Preface

To us it seems hardly possible that fifteen years have elapsed since the first edition of *The Study of Biology*. Its philosophy, considered almost radical at the time, was that it is the *process*, not merely the content or "facts" of biology, that should form the basic thrust of introductory courses. By process of science we mean *how we know what we know;* how experiments are designed, data analyzed, and conclusions drawn—in short the logic and method of science. This same philosophy continued to guide the preparation of all subsequent editions, including the fourth. The widespread acceptance of this approach, literally throughout the world, has indeed been gratifying. Although the size, format, and content of the fourth edition were enlarged significantly, a major emphasis on the process of science was rigorously maintained.

In preparing the fourth edition we made three basic types of alterations. The first and most obvious is the updating and correcting of older ideas and the addition of new information that has emerged since publication of the third edition (1977). Such updating includes new material on cell metabolism and photosynthesis, the process of initiation and termination of protein synthesis, and the discovery that genes in eukaryotic cells frequently exist in isolated segments, or what are called "interrupted sequences." These alterations enable the student to stay abreast of the most recent discoveries and hypotheses of modern biology.

A second area of change involved expanding the treatment of certain areas of biology that were dealt with only briefly in previous editions. These include:

Cell Biology. The addition of a new chapter on the structure and function of membranes emphasizes the important role they are now thought to serve in the general metabolic life of the cell.

Plant and Animal Physiology. The much-expanded treatment of both neurophysiology and endocrinology reflects the increasing importance of these fields over the past decade. The original two chapters on animal physiology in the third edition were increased to six.

Genetics and Development. We expanded considerably the treatment of genetic control mechanisms, protein synthesis, the genetics of cancer, recombinant DNA, and genetic engineering.

Evolution and Ecology. This material was increased from two to five chapters and reorganized into a more complete and integrated unit. We included expanded treatment of taxonomy (including the cladist–pheneticist controversy and numerical taxonomy), adaptation, community structure, biomes, and population and island biogeography. In addition, we treated more fully the process of natural selection, especially that of speciation, than in previous editions.

A third and final area of revision included the filling in of major gaps, that is, subject areas that were omitted completely or treated only in passing in the third edition:

The Diversity of Life. Three completely new chapters on this subject were added. They present a survey of the living world from the Monera and Protista through plants, fungi, and animals—approached from an evolutionary point of view. Because many introductory courses now include some discussion of diversity, we felt that addition of this material would be far more useful than the general overviews of plant and animal phylogeny provided in the previous editions. To make this material more realistic and dynamic, we included numerous and sometimes unusual photographs of organisms in their natural surroundings (rather than line drawings or photographs of preserved specimens).

A completely new section on the exciting field of immunology, a topic that was completely omitted in previous editions, has been added to Chapter 20 (Developmental Biology). Since so many significant advances have been made in this field at both the cellular and molecular levels during the past decade, we felt strongly that a new, in-depth discussion was required. We included the material on immunology in the chapter on developmental biology because the cellular response

to antigen has provided biologists with a model for gene regulation, and thus differentiation, at the DNA level.

As in the third edition, we included numerous "Supplements" to introduce historical views of a particular discovery: "How Do We Know" passages describing the way a particular idea has been established, and presenting controversial scientific and social issues. In these latter supplements, as before, we often cast the discussion in the form of a debate, presenting different perspectives on issues such as sociobiology, race and I.Q., *XYY* chromosomes and crime, and the human population issue. Many users of the third edition commented enthusiastically on this use of the supplementary essays, and urged that we continue and expand this treatment of such topics. Some even suggested new topics of debate for additional supplements. We appreciate very much these encouraging thoughts and suggestions.

