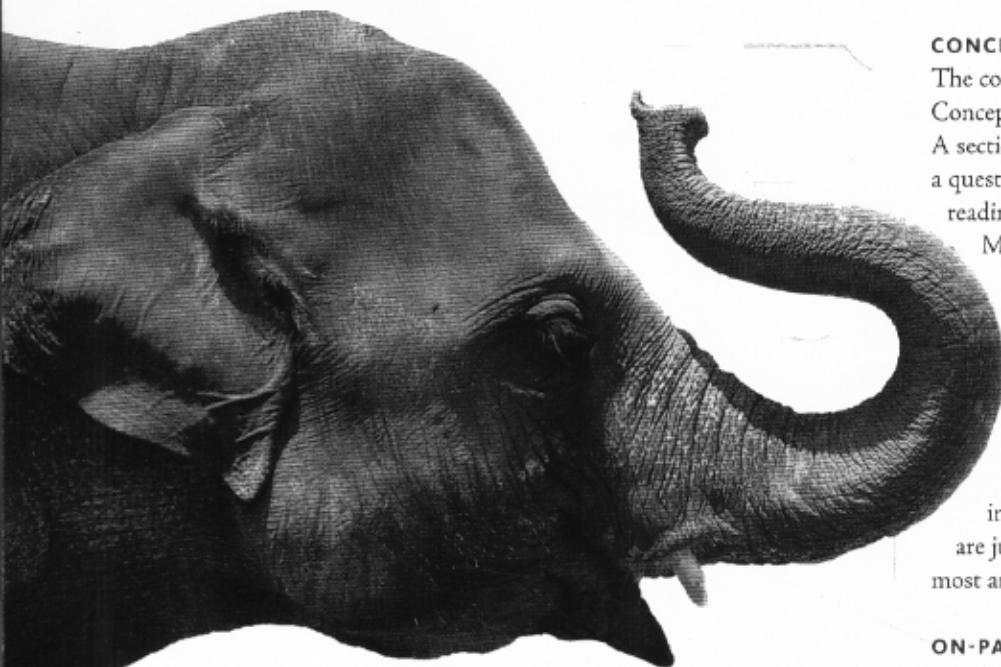


Preface



We wrote this book to provide an accessible and appealing introduction to the study of life. Most students who use it will not become biologists, but all can benefit from an enhanced understanding of biological processes. For example, knowing how cells and bodies work helps a person make informed decisions about nutrition, life-style, and medical care. Recognizing the breadth of biodiversity, the mechanisms by which it arises, and the ways in which species interact brings to light the threats posed by human-induced extinctions. Realizing how living and nonliving components of ecosystems interact makes it clear why human activities such as adding greenhouse gases to the atmosphere puts us and other species at risk.

Our quest to educate and edify is shared by the National Geographic Society, with whom we have partnered for this edition. You will see the fruits of this partnership throughout the text—in spectacular new photographs, informative illustrations, and text features that highlight the wide variety of work supported by the society.

FEATURES OF THIS EDITION

SETTING THE STAGE

Each chapter opens with a dramatic two-page photo spread. A brief Links to Earlier Concepts paragraph reminds students of relevant information that has been covered in previous chapters, and concise Key Concept statements summarize the current chapter's content. An eye-catching image that appears in icon form next to each key concept also occurs within a relevant section, as part of a visual message that threads through the chapter.

CONCEPT SPREADS

The content of every chapter is organized as a series of Concepts, each explored in a section that is two pages or less. A section's Concept is reflected in its title, which is posed as a question that the student should be able to answer after reading the text. Bulleted sentences in the Take Home Message summarize and reinforce the Concept and supporting information provided in the section.

PEOPLE MATTER

Our new People Matter feature illustrates the relevance of ongoing research, and also highlights the diversity of the modern scientific community. Individuals whose work is spotlighted in this feature include well-established scientists, young scientists who are just beginning their careers, and a few nonscientists; most are National Geographic Explorers or Grantees.

ON-PAGE GLOSSARY

A new On-Page Glossary comprises boldface key terms introduced in each section. This section-by-section glossary offers definitions in alternate wording, and can also be used as a quick study aid. All glossary terms also appear in boldface in the Chapter Summary.

EMPHASIS ON RELEVANCE

Each chapter ends with an Application section that explains a current topic in light of the chapter content. For example, in Chapter 29, students use what they just learned about neural control to understand how sports-induced concussions permanently injure the brain—which is under intense study by scientific and athletic communities at this writing. Each Application also relates to a core interest of the National Geographic Society: Education, Conservation, Exploration, Get Involved, or Sustainability.

