

Biology

SEVENTH EDITION

CLAUDE A. VILLEE

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PREFACE

The principles of biology can be learned using as a model the frog, dogfish, daisy, fern or even the colon bacillus. However, most students have a special interest in human biology—in the structure, function and development of the human body—generated perhaps by their plans for a career in medicine, dentistry, or another of the health sciences, or simply by a narcissistic interest in how their own body is put together and how it works. The earlier editions of this text have emphasized the human aspects of biology and the biology of human beings; this edition extends and strengthens that emphasis. Like the earlier ones, this edition is neither encyclopedic nor cursory but attempts to present the concepts of biology and their relevance to human beings in an interesting and understandable fashion.

The changes in the seventh edition reflect the continuing rapid development of the biological sciences. Our understanding of the events of life at the molecular, cellular, organismal and population levels of biological organization has been increasing quickly. Remarkable advances have been made in recent years in our understanding of many aspects of biological sciences. However, to be understood and fully appreciated, these newer discoveries must be viewed against the background of the more classical aspects of biology. These advances not only have reemphasized the basic unity of life but also have demonstrated the fundamental similarity of life processes that occur in all organisms.

The discussions of cell structure and organelles, cell cycle, intermediary metabolism, molecular function, protein synthesis, bioenergetics, endocrinology, immunology, and immunogenetics have been completely revised. The chapters dealing specifically with plant biology have been completely rewritten. I am especially indebted to Dr. Knut Norstog, who read the manuscript of these chapters, made many helpful suggestions for their improvement and permitted me to borrow several illustrations from his and the late Dr. Robert Long's *Plant Biology*. The chapter on human evolution was reviewed by Dr. Michael Charney and rewritten in the light of his helpful suggestions. Many illustrations have been replaced and new ones added. The new line drawings for this edition were made by John Hackmaster, Celeste Brennan, Linda Downham, and Susan O'Neill. The appendices contain a discussion of some of the basic physical and chemical principles on which modern biology is founded and a taxonomic summary of the many kinds of living organisms arranged according to the Five Kingdom System proposed by R. H. Whittaker.

A course in general biology attempts to provide the student with an understanding and appreciation of the vast diversity of living things, their special adaptations to their environment, and their evolutionary and ecologic relationships. It should also emphasize the basic unity of

life and the fundamental similarities of the problems that have been faced and solved by all living things. However, there has never been general agreement among biologists as to the sequence in which the several topics in a general biology course should be taught. This is understandable, for reasonable arguments can be advanced for each of the many possible combinations and permutations. The various aspects of biology are intimately related and each could be grasped much more readily if all the other aspects had been learned previously. Since this cannot be done (except perhaps by a student repeating the course!), each instructor must choose the sequence that seems optimal to him. The various parts and chapters in this text can be taken up in any of a number of sequences.

An appreciation of science requires not only a grasp of the product of science but also an insight into the processes by which scientific knowledge is acquired. An introduction to the methods of science is given in Chapter 1, and throughout the text examples of experimental work are presented to illustrate modern methods in biology. The second introductory chapter presents the major generalizations of modern biology. Part 1 discusses the molecular and cellular basis of biology, the architecture of cells and tissues, and the properties and constituents of enzyme systems, ending with a description of the grand metabolic design by which living systems obtain and utilize free energy by photosynthesis and oxidative phosphorylation.

Part 2, concerned with single-celled organisms and plants, opens with a discussion of biological interrelationships, the cyclic use of matter and the interactions among species of plants and animals. It continues with a consideration of prokaryotes, viruses, protists and fungi. The special characteristics of each division of algae and fungi are described, together with their life cycles and economic importance to humans. Chapter 9 presents the primitive land plants and discusses the evolution of mosses and ferns. The gymnosperms and angiosperms are described in Chapter 10. These, the largest in size and in number of types, are of special importance to human life as sources of food, flowers, scents, seasonings and lumber. A discussion of the general physiologic and morphologic attributes of green plants, including plant hormones, follows, and Part 2 ends with a description of plant development and the functions of roots, soil, stems and leaves. A similar survey of the invertebrate and vertebrate animals living today and their structural and functional adaptations is presented in Part 3. The organ systems of the frog are described in some detail, since this animal is frequently used to demonstrate vertebrate characteristics.

In Part 4 the structure and functions of organ systems of the human body are presented and compared with those of other vertebrates. Part 5 is concerned with the biological basis of behavior, and in these chapters the essential features of the human nervous system are described and compared with the nervous systems of other organisms. The section continues with descriptions of receptors and effectors and ends with a chapter on integration by endocrines and their role in determining behavior.

Part 6 deals with reproductive and developmental biology. The subject is presented primarily from the viewpoint of human reproduction and development, but these are compared with similar processes in other vertebrates. Part 7 deals with heredity and evolution, beginning with the physical basis of inheritance and the principles of classic transmission genetics. A greatly revised and rewritten discussion of the

genetic code and the transfer of biological information in DNA molecules from generation to generation is given in Chapter 29. The principles of population genetics and differential reproduction and the basis for our present concepts of the mechanisms of evolution are detailed in Chapter 30. This is followed by a description of the principles of evolution, the evidence for evolutionary changes, and some theories regarding the mechanisms of evolution and the role of differential reproduction as a driving force in evolution. It ends with a discussion of the possible mechanisms of the origin of life itself on this planet.

The evolutionary and ecologic relationships of living organisms are the two major unifying threads running through the text. Part 8 presents a discussion of the principles of ecology; those aspects concerned primarily with the ecologic relationships of individuals are considered in Chapter 34, and those concerned with populations and communities and their characteristics are described in Chapter 35, which also includes a discussion of adaptations, ecosystems and the various types of biomes found on land, in the sea, and in fresh water lakes. The final chapter on human ecology considers some of our present predicaments involving overpopulation, pollution, and the depletion of our natural resources.

A glossary giving the derivations and definitions of some important biological terms is also included. The student will find further definitions of biological terms in an unabridged dictionary. Special biological dictionaries have been published; an excellent and inexpensive one is *A Dictionary of Biology* by Abercrombie, Hickman and Johnson, published by Penguin Books.

The questions at the end of each chapter are designed to assist the student in reviewing the material presented and in testing his comprehension of the principles and facts discussed. Suggestions for further reading are given at the end of each chapter. Complete citations for these references will be found in the bibliography in the appendix.

I am greatly indebted to the many instructors who have made suggestions for revisions based upon their experience in using previous editions of the text. My special thanks are due to Edwin M. Banks, Arthur C. Borror, John Bauman, William H. Behle, Jeffrey M. Camhi, Herbert M. Clarke, Carl Hammen, Donald O. Hebb, Joseph Hichar, Bartholemew Kunny, Ralph W. Lewis, Irving McNulty, Fred R. Rickson, James Slater, Elizabeth Souter, Shirley Sparling, and Richard T. Wilfong.

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