PREFACE

During the last few decades, biology has become the fastest growing area of science. Building on advances made in physics and chemistry early in this century, research in biology has generated massive amounts of information and created whole new areas of investigation, ranging from molecular genetics to biogeochemical cycles. In the process, biology has not only grown, but has essentially changed during the last fifty years from a science that describes and catalogs the natural world to one that provides a detailed explanation of the mechanics of the natural world. Even at the present level of understanding, biology is rapidly becoming a predictive science.

This transformation has altered the ways in which biology is studied and how it is taught. New findings are being generated at a rate that threatens to overwhelm those involved in teaching and research. For the student of biology, especially the nonmajor, the conceptual framework can easily be obscured by the overwhelming level of details.

The Rationale for This Book

Mindful of the changes that have swept over biology, this text is written for a one-term introductory biology course for the nonmajor. Unlike other texts, it is not an abridged or diluted version of a textbook originally designed for majors. It has been written by an author who works with undergraduates on a daily basis, teaching basic courses in a biology curriculum to both majors and nonmajors.

In recognition of the need for nonscience students to acquire knowledge of basic biological concepts, rather than an array of facts, each chapter is organized around one or two central ideas. For example, the organizing concept in Chapter 5 is the cell cycle. Once the cell cycle has been explained, the process of mitosis, meiosis, cancer, and aging are interpreted in light of this concept. Without question, new discoveries will continue to refine the concept of the cell cycle and the related processes. If students have a firm grounding in the cell cycle, they will be equipped with a way of thinking about and interpreting newly discovered details, and be able to integrate them into a conceptual framework.

The speed at which technology is being developed from scientific knowledge and the pressure of human population growth make it clear that difficult, informed decisions need to be made at all levels, from the personal to the global. A great many of these decisions, ranging from genetic screening to global warming, will require knowledge of biological principles. Elected leaders and citizens outside the community of biologists need to have a working knowledge of biology in order to shape and support the decisions regarding biological developments that will need to be made in the coming decades. A course and a text based on a hierarchical approach, which links a basic set of biological concepts, can provide the basis for transmitting these principles without unnecessary detail or jargon.

This text has been written with several premises in mind:

1. The use of a limited number of clearly presented, interlinked concepts is the best approach to learning a complex, detailed subject such as biology.
2. A text for nonmajors should be written in a straightforward, clear fashion with relevant examples that students can apply to themselves.
3. The figures and photographs should teach rather than merely illustrate the ideas under discussion.
4. The concepts must be linked by a small number of basic, organizing themes.

The Interwoven Themes

Areas of biology that were once islands of knowledge are rapidly being integrated into a larger picture. As this process continues, a small number of organizing ideas are proving useful in interpreting biological processes. Two of the most powerful of these themes are genetics and evolution. During the last four decades, genetics has illuminated with great clarity the physical and mechanistic bases for the key characteristics of living organisms: how they reproduce, develop, and function.

Evolution is the result of natural selection of genetic variation. All organisms have an evolutionary history that can be extended backward in time to the origin of life on Earth. As forms diverged under natural selection, they carried genetic evidence of their relationship. The recent discovery that the gene controlling eye formation is an ancient genetic

innovation links all organisms with eyes to a common ancestor.

The themes of genetics and evolution are used throughout the texts to organize and link the concepts presented in each chapter. In each chapter, the concepts are presented in an evolutionary context. For example, excretion in multicellular organisms is associated with a tubular structure lined with epithelial cells. This basic unit functionally links the flame cells of the rotifer with the human kidney. A discussion of the genetics of kidney disorders provides an insight into the nature and function of genes involved in excretion.

The Organization

The text is divided into seven parts. Part I presents background to understanding the origin, organization, and basic functions of all organisms. The chemical and biological bases of life and the basic properties of all living systems including structure of cells, energy transfer, and cellular reproduction are discussed.

Part II deals with the basic principles of genetics, from Mendelian patterns of inheritance and gene action to applications of genetic engineering. These principles are related to organisms ranging from bacteria to humans to everyday events such as having your cat vaccinated and buying milk.

In Part III, the development of the theory of evolution is discussed and then related to the origin of species, and the events above the species level, emphasizing the relationship between the physical environment and adaptations that allow fitter individuals to survive and leave more offspring.

Many biology texts, especially those for nonmajors, give only cursory treatment to the biology of plants. The emphasis of Part IV is on terrestrial plants and how they developed different adaptations to the same environmental challenges as animals, namely, seasonal variation, protection, desiccation, and gravity.

Part V deals with control systems in animals, briefly describing the evolutionary history of adaptations for establishing and maintaining homeostasis, with a focus on the structure and function of body systems in humans. This serves two purposes: It provides students with an evolutionary perspective and motivates them to learn about concepts to which they can personally relate.

In Part VI, the chapters cover reproduction in plants and animals to contrast again how plants and animals have solved some basic reproductive problems: fertilization in the absence of water, protection of the developing embryo, and the developmental strategies employed in producing the structures of the adult organism.

