

# PREFACE

**T**he mission of my text, *Biology*, has always been to give students an understanding of biological concepts and a working knowledge of the scientific process. If one understands the concepts of biology and the methodology of science, they can be used to understand the particulars of new ideas or a system on any scale from the cell to the biosphere. By now, we are well into the twenty-first century, and the field of biology has been flooded with exciting new discoveries and insights way beyond our predictions even a few short years ago. It is our task, as instructors, to make these findings available to our students so they will have the background to keep up with the many discoveries still to come. At the same time, we must provide students with a firm foundation in those core principles on which biology is founded. This means that the tenth edition of *Biology* is both new and old at the same time. With this edition, instructors will be confident that they are "up to date," while still teaching the fundamental concepts of biology in a way that allows students to apply them in new and different ways. In this edition you will find:

- *Increased Evolutionary Coverage*
- *Currency of Coverage*
- *Media Integration*

## Birth of *Biology*

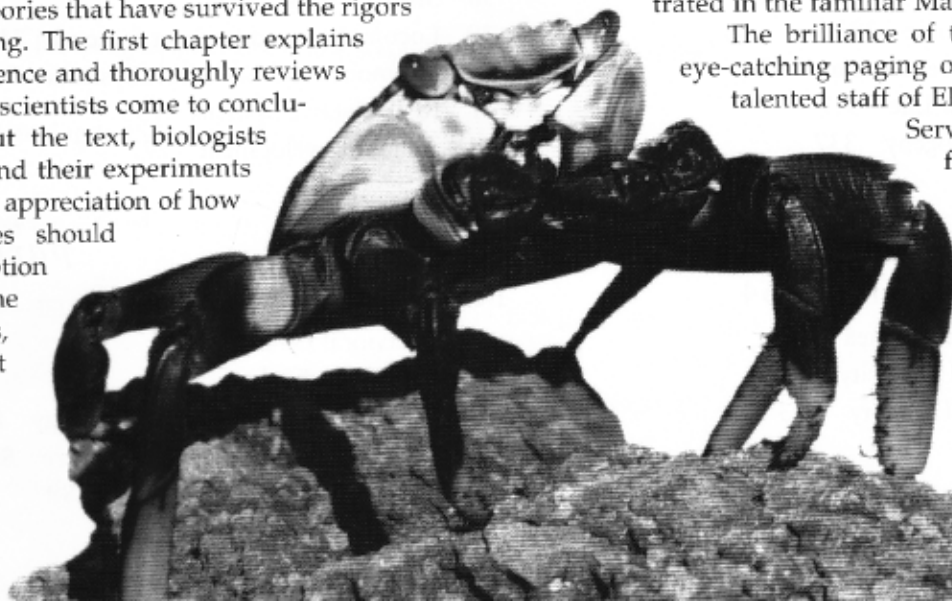
I am an instructor of biology as are the contributors that have lent their several talents to this edition of *Biology*. Collectively, we have taught students for many years from the community college to the university level. We are all dedicated to the desire that students develop a particular view of the world—a biological view. When I wrote the first edition of *Biology*, it seemed to me that a thorough grounding in biological principles would lead to an appreciation of the structure and function of individual organisms, how they evolved, and how they interact in the biosphere. This caused me to use the levels of biological organization as my guide—thus, this edition, like the previous editions, begins with chemistry and ends with the biosphere.

Students need to be aware that our knowledge of biology is built on theories that have survived the rigors of scientific testing. The first chapter explains the process of science and thoroughly reviews examples of how scientists come to conclusions. Throughout the text, biologists are introduced, and their experiments are explained. An appreciation of how science progresses should lead to the perception that, without the scientific process, biology could not exist.

## Evolution of *Biology*

While I have always guided the development of each new edition of *Biology*, many instructors have lent their talents to ensuring its increasing success. I give my utmost thanks to all the reviewers and contributors that have been so generous with their time and expertise. This edition, I want to particularly thank Andrew Baldwin, of Mesa Community College, who revised the ecology chapters; Rebecca Roush, of Sandhills Community College, for her work on Part VI; Michael Thompson, of Middle Tennessee State University, who did the first chapter and the genetics chapters; and Stephanie Songer, of North Georgia College and State University, who revised Part IV and many chapters in Part V. My involvement ensured that each of these chapters, along with the chapters I revised, are written and illustrated in the familiar Mader style.

The brilliance of the illustrations and the eye-catching paging of *Biology* are due to the talented staff of EPS (Electronic Publishing Services Inc.), who took my first attempts and altered them to produce the most detailed, refined, and pedagogically sound presentations ever developed for an introductory biology book.



