Preface

The study of biology continues to undergo profound changes as we approach the twenty-first century. Courses and textbooks that emphasize facts, vocabulary, isolated concepts, and content without context are being supplanted by new curricula designed to provide students with an understanding of the scientific enterprise and the excitement that characterizes studies of the living world. We wrote *Biology: The Network of Life* as a textbook to compliment this new way of teaching and learning. Since the publication of the first edition we have communicated with hundreds of colleagues. Their comments and suggestions validated the relevancy of our approach and aided us considerably in refining the second edition.

GOALS OF THE SECOND EDITION

We have pursued six goals in writing the second edition: They are:

- To convey *fundamental knowledge* of the major principles, concepts, and ideas of modern biology.
- To explain principles, concepts, and ideas related to biology within a framework of the *process of science*. Accurate historical information is an essential component of the approach.
- To promote an understanding of *scientific inquiry*, the methods, approaches, and techniques scientists use to answer interesting questions.
- To present *content in context* to facilitate learning.
- To concentrate on *relevant information* that has significance, now and in the future.
- To provide students with a background that will encourage *lifetime learning* and ongoing interest in biology.

THE PROCESS OF SCIENCE

The framework of *Biology: The Network of Life* is that scientific information is presented within a context of the *process of science*. The process of science considers the total dynamic enterprise of science. It encompasses questions that biologists address, the origins of those questions, the methods used to tackle the questions, the answers achieved, the resulting effect on the general picture of nature, the directions of new research, the institutions in which all the work is performed and the social context in which questions arise, are investigated, and are funded.

Central to the process of science are questions that motivate *scientific inquiry*. Scientists work hard to answer important questions, using diverse methods, techniques, and technologies. They also raise new questions, often as a consequence of answers obtained to old questions, or as a result of new, related observations, technological advances, or relevant information from another field. In some cases, questions that drive research are answered quickly, within a few months or years. Some questions, however, were posed by our ancient ancestors and, to this day, have not been answered completely. Early Greek philosophers first asked, "Why do offspring resemble their parents?" Although we now have a reasonably solid answer to that question, it is not yet complete because molecular geneticists continue to make new discoveries that apply to the original, ancient question. Finally, some questions, after driving research for a period of time, turn out to be dead ends. For example, in 1628, William Harvey published a book in which he accurately described the motion of the heart and the circulation of blood in humans. Soon after this a new question arose: "Do plants have hearts?" Although this question stimulated research for many years and led to a better understanding of plant structure, no one found a plant heart, and scientists turned to other questions. Thus science can be thought of as a *lineage of questions* in which the search for

answers to one question or a set of questions leads to a new question or even a whole new set.

Lineage of Questions

The concept of lineage of questions reflects the dynamic nature of biology. It is often difficult to grasp the ever-changing nature of biology because of the enormous amount of information being generated. However, historians have shown that science is constantly changing. This feature of science is often confusing to students, who may believe that change means that earlier conceptions were wrong. In fact, change is consistent with the dynamic nature of science. We emphasize the concept of the lineage of questions so that it is integral to the framework of the second edition.

Each unit of *Biology: The Network of Life* 2nd edition opens with a lineage of questions that serves as an organizational structure to enhance teaching and learning. Within each unit we examine the origin of significant questions, describe how they are derived from earlier questions, consider various methods used to answer them, and discuss the social context in which they were studied. This approach allows students to understand that the search for knowledge in science is an interesting, dynamic process, not a rigid procedure as described by the mythical scientific method.

CONTENT IN CONTEXT

To maintain our focus on scientific process, facilitate learning of fundamental principles and ideas, and ensure our concentration on relevant information, all content is presented *in context*. This can mean different things within the organization of the text. Within chapters, specific topics are generally introduced where there is a *need to know*. For example, detailed discussion of proteins, enzymes, and nucleic acids appears in the fourth chapter of our genetics unit, Chapter 17, where we consider the discovery of DNA as being the genetic material. For five of the six units in the book, material is presented in the framework of scientific process. However, Unit I differs from the other units because time is used as the context for presenting information about origins of the universe, Earth, and life.

COVERAGE AND ORGANIZATION

Biology: The Network of Life 2nd edition consists of six units, each of which deals with major areas of contemporary importance. We present information, ideas, and concepts in the approximate sequence in which they originated or became known to scientists. This sequence reflects the actual development of science and allows students to follow the progression of scientific ideas that have led to what we currently know. It also gives a sense of the direction of future research in the life sciences. By emphasizing the historical development of knowledge, we can better understand the process of science and social context in which science operates.