SELF-ASSESSMENT TOOLS

Many figure captions now include a Figure-It-Out Question and answer that allow students to quickly check their understanding of the illustration. At the end of each chapter, Self-Quiz and Critical Thinking Questions provide additional self-assessment material. A new chapter-end Data Analysis Activity sharpens analytical skills by asking the student to interpret data presented in graphic or tabular form. The data is related to the chapter material, and is from a published scientific study in most cases. For example, the Activity in Chapter 13 (Observing Patterns in Inherited Traits) asks the student to interpret data from an experiment revealing the suppressive effect of cystic fibrosis mutations on cellular uptake of *Salmonella* bacteria. This Activity continues the explanation of cystic fibrosis inheritance patterns begun in the chapter's Application section.



CHAPTER-SPECIFIC CHANGES This new edition contains 275 new photographs and almost 200 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.

Chapter 1, Invitation to Biology

Renewed and updated emphasis on the relevance of new species discovery and the process of science; new features spotlight Smithsonian curator Kris Helgen and marine biologist Tierney Thys.

Chapter 2, Life's Chemical Basis

New graphics illustrate elements and radioactive decay; new feature spotlights volcanologist Ken Sims sampling radioisotopes in lava.

Chapter 3, Molecules of Life

New illustrations of carbon rings and tertiary structure; new feature spotlights discovery of carbohydrates in gas surrounding a sunlike star.

Chapter 4, Cell Structure

New photos illustrate surface-to-volume ratio, prokaryotes, biofilms, food vacuoles, chloroplasts, amyloplasts, basal bodies, and *E. coli* on food. New art illustrates plant cell walls, plasmodesmata, and cell junctions. Comparison of microscopy techniques updated using *Paramecium*. New features highlight electrical engineer Aydogan Ozcan's cell phone microscope, and astrobiologist Kevin Hand's work with NASA.

Chapter 5, Ground Rules of Metabolism

New photos illustrate potential energy, activation energy, energy transfer in redox reactions, turgor, phagocytosis, and alcohol abuse. Temperature-dependent enzyme activity now illustrated with polymerases. New feature highlights pressure-tolerant enzymes of deep sea amphipods. Expanded material on cofactors consolidated with ATP into new section. New activity requires interpretation of pH activity graphs of four enzymes from an extremophile archaeon.

Chapter 6, Where It Starts—Photosynthesis

New photos illustrate phycobilins, and adaptations of C4 plants. New feature highlights conservation work of forester Willie Smith.

Chapter 7, How Cells Release Chemical Energy

New photos illustrate alcoholic and lactate fermentation, mitochondria, and mitochondrial disease. Revised art shows aerobic respiration's third stage. New feature highlights Benjamin Rapoport's glucose-driven, implantable fuel cell.

Chapter 8, DNA Structure and Function

Chromosome and DNA artwork has been revised for consistency throughout unit; DNA replication art updated.

New photos illustrate DNA, x-ray diffraction, and mutation. New section consolidates material on DNA damage and mutations. New Figure spotlights marine biologist Mariana Fuentes, who studies how global warming is impacting sex ratios in sea turtle populations. Sex determination figure removed (text content remains).

Chapter 9, From DNA to Protein

New feature highlights Jack Horner's discovery of *T. rex* collagen in an ancient fossil. Expanded material on the effects of mutation includes new micrograph of a sickled blood cell. Ricin essay expanded to include other RIPs along with new photos and illustrations. New activity requires interpretation of data on the effects of an engineered RIP on cancer cells.

Chapter 10, Control of Gene Expression

New photos illustrate a polytene chromosome, *antennapedia* gene and mutation, X chromosome inactivation, *Arabidopsis* mutations, and breast cancer survivors; new feature details evolution of lactose tolerance. New section covers epigenetics; new activity requires analysis of retrospective data on an epigenetic effect.

Chapter 11, How Cells Reproduce

New photos illustrate mitosis, the mitotic spindle; new section details telomeres. New feature highlights behavioral ecologist Iain Couzin's hypothesis about collective behavior in metastatic cells.

Chapter 12, Meiosis and Sexual Reproduction

New features highlight evolutionary biologist Maurice Neiman's work on the selective advantage of asexuality in the New Zealand mud snail, and asexuality in bdelloid rotifers. New photos illustrate crossovers and DNA repair during mitosis and meiosis.

Chapter 13, Observing Patterns in Inherited Traits

New figure illustrates how genotype gives rise to phenotype; new photos illustrate epistasis and continuous variation. Coverage of environmental effects on gene expression expanded and updated with new epigenetics research and new feature highlighting psychologist Gay Bradshaw's work on PTSD in elephants.

Chapter 14, Human Inheritance

New feature spotlights geneticist Nancy Wexler's work on Huntington's disease; new photo illustrates albinism.