

PREFACE



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Since the last edition of this book was published, researchers have discovered ice on Mars and have documented rapid glacial melting here on Earth. They have identified thousands of new species, including a spider (left) now named after a television show host. They have also uncovered a wealth of information about extinct species, including some of our own close relatives. Biologists have created a vaccine that protects against cervical cancer, and can now make adult cells behave like embryonic stem cells.

In short, what we know about biological systems changes very rapidly. Given the pace of the changes, we would do well to help our students become lifelong learners. Most of the students who use this book will not be biologists, and many will never take another science course. Yet, as voting members of our society, all will face decisions that require a basic understanding of the principles of biology and the process of science in general. This book provides a foundation for such decisions. It teaches students how to draw connections between abstract ideas and everyday experiences, between recent discoveries and long-standing biological theories.

New To This Edition



Graphically Enhanced Key Concepts

The opening pages of each chapter introduces **Key Concepts**, concise statements that set the stage for the more detailed discussion that follows. In this edition, each key concept is accompanied by a photo or graphic that

catches the student's eye. The student will encounter these images again within the chapter and in the **Illustrated Chapter Summary** as part of a visual message that threads through each chapter.

Improved Integration Among Chapters We retained the **Links to Earlier Concepts** on the opening spread of each chapter. This brief paragraph reminds students of relevant information that has been covered in previous chapters. We have also improved the usefulness of the in-chapter Links references by including a brief description of the relevant material. For example, the heading of the section that covers membrane potential in neurons notes that this material links to "Potential energy 5.2, Transport proteins 5.7."

Section-Based Glossary In addition to a full glossary of terms at the end of the book, each section now has a **Section-Based Glossary**. Important new terms that are boldfaced and defined in the text of a section are redefined in the Section-Based Glossary. A student can simply glance at this glossary for a quick check of a term's definition. As an additional aid, the Chapter Summary includes all glossary terms used in context. Here again, the terms appear in boldface.

Figure-Based Self-Assessment Questions Many figure captions now include a **Figure-It-Out Question** that allows

the student to check whether he or she understands the figure's content. For example, Figure 12.5, which shows the stages of meiosis, is accompanied by a question that asks the student to identify the stage of meiosis in which the chromosome number becomes reduced. Answers to Figure-It-Out questions are provided on the same page. Additional self-assessment material is provided in the Self-Quiz and Critical Thinking Questions at the end of the chapter.

Emphasis on Analyzing Scientific Data A new chapter end feature, the **Data Analysis Activity**, sharpens the student's analytical skills while reinforcing the process of science.

Each activity asks the student to interpret data presented in graphic or tabular form. The data is related to the chapter material, and has usually been taken directly from a published scientific study or experiment. For example, the Data



Analysis Activity in Chapter 27, Plant Reproduction and Development, asks for analysis of data from a study that tested whether gerbils are the main pollinators of certain desert plants (left).

Chapter-Specific Changes This new edition contains 140 new photographs and almost 400 new or updated illustrations. In addition, the text of every chapter has been updated and revised for clarity. A page-by-page guide to new content and figures is available upon request, but we summarize the highlights here. Note that we have added a new final chapter, *Human Effects on the Biosphere*. We have also deleted a chapter (*Plants and Animals—Common Challenges*) that appeared in the previous edition. Material that had been in the *Common Challenges* chapter is now integrated into other chapters.

- **Chapter 1, Invitation to Biology** Revised and expanded coverage of critical thinking and the process of science; levels of life's organization now illustrated with the same organism.
- **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** New opening essay discusses health impacts of *trans* fats; importance of protein structure now exemplified by prions.
- **Chapter 4, Cell Structure** New opening essay about *E. coli* O157:H7 contamination of food; expanded discussion and new photos of archaeans.
- **Chapter 5, Ground Rules of Metabolism** Example in opening essay is now ADH, to tie in with revisited section about ethanol metabolism, defects in the pathway that affect drinking behavior, and metabolic effects of alcohol abuse.
- **Chapter 6, Where It Starts—Photosynthesis** New opening essay about biofuels ties in to discussion regarding photosynthesis, carbon dioxide, and global climate change.
- **Chapter 7, How Cells Release Chemical Energy** Introductory section now discusses the relationship between the evolution of oxygenic photosynthesis and that of aerobic respiration.