Unit I, *The Sphere of Life*, deals with the origins of the universe, Earth, and the life that came to exist on Earth. Starting with the mythical world views of our ancient ancestors, this unit traces scientific thought on the origins of the universe and Earth. Current hypotheses on the origin of life and the early evolution of cells are then discussed. The nature and functions of cells and their ability to transform energy set the stage for a survey of the tremendous diversity of life that exists on Earth.

Unit II, *The Interactions of Life*, focuses on our environment, knowledge of the global distribution of life, the interactions that occur among plants and animals, and the impact that humans have had and are having on our environment. It begins by explaining the physical forces that act on earth, world climate, and the development of biomes. The unit then traces the roots of modern ecology and explains its major concepts. Separate chapters focus on our knowledge of terrestrial and aquatic ecosystems. The growth and impact of the human population and an up-to-date chapter on global climate change end the unit.

The detailed level of understanding we now have in genetics represents one of the most stunning breakthroughs in biology. New genetic technologies are revolutionizing medicine and agriculture, and these changes raise controversial social questions. In Unit III, *The Language of Life*, we follow the entire development of the field of genetics from Aristotle to the present. While exploring some of the elegant experiments that led to our current knowledge, students will experience the ingenuity and power of critical thinking applied to answering interesting scientific questions.

Unit IV, *The Evolution of Life*, explains the central unifying idea of modern biology. We trace the origin of the theory of evolution and show how the theory arose to answer a set of interesting scientific questions. The nature of scientific theories is discussed along with the relationship between scientific theory and religious thought. Following the development of the theory of evolution to the present, students can appreciate how the original theory has expanded and how it relates to the various fields of biology. A chapter on human evolution discusses current hypotheses of human origins, and two chapters on animal behavior explore the evolutionary significance of this subject.

Plants are discussed throughout the entire text, but Unit V, *Plant Systems of Life*, examines specific features of plants. We explain why, until the nineteenth century, the study of plants was limited to identification and description. Modern knowledge of plant life is described by following the general life history of a plant from seed to adult. Current research on how plants handle environmental stress and on plant adaptation is included.

The concluding unit, Unit VI, *Human Systems of Life*, explores the area of biology that currently commands the greatest amount of research funding worldwide. This unit has increased coverage of human body systems, especially in Chapters 34 and 35. Individual chapters trace the growth of our knowledge of different human organ systems and describe the

frontiers of research. A chapter on human defense systems leads into an examination of human disease, both infectious and noninfectious, and discusses current ideas about cancer, vascular disease, AIDS, risk factors, and lifestyle management, along with the future of biology.

Distinguishing Features of the Second Edition

Besides the content changes to the second edition, there are new features to help you learn biology.

Lineage of Questions and Unit Conclusions. The lineage of questions summarize the significant questions scientists have investigated over time; they appear on the first page of each unit to set the stage for the topics to be studied. The unit conclusions appear on the final page of each unit and relate what was studied to the process of science.

Chapter Outlines open each chapter to establish a conceptual framework for that chapter.

Chemistry in Context. An important part of our approach is to integrate the coverage of chemistry exactly when and where it is needed to understand biology concepts. To that end, basic chemistry concepts are introduced in Chapter 2 in a setting of chemical element origin and universe evolution. Chapter 3 introduces energy transformation processes in relation to cell evolution. A new Chapter 4 expands on the background given in Chapter 3 by including such topics as forms of energy in the physical and biological realms, energy-managing molecules, photosynthesis, glycolysis and cellular respiration, the process of chemiosmosis, and the significance of biological energy transformations in the history of life on Earth. A new appendix, Chemistry in the Biological Context, is a self-contained resource and reference tool for students.

"Focus on Scientific Process" features are stimulating essays within each chapter. These essays might describe a classic experiment, recount the development of a major new theory or the rejection of an old one, explain the use of technology in answering old and new questions, describe complex ecological research, or interpret the significance of certain biological processes in understanding the history of life. An index of all the Focus features follows the table of contents.

"Before You Go On" is an in-text summary that highlights key ideas; it allows students to review their comprehension of the main points of the chapters as they read the text.

The Illustration Program is revised to enhance the visual aspect of learning biology. Nearly 60 percent of the line art and photographs are new to this second edition. Color is used consistently to indicate chemical, anatomical, and physiological detail.

Figures with Questions. Many of the figures in the text include a question or two about the figure. These questions allow students to test themselves and use their critical thinking skills to draw conclusions. Answers to the Figure Questions are at the end of the chapter for convenient reference.

Chapter-End Material includes the following elements to help students study the text:

Summaries recap the salient principles and concepts presented in each chapter. **Working Vocabulary** lists key terms new to the text discussion. **Review, Essay, and Discussion Questions** help students synthesize the information discussed. **Reference and Recommended Readings** indicate where students can look for more information on chapter topics.

