

Preface

This book focuses on the evolution and mechanisms of animal body functions from genes to organ systems to the whole organism interacting with its environment. It is designed for mid- to upper-level undergraduate courses in general biology and zoology programs, and for pre-professional programs in animal husbandry, veterinary science, marine biology, and wildlife and fisheries biology.

The text follows an “integrative systems” approach, which involves both vertical and horizontal integration. **Vertical integration** concerns the hierarchical nature of physiology, in which organ systems and their functions arise from cells and their molecular components, and from the evolutionary forces that gave rise to those components. The chapter sequence and content reflect this: after an introduction to the major themes of physiology, the chapters proceed from molecular and cellular physiology to classical organ systems. Organ systems are grouped according to universal functions of whole-body regulation and integration, support and movement, maintenance, and reproduction. For each organ system, both the evolutionary forces and the cellular and molecular underpinnings are discussed, including new research in genomics, which is having major impacts on all areas of biology. Where necessary, sufficient relevant anatomy is included to make the inseparable relation between structure and function meaningful.

Horizontal integration concerns the interactions of all organ systems to yield a whole functioning organism. Too often, students view the subject of physiology as separate entities (systems) unclosely linked to each other and to the functioning of the intact organism. The text works to overcome this in two ways. First, the text’s central themes are homeostasis and other integrated forms of regulation—how processes from the genetic to the behavioral level allow an animal’s body to meet changing demands while maintaining the internal consistency necessary for all cells and organs to function. At the end of each chapter, a perspective on homeostasis and integration is provided to ensure that the student understands how the components in that chapter interact with other components and contribute to the whole body. Second, special integrative chapters—Fluid and Acid-Base Balance, and Energy Balance and Thermal Physiology—focus on crucial whole-body phenomena that are dependent on more than one organ system.

In addition to an integrated systems organization, the text also incorporates a **comparative approach** throughout. Mechanisms employed by major and exemplary groups of inverte-

brates and vertebrates are included, for three purposes. First, comparisons among types of animals are selected to illuminate important universal functions and principles, emphasizing the unity of life. Second, unique or striking adaptations are featured that reveal the diversity that can result from evolutionary adaptation. Finally, the text incorporates detailed coverage of animal species of relevance to those preparing for animal-related careers, especially vertebrates.

The scope of this text has been limited by judicious selection of pertinent content that a student can reasonably be expected to assimilate in a one-semester course. To keep pace with today’s rapid advances in the biological sciences, students interested in careers related to animal physiology must be able to draw on their overall understanding of concepts instead of merely recalling isolated facts. For this reason the text is designed to promote understanding of the basic principles and concepts of physiology rather than the memorization of details. Yet depth, where needed, is not sacrificed. All aspects of physiology receive coverage, including separate chapters on immune and reproductive systems, and detailed coverage of pre- and postgastric digestion. Furthermore, new information based on recent discoveries has been included in all chapters.

Even the most tantalizing of subject matters can be drudgery to study and difficult to comprehend if not effectively presented. The text maintains a logical, straightforward, understandable style that emphasizes how each individual concept is an integral part of the whole subject matter. Every effort has been made to assure smooth reading through good transitions, logical reasoning, and integration of ideas throughout the text.

Features and Learning Aids

■ Homeostasis and integration

Following the integrated systems approach, each chapter concludes with a narrative, **Chapter in Perspective: Homeostasis and Integration**, which helps the student put into perspective how the system just discussed contributes to the whole animal.

■ Feedforward statements as subsection titles

Instead of traditional short, topic titles for each major subsection (for example, “Evolution of Vertebrate Circulation”),

the text begins each chapter section with a summary statement of a major concept (e.g., "The vascular system evolved from one circuit to two separate circuits in vertebrates.").

■ Cross-referencing

Many chapters build on material presented in immediately preceding chapters, yet each chapter is designed to stand on its own to allow the instructor flexibility in curriculum design. With extensive cross-references provided, the sequence of presentation can be varied at the instructor's discretion.

