inheritance of CF mutation. Environmental effects section rewritten to include epigenetics and pelage cycle.

- **Chapter 14, Chromosomes and Human Inheritance** Opening essay on human skin color moved to this chapter. Chapter reorganized to strengthen introduction to human genetics; genetic screening section updated; many photos replaced with newer versions.
- **Chapter 15, Studying and Manipulating Genomes** New opening section on personal genetic testing; updated genomics section includes expanded material on DNA profiling. New brainbow photo.
- **Chapter 16, Evidence of Evolution** New graphics include a page from Darwin's evolution journal and updated paleogeography illustrations.
- **Chapter 17, Processes of Evolution** New illustrated examples include allopatric speciation in snapping shrimp, sympatric speciation in Lake Victoria cichlids, ring species; coevolution of an ant and a butterfly.
- **Chapter 18, Organizing Information About Species** Expanded and updated phylogeny/cladistics section; *Hox* gene comparison material updated with new examples and photos.
- **Chapter 19, Life's Origin and Early Evolution** Opening essay focuses on astrobiology. Added micrographs and discussion of bacteria with internal membranes. Improved figure illustrates step on the road to life.
- **Chapter 20, Viruses, Bacteria, and Archaea** Opening essay discusses SIV and evolution of HIV. More detailed depiction of HIV replication. Coverage of prions moved to Chapter 3. New figure shows viral recombination.
- **Chapter 21, Protists—The Simplest Eukaryotes** New opening essay about malaria. New step-by-step figure illustrating *Plasmodium* life-cycle. Clearer, simpler illustration of *Chlamydomonas* life cycle. Choanoflagellates now introduced here.
- **Chapter 22, The Land Plants** Essay about Nobel Prize winner W. Mathai's work. Life cycle figures revised.
- **Chapter 23, Fungi** New opening essay about the threat wheat stem rust poses to food supplies. Life cycle figures revised for clarity. Additional photos of fungal diversity.
- **Chapter 24, Animal Evolution—Invertebrates** Improved or new graphics of animal evolutionary tree, types of body cavities, crab life cycle, grasshopper anatomy.
- **Chapter 25, Animal Evolution—Vertebrates** New evolutionary tree diagram, graphic of tunicate. Discussion of fish evolution revised. New graphic illustrates major mammal orders. Material on human evolution moved to separate chapter.
- **Chapter 26, Human Evolution** Opening essay describes recent evidence that Neanderthals mated with *Homo sapiens*. The chapter covers primate groups and the latest discoveries regarding human ancestry.
- The chapter *Plants and Animals—Common Challenges* has been deleted and material previously covered therein is now integrated into other chapters.
- **Chapter 27, Plant Tissues** New introductory essay on carbon sequestration by plants; reorganized tissue section now includes thumbnail photos; many revised illustrations and new micrographs.
- **Chapter 28, Plant Nutrition and Transport** Plant nutrient table revised to include functions; soil water uptake artwork revised; new artwork and micrographs of xylem tubes; expanded discussion of stomata function.
- **Chapter 29, Life Cycles of Flowering Plants** Material on early plant development, senescence, and dormancy moved to this chapter and expanded. Many new photos.
- **Chapter 30, Communication Strategies in Plants** Extensively revised and expanded to reflect paradigm shifts driven by recent research. New introductory essay on health benefits of cocoa; new section introducing plant hormones added; material on major hormones expanded and reorganized by section; new section on plant stress responses added.
- **Chapter 31, Animal Tissues and Organ Systems** New graphics depicting levels of organization, endocrine versus exocrine glands. Added discussion of carcinomas, vitiligo, loss of body hair in human evolution.
- **Chapter 32, Neural Control** Added latest research on effects of Ecstasy use. Additional info about the role of neuroglia in disease. Split-brain research deleted.
- **Chapter 33, Sensory Perception** Updated discussion of olfaction with new figure. Increased coverage of diversity of visual systems. More about effects of noise pollution.
- **Chapter 34, Endocrine Control** New graphic of human endocrine system. Added section about thymus. Added information about phthalates as endocrine disruptors.
- **Chapter 35, Structural Support and Movement** New essay about effects of myostatin. Improved figures depicting muscle contraction.
- **Chapter 36, Circulation** Updated art throughout. Added illustration of a stent.
- **Chapter 37, Immunity** Innate responses material expanded to two sections that include updated illustrations and photos; also added neutrophil nets. Expanded sections on immune dysfunction, vaccines.
- **Chapter 38, Respiration** New essay about carbon monoxide poisoning. New graphic of CO₂ transport.
- **Chapter 39, Digestion and Nutrition** New essay about the importance of gut bacteria. Discussion of stomach and small intestine revised to improve flow.
- **Chapter 40, Maintaining the Internal Environment** New figures for urine formation and renin-angiotensin-aldosterone system. New coverage of hibernation.
- **Chapter 41, Animal Reproductive Systems** New graphics depicting sperm formation, female genitals. Section about FSH and twins deleted.
- **Chapter 42, Animal Development** Updated essay with discussion of "octomom" and early opposition to IVF.
- **Chapter 43, Animal Behavior** Added discussions of kinesis and taxis, epigenetic effects, behavioral plasticity.
- **Chapter 44, Population Ecology** New essay about Canada goose population explosion. Human population material updated.
- **Chapter 45, Community Ecology** New studies of competition cited. Revised discussion of disturbance and exotic species.
- **Chapter 46, Ecosystems** New essay on phosphate pollution. Section on carbon cycle revised and updated.
- **Chapter 47, The Biosphere** Added information about latest deep ocean life. New biome photos.
- **Chapter 48, Human Impacts on the Biosphere** Biological magnification, ozone depletion and pollution now covered in this section