## The Learning System

Mader books excel in pedagogy, and *Biology* is consistent with the usual high standard. Pages xii–xv of this preface review “The Learning System” of *Biology*. As explained, each part opening page introduces that part in a new engaging way that explains the rationale of that part. The chapter opening page lists the key concepts under the major sections for that chapter. In this way, students are given an overview of the chapter and its concepts. The opening vignette captures student interest and encourages them to begin their study of the chapter. New to this edition, major sections end with “Check Your Progress” questions designed to foster confidence as they proceed through the chapter. “Connecting the Concepts” at the end of the chapter ties the concepts of this chapter to those in other chapters. The end matter gives students an opportunity to review the chapter and test themselves on how well they understand the concepts.

The Mader writing style is well known for its clarity and a simplicity of style that appeals to students because it meets them where they are and assists them in achieving mastery of the concept. Concepts are only grasped if a student comes away with “take-home messages.” Once students have internalized the fundamental concepts of biology, they will have developed a biological view of the world that is essential in the twenty-first century.

## Changes in *Biology*, Tenth Edition

The tenth edition builds on the visual appeal of the previous edition. New illustrations have been developed that are just as stunning as those prepared for the ninth edition, and many new photographs and micrographs have been added.

*Biology* has a new table of contents that consolidates chapters so that the book is shorter by some forty pages compared to the last edition. No individual chapter is overly long, however. In Part II, certain material from Chapter

12 was moved into Chapter 10, *Meiosis and Sexual Reproduction* and Chapter 11, *Mendelian Patterns of Inheritance*. In Part III, *Speciation and Macroevolution* is a much needed new chapter. In Part VI, the two invertebrate evolution chapters from the previous edition have become Chapter 28, *Invertebrates*. In Part VIII, Chapter 45, *Community and Ecosystem Ecology* is a consolidation of two chapters from the previous edition.

I believe you will be interested in knowing about these chapters that demonstrate the quality of *Biology*, Tenth Edition:

- Chapter 1, *A View of Life*, was revised to have a new section: “Evolution, the Unifying Concept of *Biology*.” This section presents basic evolutionary principles and contains a depiction of the Tree of Life, which introduces the three domains of life and the various types of eukaryotes. Prokaryotes and eukaryotes are also pictorially displayed.

### Part I The Cell

- Chapter 5, *Membrane Structure and Function*, introduces the concept of cell signaling. New to this edition, the plasma membrane art now depicts the extracellular matrix (see Fig. 5.1), which has a role in cell signaling—a topic that is further explored in the Science Focus, “How Cells Talk to One Another.”
- Chapter 8, *Cellular Respiration*, begins with a new section that now emphasizes that cellular respiration is the reason we eat and breathe (see Figure 8.1). The fermentation section in this edition precedes the events that occur in mitochondria and is enhanced by a new Science Focus box, “Fermentation Helps Produce Numerous Food Products.” The chapter now ends with a comparison of photosynthesis to cellular respiration (see Fig. 8.12).

## Overview of Changes to *Biology*, Tenth Edition

### VISUALS

The brilliant visuals program of the previous edition is enhanced even more by the addition of many new micrographs and innovative page layouts.

### CELLULAR BIOLOGY

Cell signaling receives expanded coverage as a mechanism of cellular metabolism and cell division control.

### GENETICS

Reorganization of the genetics chapters results in increased genome coverage, including the role of small RNA molecules in regulation.

### SYSTEMATICS

Cladistics is better explained, and new evolutionary trees are presented for protists, plants, and animals.

### EVOLUTION

A new chapter, *Speciation and Macroevolution*, points to the possible role of Hox genes in punctuated evolution.

### PLANT EVOLUTION

A reorganization of Chapter 23 better describes the evolution of plants from an aquatic green algal ancestor.

### ANIMAL EVOLUTION

Reorganization of Part VI results in two new animal diversity chapters: the invertebrates and the vertebrates.

## Part II Genetic Basis of Life

- Chapter 9, *The Cell Cycle and Cellular Reproduction*, builds on the topic of cell signaling that was introduced in Chapter 5. Cell signaling is the means by which the cell cycle, and, therefore, cell division is regulated. A new Science Focus box shows how the G<sub>1</sub> checkpoint is highly regulated by cell signaling, and Figure 9.8 dramatically illustrates how a breakdown in cell cycle regulation may contribute to cancer.
- Chapter 13, *Regulation of Gene Activity*, is an excellent chapter that instructors will not want to overlook because it explains how humans can make do with far fewer protein-coding genes than have been discovered by DNA sequencing of our genome. The chapter is updated by continued emphasis on chromatin structure, many references to the regulatory role of RNA molecules including a new Science Focus box, "Alternative mRNA Splicing in Disease."
- Chapter 14, *Biotechnology and Genomics*, has an expanded section on genomics. Much of chromatin consists of introns and intergenic sequences which may have important functions still to be discovered (see Fig. 14.8). Molecular geneticists are seeking a new definition of a gene that can apply to both protein-coding and non-protein-coding sequences. The chapter also discusses genomic diversity. The new Science Focus box, "DNA Microarray Technology," explains how this technique is now being applied to identify genes involved in health and disease. Another new Science Focus box, "Copy Number Variations," gives another example

of genetic diversity within the population and its relationship to health and disease.

