

P

PREFACE

Biology is a huge field, with a wealth of new discoveries being made every day, and biology-related issues such as climate change, stem cell research, and personal genetics often making headlines. This avalanche of information can be intimidating to non-scientists. This book was designed and written specifically for students who most likely will not become biologists and may never again take another science course. It is an accessible and engaging introduction to biology that provides future decision-makers with an understanding of basic biology and the process of science.

A Wealth of Applications This book is packed with everyday applications of biological processes. At every opportunity, we enliven discussions of biological processes with references to their effects on human health and the environment. This edition also continues to focus on real world applications pertaining to the field of biology, including social issues arising from new research and developments. Descriptions of current research, along with photos of scientists who carry it out, underscore the concept that biology is an ongoing endeavor carried out by a diverse community of people. Discussions include not only what was discovered, but also how the discoveries were made, how our understanding has changed over time, and what remains to be discovered. These discussions are provided in the context of an accessible introduction to well-established concepts that underpin modern biology. Every topic is examined from an evolutionary perspective, emphasizing the connections between all forms of life.

Accessible Text Understanding stems from making connections between concepts and details, so a text with too little detail reads as a series of facts that beg to be memorized. However, excessive detail can overwhelm the introductory student. Thus, we constantly strive to strike the perfect balance between level of detail and accessibility. We once again revised the text to eliminate details that do not contribute to a basic understanding of essential concepts. We also know that English is a second language for many introductory students, so we avoid idioms and aim for a clear, straightforward style.

Analogies to familiar objects and phenomena will help students understand abstract concepts. For example, in the discussion of transpiration in Chapter 27 (Plant Form and Function), we explain that a column of water is drawn upward through xylem as a drinker draws fluid up through a straw.

In-Text Learning Tools To emphasize connections between biological topics, each chapter begins with an **APPLICATION** section that explores a current event or controversy directly related to the chapter's content. For example, a discussion of binge drinking on college campuses introduces the concept of metabolism in Chapter 4. This section presents an overview of the metabolic pathway that breaks down alcohol, linking the function of enzymes in the pathway to hangovers, alcoholism, and cirrhosis. The section is illustrated with a photo of a tailgate party that preceded a recent Notre Dame–Alabama football game, and also a photo of Gary Reinbach just before he died at age 22 of alcoholic liver disease. (In the index, you'll find health-related applications denoted by red squares and environmental applications by green squares.)

To strengthen a student's analytical skills and offer insight into contemporary research, each chapter includes an exercise called **DIGGING INTO DATA** that is placed in a section with relevant content. The exercise consists of a short text passage—usually about a published scientific experiment—and a table, chart, or other graphic that presents experimental data. A student can use information in the text and graphic to answer a series of questions. For example, the exercise in Chapter 2 asks students to interpret results of a study that examined the effect of dietary fat intake on “good” and “bad” cholesterol levels.

The chapter itself consists of several numbered sections that contain a manageable chunk of information. Every section ends with a boxed **TAKE-HOME MESSAGE** in which we pose a question that reflects the critical content of the section, and then answer the question in bulleted list format. Every chapter has at least one **FIGURE IT OUT QUESTION** with an answer immediately following. These questions allow students to quickly check their understanding as they read. Mastering scientific vocabulary challenges many students, so we have included an **ON-PAGE GLOSSARY** of key terms introduced in each two-page spread, in addition to a complete glossary at the book's end. The end-of-chapter material features a **VISUAL SUMMARY** that reinforces each chapter's key concepts. A **SELF-QUIZ** poses multiple choice and other short answer questions for self-assessment (answers are in Appendix I). A set of more challenging **CRITICAL THINKING QUESTIONS** provides thought-provoking exercises for the motivated student. The end matter of several chapters now includes a **VISUAL QUESTION** that reinforces learning in a nonverbal style.

Design and Content Revisions Throughout the book, text and art have been revised to help students grasp difficult concepts. The following list highlights some of the revisions to each chapter.

Introduction

- 1 Invitation to Biology** Renewed and updated emphasis on the relevance of new species discovery and the process of science.

Unit 1 How Cells Work

- 2 Molecules of Life** New graphic illustrates radioactive decay.
- 3 Cell Structure** Application section updated with current statistics and 'pink slime' story. Micrograph comparisons now feature *Paramecia* and include a confocal image. Essay about the nature of life expanded to add Gerald Joyce's "life is squishy" concept.
- 4 Energy and Metabolism** Application section now illustrated with a real-life example. Diffusion illustrated with a tea bag in hot water.
- 5 Capturing and Releasing Energy** Application section updated with current statistics and illustrated with a current photo of air pollution in China. Yogurt production added to fermentation section.

Unit 2 Genetics

- 6 DNA Structure and Function** Content reorganized: material on cloning folded into Application section for concept connection, and chromosome structure now appears after DNA structure. New art demonstrates how replication errors become mutations.
- 7 Gene Expression and Control** Ricin discussion revised to include medical applications. New material includes hairlessness mutation (in cats), evolution of lactose tolerance, heritability of DNA methylations, telomeres.
- 8 How Cells Reproduce** New material on telomeres, asexual vs. sexual mud snails. New micrograph shows multiple crossovers.
- 9 Patterns of Inheritance** Epistasis is now illustrated with human skin color. New material about environmentally-triggered hemoglobin production in *Daphnia*; continuous variation in dog face length arising from short tandem repeats foreshadows DNA fingerprinting in chapter 10.

- 10 Biotechnology** Updated coverage of personal genetic testing includes social impact of Angelina Jolie's response to her test. New photos illustrate genetically modified animals. New "what the daddy?" critical thinking question offers students an opportunity to analyze a paternity test based on SNPs.

Unit 3 Evolution and Diversity

- 11 Evidence of Evolution** Photos of 19th century naturalists added to emphasize the process of science that led to natural selection theory. How banded iron formations provide evidence of the evolution of photosynthesis added to fossil section. Plate tectonics updated to reflect new evidence of lava lamp mantle movement.
- 12 Processes of Evolution** New opening essay on resistance to antibiotics as an outcome of agricultural overuse (warfarin resistance now exemplifies directional selection). New art illustrates founder effect, and hypothetical example in text replaced with reduced diversity of ABO alleles in Native Americans. New art illustrates stasis in coelacanths.
- 13 Early Life Forms and the Viruses** New introductory essay about study of the human microbiome, new coverage of Ebola, and figure depicting mechanisms of gene exchange in prokaryotes.
- 14 Plants and Fungi** Additional coverage of fungal ecology, including information about white-nose syndrome in bats.
- 15 Animal Evolution** New introductory essay about invertebrates as a source of medicines. Updated information about Neanderthals and added coverage of the newly discovered *Dennisovans*.

Unit 4 Ecology

- 16 Population Ecology** Updated coverage of human demography.
- 17 Communities and Ecosystems** New photos illustrate species interactions; updated coverage of the increases in greenhouse gases.
- 18 The Biosphere and Human Effects** New essay about dispersion of radioactive material released at Fukushima and new Digging for Data about bioaccumulation of this material in tuna.