STUDENT AND INSTRUCTOR RESOURCES

Test Bank Nearly 4,000 test items, ranked according to difficulty and consisting of multiple-choice (organized by section heading), selecting the exception, matching, labeling, and short answer exercises. Includes selected images from the text. Also included in Microsoft® Word format on the PowerLecture DVD.

ExamView® Create, deliver, and customize tests (both print and online) in minutes with this easy-to-use assessment and tutorial system. Each chapter's end-of-chapter material is also included.

Instructor's Resource Manual Includes chapter outlines, objectives, key terms, lecture outlines, suggestions for presenting the material, classroom and lab enrichment ideas, discussion topics, paper topics, possible answers to critical thinking questions, answers to data analysis activities, and more. Also included in Microsoft® Word format on the PowerLecture DVD.

Student Interactive Workbook Labeling exercises, self-quizzes, review questions, and critical thinking exercises help students with retention and better test results.

PowerLecture This convenient tool makes it easy for you to create customized lectures. Each chapter includes the following features, all organized by chapter: lecture slides, all chapter art and photos, bonus photos, animations, videos, Instructor's Manual, Test Bank, Examview testing software, and JoinIn polling and quizzing slides. This single disc places all the media resources at your fingertips.

The Brooks/Cole Biology Video Library 2010 featuring BBC Motion Gallery Looking for an engaging way to launch your lectures? The Brooks/Cole series features short high-interest segments: Pesticides: Will More Restrictions Help or Hinder?; A Reduction in Biodiversity; Are Biofuels as Green as They Claim?; Bone Marrow as a New Source for the Creation of Sperm; Repairing Damaged Hearts with Patients' Own Stem Cells; Genetically Modified Virus Used to Fight Cancer; Seed Banks Helping to Save Our Fragile Ecosystem; The Vanishing Honeybee's Impact on Our Food Supply.

Webtutors for WebCT and BlackBoard Jump-start your course with customizable, rich, text-specific content. Whether you want to Web-enable your class or put an entire course online, WebTutor delivers. WebTutor offers a wide array of resources including media assets, quizzing, web links, exercises, flashcards, and more. Visit webtutor.cengage.com to learn more. New to this edition are pop-up tutors, which help explain key topics with short video explanations.

Biology CourseMate Cengage Learning's Biology CourseMate brings course concepts to life with interactive learning, study, and exam preparation tools that support the printed textbook, or the included ebook. With CourseMate, professors can use the included Engagement Tracker to assess student preparation and engagement. Use the tracking tools to see progress for the class as a whole or for individual students.

Premium eBook This complete online version of the text is integrated with multimedia resources and special study features, providing the motivation that so many students need to study and the interactivity they need to learn. New to this edition are pop-up tutors, which help explain key topics with short video explanations.

ACKNOWLEDGMENTS

Writing, revising, and illustrating a biology textbook is a major undertaking for two full-time authors, but our efforts constitute only a small part of what is required to produce and sell this one. We are truly fortunate to be part of a huge team of very talented people who are as committed as we are to creating and disseminating an exceptional science education product.

Biology is not dogma; paradigm shifts are a common outcome of the fantastic amount of research in the field. Thus, ideas about what material should be taught and how best to present that material to students changes even from one year to the next. It is only with the ongoing input of our many academic reviewers and advisors (see *opposite page*) that we can continue to tailor this book to the needs of instructors and students while integrating new information and models. We continue to learn from and be inspired by these dedicated educators. A special thank-you goes to Michael Plotkin for his thoughtful, thorough input on current paradigms in evolutionary biology.

On the production side of our team, the indispensable Grace Davidson orchestrated the flow of countless files, photos, and illustrations while managing schedules, budgets, and whatever else happened to be on fire at the time. Grace, thank you for your continued patience and dedication. Photoresearch for this book presents a special challenge because we often request images from unusual or difficult-to-reach sources. Paul Forkner, thank you for your persistence and determination to track down many of the exceptional photos that make this book unique. Copyeditor Anita Wagner and proofreader Diane Miller, your valuable suggestions kept our text clear and concise.

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LISA STARR AND CHRISTINE EVERS
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