- *Chapter 8, DNA Structure and Function* Opening essay now discusses the cloning of 9/11 rescue dog Tracker; discussion of animal cloning techniques and applications expanded.
- *Chapter 9, From DNA to Protein* Expanded introductory material now includes an overview of genetic information and gene expression; all new illustrations of translation.
- *Chapter 10, Controls Over Genes* Theme of evolutionary connections strengthened throughout; for example, in the comparison of effects of mutations in the same homeotic gene in humans and flies.
- *Chapter 11, How Cells Reproduce* Mitosis panel now compares micrographs of plant and animal cells; new section on cell cycle controls and neoplasms.
- *Chapter 12, Meiosis and Sexual Reproduction* Opening essay updated; new photo shows pollen grains germinating on stigma; meiosis and segregation graphics updated.
- *Chapter 13, Observing Patterns in Inherited Traits* Updated essay with current model of CF pathogenesis and greater emphasis on genetics behind the ubiquity of the allele.
- *Chapter 14, Human Inheritance* New opening essay explores the genetics of skin color variation and discusses evolutionary advantages that reinforce small allelic differences.
- *Chapter 15, Biotechnology* New opening essay discusses personal genetic testing; updated, expanded genomics section.
- *Chapter 16, Evidence of Evolution* New graphics include a sheet from Darwin's evolution journal and "missing links" in cetacean evolutionary history; updated geologic time scale now graphically correlated with Grand Canyon stratigraphy.
- *Chapter 17, Processes of Evolution* New illustrated examples include allopatric speciation in snapping shrimp; sympatric speciation in Lake Victoria cichlids; adaptive radiation of honeycreepers; coevolution of the large blue butterfly and *Maculinea arion* ant. Stasis and exaptation added.
- *Chapter 18, Life's Origin and Early Evolution* New opening section now focuses on astrobiology; added information about biomarkers as historical evidence.
- *Chapter 19, Viruses, Bacteria, and Archaeans* New opening section discusses evolution of HIV; new art of HIV replication cycle; new information about influenzas H5N1 and H1N1.
- *Chapter 20, The Protists* Opening section now covers harmful algal blooms; new graphic showing relationships of protists to other groups; new art of *Plasmodium* life cycle.
- *Chapter 21, Plant Evolution* Opening section now focuses on Nobel Prize winner Wangari Maathai's efforts on behalf of tropical forests; new section focusing on the ecological and economic importance of angiosperms.
- *Chapter 22, Fungi* Opening section describes the threat wheat stem rust poses to world food supplies; more extensive coverage of fungi as plant and human pathogens.
- *Chapter 23, Animals I: Major Invertebrate Groups* Updated evolutionary tree showing relationships among animal groups; major reorganization of coverage of insects and improved discussion of their ecological, economic, and health impacts.
- *Chapter 24, Animals II: The Chordates* New evolutionary tree diagrams for chordates and for primates.
- *Chapter 25, Plant Tissues* New opening essay about carbon sequestration in plant tissues; new section introduces stem specializations illustrated with photos of common food plants.
- *Chapter 26, Plant Nutrition and Transport* Added function(s) to nutrients table; new photo of erosion in Providence Canyon, Georgia.
- *Chapter 27, Plant Reproduction and Development* New opening essay about colony collapse disorder illustrated with photos showing superior fruit from insect-pollinated flowers.
- *Chapter 28, Animal Tissues and Organ Systems* Opening essay about stem cells updated; improved coverage of embryonic tissues, development of body cavities.
- *Chapter 29, Neural Control* Information about results of new studies of Ecstasy; material related to vertebrate nervous systems heavily reorganized to improve flow.
- *Chapter 30, Sensory Perception* New graphics depicting effects of visual disorders; improved discussion of visceral sensations.
- *Chapter 31, Endocrine Control* Added a subsection of neuroendocrine interactions; more coverage of adrenal gland disorders and how complications of diabetes arise.
- *Chapter 32, Structural Support and Movement* Opening section now discusses effects of mutations that affect myostatin; new graphic illustrating knee anatomy and opposing muscles of the arm; new material on classifying muscle fibers as red versus white and fast versus slow.
- *Chapter 33, Circulation* Opening section now focuses on a young athlete saved by CPR and use of an automated external defibrillator; historical material about the first EKG deleted.
- *Chapter 34, Immunity* New intro essay about HPV and cervical cancer, including Gardasil vaccine. New section details how antigens and immunity factor in transfusion reactions.
- *Chapter 35, Respiration* New figure emphasizing the two sites of gas exchange; improved figure illustrating countercurrent flow in fishes; added information about pneumonia and asthma.
- *Chapter 36, Digestion and Human Nutrition* New information about a common allele associated with obesity; discussion of stomach and intestines reorganized to improve flow; added information about celiac disease, health effects of different lipids, and how to interpret nutrition labels.
- *Chapter 37, The Internal Environment* Added discussion of invertebrate solute-regulating systems; new figure depicting urine formation.
- *Chapter 38, Reproduction and Development* Heavy revision to shorten chapter; opening section now discusses the history of IVF and the "octomom" story.
- *Chapter 39, Animal Behavior* New material on behavioral genetics and expanded coverage of mechanisms of learning.
- *Chapter 40, Population Ecology* Opening essay now focuses on soaring numbers of Canada goose; human life table and age-structure diagrams updated.
- *Chapter 41, Community Ecology* New description and photo of interspecific competition; more focused, concise coverage of exotic species; new subsection about herbivory.
- *Chapter 42, Ecosystems* Opening section focuses on phosphate pollution of waterways; new diagrams of water, carbon, nitrogen, and phosphorus cycles.
- *Chapter 43, The Biosphere* Discussion of deserts expanded; soil profiles integrated into biome descriptions.
- *Chapter 44, Human Effects on the Biosphere* Includes material about declining biodiversity, desertification, deforestation, water shortages and pollution, biological accumulation and magnification, effects of trash on marine ecosystems, depletion of the ozone layer, ground level ozone pollution, effects of climate change, conservation biology and sustainable uses of resources.