

Preface

There are many levels of understanding of the living world. For most people a certain general understanding arises from casual and chance observation of living things around them. A more satisfying and deeper understanding of life comes from the study of biology. The goal of this book is to help students effectively plan and organize the observation, the analysis, and the search for understanding of the biological world and Aristotle's "certain grandeur."

This book is designed for biology majors, for majors in other science disciplines who take a biology course, for all categories of preprofessional students, and for many of the students in the nursing and paramedical fields. It also can be used in courses that majors and nonmajors take together.

The organismic aspects of biology are emphasized in this text. Whether an organism is unicellular, a loosely integrated multicellular form, or a complexly organized higher plant or animal, it is a living, functioning unit that must maintain the integrity of its internal environment and interact successfully with the external environment. The internal environment must be suitable for cellular life so that cells can carry on their individual functions and make their contributions to the life of the whole organism. To accomplish this, the organism integrates functions that control the internal environment and interacts successfully with its external environment in many ways.

Organisms also are evolutionary units of populations in that they are subjected to natural selection. Present-day organisms are the products of evolutionary processes, and some of them reproduce to become parents of future generations. Thus, organismic functions can also be thought of in this evolutionary context, that is, as adaptations whose suitability is tested by the forces of natural selection. This evolutionary theme is complementary to consideration of immediate solutions for organismic problems of maintenance and interaction with environment. It puts the life of the individual organism into perspective relative to the continuing life of the species.

At key points the book focuses directly on the human organism, including physiological function of organ systems, nervous and hormonal regulation, reproduction and development, and evolution. But human biology is always treated as part of biology in general because of the clear recognition that we humans are part of the world of life and that we have many problems and processes in common with other organisms.

The organization of this book is straightforward to allow for direct pursuit of the goals and principal themes. Chemistry and cell biology are introduced early as the foundation for analyzing the more complex organismic functions and processes. After the fundamental processes have been presented, the broader topics of development, evolution, and ecology are discussed. Surveys of organisms are presented at the end of the book for purposes of flexibility, since there is tremendous variability in the placement of the surveys in courses at various institutions. The survey material can be inserted anyplace that suits local course requirements. Within this framework, sections and individual chapters have become sufficiently autonomous to make the text functional in virtually any course organization.

Some new approaches have been taken to the old problems of organization and content. For example, a balance has been struck regarding the organization of various topics in the biology of plants and animals. Fundamental biological unity is recognized where it is scientifically and educationally sound to do so. Thus, plants and animals are considered together when discussing basic cell biology, genetics, reproduction, development, evolution, and ecology.

But plants and animals also differ in basic ways. For example, while water and mineral ion absorption by roots of vascular plants and the digestive and absorptive processes by which animals obtain nutrients are processes that might be broadly categorized as nutrient procurement, they both are worthy of careful, separate examination. Likewise, plant transport processes and animal circulation are fundamentally different sets of processes. Separate consideration also is given to plant hormonal regulation, which is primarily involved in growth control, and animal hormonal regulation, which is involved much more in short-term modulation of physiological processes.

A new organizational approach also has been taken to the discussions of chemical reaction mechanisms, photosynthesis, and cell respiration. Because the placement of these topics is a problem for many instructors, there is flexibility within that section of the text. Chapter 5 deals with energy relationships and chemical reaction mechanisms, and it includes information relevant to both chapter 6 (photosynthesis) and chapter 7 (cellular energy conversions). But chapters 6 and 7 are specifically designed to be interchangeable in sequence. Slight redundancy regarding phosphorylation mechanisms occurs in these chapters, but it is a small price to pay for the flexibility gained for users of the book. Most teachers find that the topic of phosphorylation mechanisms bears some repetition anyway.

A new approach has also been taken to one of the fastest expanding fields in modern biology: the study of resistance and immune mechanisms. Because expressions of immune responses involve developmental events that occur throughout the lives of organisms, these topics have been included in a chapter on lifelong developmental change (chapter 26). Chapter 26 also treats other developmental changes that occur throughout life, such as wound healing and regeneration, cancer and other abnormal growths, and aging.

The discussion of DNA structure, including the history of its discovery, is presented in chapter 2 as part of the general discussion of large, biologically important molecules. This strategy is logical from a biochemical viewpoint and avoids a prolonged digression into DNA structure that might interrupt the discussion of genetics, where only those aspects of DNA structure that are most directly relevant to genetic mechanisms are discussed.

Fast-developing fields of biology have been approached carefully so as to present solid introductions that should motivate students to read further on these topics, but yet not include some findings that are still so new or controversial that they may not stand unchallenged even until the book is in students' hands. This cautious approach has been taken with a number of topics, including the ecological significance of the various photosynthetic mechanisms, peptide hormones and their relationships to transmitters in animal brains, certain cellular secondary messengers, genetic engineering and "split genes," and interferons.

Terminology in this text agrees with current international conventions for naming chemical compounds. Thus, for example, instructors will find discussion of fructose biphosphate and ribulose biphosphate instead of the older names fructose diphosphate and ribulose diphosphate. And glyceraldehyde phosphate (GAP) replaces phosphoglyceraldehyde (PGAL). This terminology has been adopted, with strong encouragement from reviewers, because it is universally used in current biological research literature and in virtually all modern advanced biology texts.

The International System of units (S.I. units) has been used for all physical measurements, although in the case of heat energy measurements references to both the more familiar calories, which have a strong reference framework in everyday life, and joules, the approved S.I. units for heat energy, are found.