Part VII deals with organisms and their interactions with the physical environment. This section begins with a description of the structure and life cycle of populations, and how populations form communities. It stresses the important point that natural communities enhance and reinforce the lives of the species that make up the community, and that disruption of any species or of the physical environment can have devastating consequences on the community. The last chapter emphasizes the fact that human populations have grown to the point where the limited resources of the planet are being stressed, and that we need to plan now to manage our physical and biological environment in order to sustain human society.

Although the text is organized in a format that begins with the chemical level and ends with cycles and the biosphere, the text can be used in a variety of formats, including those that place ecology and the environment first. Most chapters have been written to stand alone, so that the parts and chapters can be used in an interchangeable format, providing the instructor with maximum flexibility.

The Pedagogy

Each chapter opens with a short vignette that relates to the concept or concepts to be discussed in the chapter. These episodes have been selected to relate the concepts discussed in the chapter to a real situation, either historical or contemporary, and to kindle student interest in the material to be covered.

As described earlier, each chapter is centered around a limited number of concepts, woven together with a discussion of their evolutionary and genetic aspects. The connections to other concepts and applications of the concepts are also outlined.

Within the chapter, headings are written as descriptive, summary statements that preview the material and often summarize the point of the section. This provides the student with an overview and a convenient way of reviewing the material in the chapter.

The chapters end with a summary that restates the major ideas covered in the chapters. Beginning each chapter with an example of the concept and then ending with a restatement of the concepts and their applications will help focus the students' attention on the conceptual framework and minimize the chance that they will attempt to learn by rote memorization of facts.

At the end of each chapter, questions test the students' knowledge of the facts and their ability to reason from the facts to conclusions. Some questions relate biology to our society and our culture.

Several elements of the text are designed to serve as a built-in study guide for the student. Chapter 1 provides an overview of biology and the organization of the book. This chapter is followed by a section on developing study skills. It has been positioned here to make it visible, to provide a list of study skills and how to acquire them, and to assist the student in preparing for examinations. This is followed by the opening vignette of Chapter 2 as a lead-in to the material on the chemistry and origin of life. All chapters use opening vignettes to set the stage for the topics to be discussed. Other elements in chapters serve as part of a built-in study guide. These include the use of statements as primary and secondary headings, chapter summaries in list form, a list of key terms in the chapter, all of which are defined in the text and in the glossary, and the end-of-chapter questions that test recall of facts and applications of the chapter's concepts to social issues.

Throughout the book, sidebars are used to highlight applications of concepts, discuss oddities of nature, present controversial ideas, and communicate the latest results in a field, without interrupting the flow of the text.

The Art Program

The art program is based on more than 25 years of classroom experience teaching undergraduates. To be effective, classroom illustrations must condense concepts and communicate major points effectively. This experience has been reinforced by more than a decade of preparing illustrations for textbooks of genetics, a field that underpins and informs much of modern biology. For this text, the result is uncluttered and effective illustrations that parallel the presentation of material in the text. To emphasize the parallel importance of text and art as pedagogical devices, the text and its relevant illustrations are presented on the same page or same two-page spread. Students will not have to turn pages to find figures or photos that relate to the point being discussed. In addition, colored icons in the text highlight the figure callouts, allowing the student to return quickly to the appropriate place in the text after studying the figure.

Like the text, the art program is concept driven, and the resulting illustrations are clear summaries of a concept under discussion, without unnecessary text, labels, or detail. This is accomplished by having the illustrations supported by a detailed explanation of the concept in the text, allowing the art to be an unencumbered summary, often in the form of a flow diagram of a process or concept.

The Human Connection

The book covers many aspects of biology, and presents examples from organisms ranging from prokaryotes to primates. Because it is easiest for students to relate biological concepts to their own lives, several features of the text have been constructed to connect the concepts and the process of science to the everyday experience of the students. Some of these features are as follows:

1. **Science and Society.** At the end of each chapter, one or more open-ended questions ask the students to apply what they have learned to common situations. These questions are wide ranging, and include considering how the diet of spiders might be beneficial to humans, whether it is ethical to use zoos to preserve endangered species of primates, or how to balance the risks of using radioactive isotopes with diagnosis and treatment of disease.
2. **Beyond the Basics.** Boxed material in each chapter relates concepts in the chapter to topics that either elaborate ideas presented in the chapter or are interesting, but tangential, examples that should be of interest to the students. These include heat-generating plants, speculation that early hominids used tools as killer frisbees, and the use of insects found on corpses to establish the time of death.
3. **Guest Essays.** To emphasize that science is a human endeavor, and is always in the process of refinement, the book contains essays written by scientists, describing how they became interested in science, what they study, and how their research relates to the larger context of human society. These essays are not just about the scientists, but are written *by* the scientists, providing students with insights into the lives, thoughts, and motives of biologists.

The text and coordinated ancillaries also incorporate other features, which are described in the following section.

ANCILLARIES

To assist you in teaching this course and supplying your students with the best in teaching aids, West Publishing Company has prepared a complete supplemental package available to all adopters.

For the Instructor

The comprehensive instructor's manual and test bank, prepared by Judith Lanum Mohan of Case Western University, includes teaching ideas, chapter