As introductory biology courses have become more comprehensive in the past five years, increasing length is a problem with which authors of all college biology textbooks have had to grapple. *The Study of Biology* is no exception, and we have aimed from the start to keep the length of the fourth edition within bounds. Thus, someone's pet subject may have been given shorter shrift than he or she would have liked, or omitted altogether. For any particular trespasses of this sort, we offer our apologies. We tried to steer a sensible course between a reasonably wide scope of coverage (meeting most course demands) and enough in-depth coverage to avoid superficiality. We believe that it is important for students to gain an understanding of not only *what* we know about modern biology, but also *how* we know it.

We wish to stress again that the spirit and intent of the first three editions has been scrupulously maintained. The opening chapter, dealing with the nature and logic of science (hypothesis formulation and testing, experimental design, and analysis of data) sets the stage for the rest of the book. Throughout, emphasis is placed on experimental design and detail so that the student can examine the evidence on which current theories are based; we believe that one of the most important opportunities an introductory science course offers is that of *learning how to think independently and critically*. To aid the student in acquiring critical attitudes and practice in data analysis, many of the exercises at the end of the chapters and in the instructor's guide are inquiry-based and problem-solving in nature. We have found that these exercises challenge the student to interpret scientific data, draw conclusions, and choose between alternative hypotheses.

In preparing this edition we have had considerable help from a large number of individuals. Among those who read various parts of the manuscript and offered invaluable suggestions regarding content, emphasis, and scientific accuracy were: Penelope Haunchey Bauer, Colorado State University; Robert Shaw Egan, Texas A&M University; Stanley Gartler, University of Washington; Richard Goldberg, Temple University; Richard Goldsby, University of Maryland; Judith Goodnough, University of Massachusetts; Thomas Gray, University of Kentucky; John R. Gregg, Duke University; Brian Hazlett, University of Michigan; Alice Holtz, Columbia University Medical School; Miles F. Johnson, Virginia Commonwealth University; K. W. Joy, Carleton University; Norman Kerr, University of Minnesota; Attila Klein, Brandeis University; Lewis Kleinsmith, University of Michigan; Joseph H. McCulloch, Normandale Community College; Richard Mintel, University of Virginia; Elizabeth Nicotri, University of Washington; David O. Norris, University of Colorado; Gary Ogden, Moorpark College; R. Douglas Powers, Boston College; Deborah Rabinowitz, University of Michigan; Roger R. Ragonese, Nassau Community College; James L. Seago, Jr., State University of New York; Joanne White, University of North Carolina; and David S. Woodruff, University of California, San Diego. In addition, Dr. Otto Solbrig, Harvard University, provided an especially valuable contribution with regard to all of the material on evolution and ecology. In all cases, of course, the final responsibility for what appears in print rests with us.

Many other people assisted us at various stages in the production of the manuscript. Diane Pitochelli assisted in developmental editing. Larry Bennett provided invaluable help in organizing the records of illustrations; Jack Diani and Regina Birchem provided several particularly fine photographs; Eve Fine contributed to several of the supplements, and took major responsibility for obtaining permissions for many photographs. Andy Futterman stimulated many discussions about the best way to approach the teaching of process; and Randy Bird made numerous valuable suggestions on material in many of the supplements. Very special thanks go to Nina Plurad for help with routine problems in preparing the manuscript, for her strong support on basic issues of teaching, and for maintaining an interest in the larger view of biology. Deborah Ann Baker undertook the tedious task of preparing the index, and Linda Lazar reworked and added to the glossary. To all of these individuals we owe a considerable debt of gratitude.

The staff at Addison-Wesley assisted in countless ways in the often confusing and seemingly thankless task of organizing and producing a book of this length. We owe particular thanks to James Funston, our editor for the past two editions. He advised, stimulated,

cajoled, and in many ways guided us through the revision process with a keen eye to the value of preserving the book's basic philosophy while also incorporating new material to meet the ever-changing demands of modern biology courses. Considerable help also was provided by Kathy Gregg, Margaret Pinette, Jerrold Moore, Diann Korta, and Bob Gallison who helped in editing and coordinating the entire production process.

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