## Part III Evolution

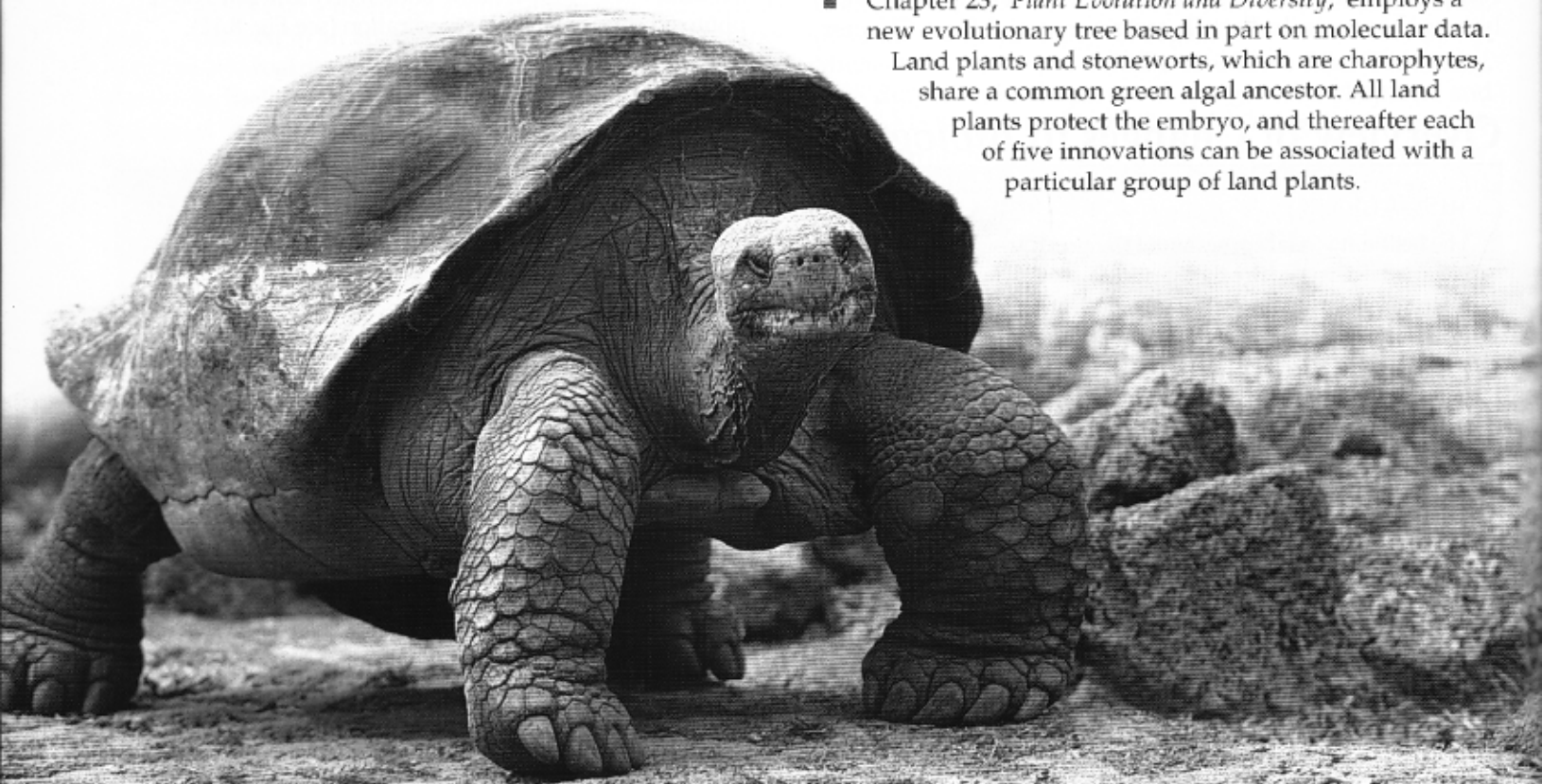
- Chapter 16, *How Populations Evolve*, is an exciting new chapter that begins with an introduction based on community acquired MRSA. This chapter is also enhanced by new figures: an example of genetic diversity (see Fig. 16.1), the gene pool (see Fig. 16.2), microevolution (see Fig. 16.3), and a natural selection experiment (see Fig. 16.10) are included. Also, sexual selection is now included in this chapter.
- Chapter 17, *Speciation and Macroevolution*, is new to this edition. This chapter begins by describing species concepts, and examples of both allopatric and sympatric speciation are given. The concepts of gradualistic and punctuated equilibrium are discussed with reference to the Burgess Shale as an example of rapid evolution to produce many species, and Hox genes are offered as a possible mechanism to bring it about.