■ Unanswered Questions

The physiological sciences are changing constantly due to new discoveries and challenges of old ideas. In most chapters, Unanswered Question boxes present short overviews and questions on controversial ideas and new hypotheses to illustrate that physiology is a dynamic, changing discipline, and to stimulate students to propose their own ideas.

■ Box features

Four other, more detailed box features are inserted within chapters where appropriate. *Beyond the Basics* exposes students to high-interest, tangentially relevant information on diverse topics including historical perspectives, environmental issues, and common diseases. *Challenges and Controversies* boxes introduce the frontiers of physiological research with new hypotheses and unsolved questions, in more depth than the Unanswered Questions boxes. *A Closer Look at Adaptation* illustrates the scope and limits of evolutionary adaptation with selected illustrative examples. *Molecular Biology and Genomics* provides examples of cutting-edge research resulting from the animal genome projects and related research to uncover the physiological functions of newly discovered genes.

■ Cellular, molecular and genomic foundations

Even though the text is primarily organized according to body systems, it provides coverage of cellular, molecular, and genomic topics in early chapters and incorporates these throughout as a basis for understanding organ function. The current tools used to explore molecular physiology are also outlined and serve as a backbone for each chapter. This is the cutting edge of physiology research.

■ Evolutionary foundations

Each chapter has an overview of major evolutionary events and selective forces. All topics are placed in a true biological context that melds both the proximate (mechanistic) approach of traditional physiology with the evolutionary explanations behind them, to explain not only the power of natural selection but also the often illogical features of life.

■ Pathophysiology

The text is also designed to help students realize that they are learning worthwhile and applicable material. Because many students using this text will have a clinical component to their careers, reference to important pathophysiological issues demonstrates the content's relevance to their professional goals. For

example, the text includes the effects of environmental toxins on some body systems, an issue of increasing concern.

■ Full-color illustrations

The anatomic illustrations, schematic representations, photographs, tables, and graphs are designed to complement and reinforce the written material. Flow diagrams are used extensively to help students integrate the written information presented.

■ Key terms, word derivations, and glossary with phonetic pronunciations

Key terms are defined as they appear in the text. A glossary at the end of the book enables students to quickly review key terms when they occur later in the book, includes phonetic pronunciations of the entries.

■ End of chapter questions, suggested readings, Infotrac articles, and web sites

Each chapter concludes with a set of review questions, suggested readings, many of which are on Infotrac College edition, and helpful physiological web site addresses.

■ Appendixes

The appendixes on the book's web site are designed for the most part to help students who need to brush up on some foundation materials that they are assumed to already have had in prerequisite courses.

- *Appendix A, The Metric System*, is a conversion table between metric measures and their English equivalents.
- *Appendix B, A Review of Chemical Principles*. Most undergraduate physiology texts have a chapter on chemistry, yet physiology instructors rarely teach basic chemistry concepts. The decision was made, therefore, to reserve valuable text space for physiological concepts and to provide instead this Appendix as a handy reference for students who need a review of basic chemistry concepts that are essential to understanding physiology.
- *Appendix C, entitled Storage, Replication, and Expression of Genetic Information*, includes a discussion of DNA and chromosomes, protein synthesis, cell division, and mutations.

Instructor and Student Ancillaries

A number of helpful resources are available to instructors and students. The Multimedia Manager includes over 400 illustrations and figures from the textbook to create custom PowerPoint presentations. Also included are many animations that illuminate key concepts in the textbook such as carrier-mediated transport, neuronal structure and function and cross-bridge interaction during muscle contraction are included to facilitate classroom discussion. The Multimedia Manager also includes a thorough test bank to aid in class preparation.

Students will appreciate the book's robust web site that contains many animations to reinforce chapter concepts as well as quizzes, flash cards, glossary terms, hypercontents, and thorough chapter summaries.

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