The Supplement Package for Biology: The Network of Life Second Edition

The text is supported with an extensive package of supplements for both the instructor and the student.

For the Instructor

The ***Instructor's Manual with Activities*** offers instructors valuable support in preparing lectures for their introductory biology course. For each chapter there are tips on teaching science, discussion questions, problem-solving exercises, suggested references for print and media, and demonstration ideas. The manual also contains 40 laboratory activities that are linked to the text.

The printed ***Test Bank*** by Lesley Blair of Oregon State University, consists of 3000 multiple-choice, true or false, matching, short answer, and essay questions that are new to the second edition.

TestMaster software in IBM and Macintosh formats is available to adopters who prefer a computerized testing system. *TestMaster* enables instructors to select problems for any chapter, scramble them as desired, or create new questions. New with this edition, ***QuizMaster*** coordinates with the *TestMaster* program. *QuizMaster* allows students to take tests at the computer. Upon completion, a student can evaluate his or her test score and view or print a diagnostic report that lists the topics or objectives that need further study. With network access to *QuizMaster*, student scores are saved on disk and instructors can use the utility program to view records and print reports for individual students, class sections, and entire courses.

Overhead Transparencies of over 250 four-color figures cover key topics in the introductory biology course. These full-color illustrations are taken from the art program of the text as well as from other sources; the transparencies are available to adopters.

The ***HarperCollins Encyclopedia of Biology*** videodisc is an exciting way to integrate multimedia presentations into your

classroom. Loaded with still images, motion footage, and animations of key biological concepts, the disc allows students to see complex biological topics in ways that are impossible to present with two-dimensional illustrations. A bar code manual accompanies the disc along with software drivers for both IBM and Macintosh computers. A guide for integrating the videodisc with the text is also available to adopters.

For the Student

The ***Study Guide***, by Amy Hacker of Oregon State University and Mette Hansen, includes chapter outlines, a summary, and key terms and concepts. Chapter Challenge sections give student study tips for tough topics in biology. There are practice tests with short-answer, multiple-choice, and critical thinking questions so students can test themselves before exam time. To order use ISBN 0-673-52355-1.

Essays on Wellness, by Barbara A. Brehm of Smith College, is a collection of 29 essays that cover a variety of human health issues. These essays can supplement Unit VI of the text. To order use ISBN 0-06-501549-5.

The ***Harper Dictionary of Biology*** is a valuable reference tool. By W. G. Hale and J. P. Margham, both professors of biology at the Liverpool Polytechnical Institute, it covers all the major subjects—anatomy, biochemistry, ecology, evolutionary theories—plus has biographies of important biologists. It contains 5600 entries that provide in-depth explanations and examples. Diagrams illustrate such concepts as genetic organization, plant structure, and human physiology. To order use ISBN 0-06-461015-2.

Writing About Biology, by Jan A. Pechenik of Tufts University, is a brief guide that prepares students to meet the demands of writing at all levels of biology. Every aspect is covered: laboratory reports, research proposals, research papers, essay exams, oral presentations, and applications for jobs or graduate schools. To order use ISBN 0-673-52128-1.

Studying for Biology, by Anton E. Lawson of Arizona State University, details ways to improve basic study skills. Several chapters cover the thinking patterns that biologists use to answer questions and formulate hypotheses and theories. The book also introduces the basic postulates of the major theories in biology. To order use ISBN 0-06-50065-X.

The Biology Coloring Book is part of new approach to learning biology. Each page shows a biologic process or concept. You create the color key and color in each part of the plate. As you color, you can read an explanation about each element in the accompanying text. When completed, the colored plates are an excellent tool for reviewing what you've learned. To order use ISBN 0-06-460307-5. Other books in the series include the ***Anatomy Coloring Book*** (0-06-455016-8), ***Physiology Coloring Book*** (0-06-043479-1), ***Botany Coloring Book*** (0-06-460302-4), and ***Zoology Coloring Book*** (0-06-460301-6).

The Illustrated Five Kingdoms: A Guide to the Diversity of Life on Earth is by Lynn Margulis, University of Massachusetts, Amherst; Karlene V. Schwartz, University of Massachusetts, Boston; and Michael Dolan, University of Massachusetts, Amherst. It contains full-page, unlabeled drawings of examples of each of the major groups (phyla) illustrated in their natural habitats. Each full-page drawing is shown in a reduced size with labels for reference. Accompanying text introduces and describes both familiar and unfamiliar plants, animals, and microorganisms. To order use ISBN 0-06-500843-X.

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We sincerely hope that all the readers of this textbook have a rewarding experience. Please send us your comments or questions about *Biology: The Network of Life* 2nd edition. Send us letters in care of HarperCollins*CollegePublishers* or feel free to connect with us through the Internet.

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