## Part IV Microbiology and Evolution

- Chapter 21, *Protist Evolution and Diversity*, has been revised because protist classification has undergone dramatic changes in recent years. This chapter is reorganized accordingly, but the biological and ecological relevance of each type of protist is still discussed.

## Part V Plant Evolution and Biology

- Chapter 23, *Plant Evolution and Diversity*, employs a new evolutionary tree based in part on molecular data. Land plants and stoneworts, which are charophytes, share a common green algal ancestor. All land plants protect the embryo, and thereafter each of five innovations can be associated with a particular group of land plants.



## Part VI Animal Evolution and Diversity

- Chapter 28, *Invertebrates*, has been thoroughly updated and revised in this edition. The chapter better defines an animal and explains the colonial flagellate hypothesis on the origin of animals. The organization of this chapter follows a new evolutionary tree based on molecular and developmental data; the biology of each group is discussed as before.
- Chapter 29, *Vertebrates*, has been reorganized, and each vertebrate group is now a major section. In keeping with modern findings, birds are considered reptiles. Each section begins with a listing of characteristics for that group and is followed by a discussion of the evolution and then the diversity of that group.

## Part VII Comparative Animal Biology

- Chapter 33, *Lymph Transport and Immunity*, has been reorganized and revised so that both nonspecific defense (innate immunity) and specific defense (acquired immunity) have their own major section. All concepts regarding antibodies have been brought together in the specific defense section. Immunity side effects has new illustrations; Cytokines and Cancer Therapy is a new subsection.
- Chapter 35, *Respiratory Systems*, is much improved in this edition from an increased emphasis on diversity to a better description of the human respiratory tract and transport of gases (see Figs. 35.3, 35.6, and 35.12). This chapter now ends with a dramatic photo of emphysema and lung cancer (see Fig. 35.15). "Connecting the

Concepts" emphasizes the contribution of the respiratory system to homeostasis by description and art.

- Chapter 41, *Reproductive Systems*, now begins with a revised comparative section that includes more photos. An illustration depicting contraceptives replaces a table, and there is a new Health Focus, "Preimplantation Genetic Diagnosis." Sexually transmitted diseases have been updated to reflect current statistics. A new bioethical issue concerns the use of fertility drugs.

## Part VIII Behavior and Ecology

- Chapter 43, *Behavioral Ecology*, has an evolutionary emphasis culminating in a new section entitled "Behaviors that Increase Fitness" in which several types of societal interactions are explored as a means to increase representation of genes in the next generation. Orientation and migratory behavior and cognitive learning are ways of learning not discussed previously.
- Chapter 45, *Community and Ecosystem Ecology*, is a combined chapter that allows instructors to cover the basics of ecology in one chapter. A discussion of symbiotic relationships and ecological succession precede the concepts of chemical cycling and energy flow in ecosystems.

## About the Author

Dr. Sylvia S. Mader has authored several nationally recognized biology texts published by McGraw-Hill. Educated at Bryn Mawr College, Harvard University, Tufts University, and Nova Southeastern University, she holds degrees in both Biology and Education. Over the years, she has taught at the University of Massachusetts-Lowell, Massachusetts Bay Community College, Suffolk University, and Nathan Matthew Seminars. Her ability to reach out to science-shy students led to the writing of her first text, *Inquiry into Life*, which is now in its twelfth edition. Highly acclaimed for her crisp and entertaining writing style, her books have become models for others who write in the field of biology.

Although her writing schedule is always quite demanding, Dr. Mader enjoys taking time to visit and explore the various ecosystems of the biosphere. Her several trips to the Florida Everglades and Caribbean coral reefs re-

sulted in talks she has given to various groups around the country. She has visited the tundra in Alaska, the taiga in the Canadian Rockies, the Sonoran Desert in Arizona, and tropical rain forests in South America and Australia. A photo safari to the Serengeti in Kenya resulted in a number of photographs for her texts. She was thrilled to think of walking in Darwin's steps when she journeyed to the Galápagos Islands with a group of biology educators. Dr. Mader was also a member of a group of biology educators who traveled to China to meet with their Chinese counterparts and exchange ideas about the teaching of modern-day biology.



For My Children  
Sylvia Mader