

PREFACE

It is nearly ten years since the third edition of *Animal Physiology* first appeared, written by Roger Eckert with the help of David Randall. Roger died in 1986 while revising the third edition, which was completed by George Augustine and David Randall. That book formed the basis for the fourth edition, which is fittingly referred to as *Eckert Animal Physiology*. Although this new edition has been extensively revised and redesigned, the approach that so successfully characterized earlier editions has been maintained: the use of comparative examples to illustrate general principles, often supported by experimental data. In addition, we have emphasized the principle of homeostasis, and we have updated the molecular and cellular coverage. Retained in this edition is the comprehensive coverage of tissues, organs, and organ systems. Cellular and molecular topics are integrated early in the book so that common threads are developed to explain and compare the interactions between regulated physiological systems that produce coordinated responses to environmental change in a wide variety of animal groups. The basic principles and mechanisms of animal physiology and the adaptations of animals that enable them to exist in so many different environments form the central theme of this book.

The diversity and adaptations of the several million species that make up the animal kingdom provide endless fascination and delight to those who love nature. Not the least of this pleasure derives from a consideration of how the bodies of animals function. At first it might appear that with so many kinds of animals adapted to such a variety of lifestyles and environments, the task of understanding and appreciating the physiology of animals would be overwhelming. Fortunately (for scientist and student alike), the concepts and principles that provide a basis for understanding animal function are relatively few, for evolution has been conservative as well as inventive.

A beginning course in physiology is a challenge for both teacher and student because of the interdisciplinary nature of the subject, which integrates chemistry, physics, and

biology. Most students are eager to come to grips with the subject and get on with the more exciting levels of modern scientific insight. For this reason, *Eckert Animal Physiology* has been organized to present the essential background material in a way that allows students to review it on their own and go on quickly to consider animal function and to understand its experimental elucidation.

Eckert Animal Physiology develops the major concepts in a simple and direct manner, stressing principles and mechanisms over the compilation of information and illustrating the functional strategies of animals that have evolved within the bounds of chemical and physical possibility. Common principles and patterns, rather than exceptions, are emphasized. Examples are selected from the broad spectrum of animal life, consciously illustrating similarities between organisms; for example, similar compounds are associated with reproduction in both humans and yeast. Thus, the more esoteric and peripheral details receives only passing attention, or none at all, so as not to distract from central ideas. We use the device of a narrative, describing experiments, to provide a feeling for methods of investigation while presenting information.

ORGANIZATION OF THE BOOK

For the first time, the chapters are organized into three parts, which we feel will promote an understanding of animals as integrated systems at every level of organization. Each part is introduced by an opening statement that gives students an overview of the material to follow. Part I contains four chapters and is concerned with the central principles of physiology. Part II (Chapters 5–11) deals with physiological processes, while Part III (Chapters 12–16) discusses how these basic processes are integrated in animals living in a variety of environments. All 16 chapters have been extensively reworked and reorganized to stay abreast of new scientific developments.

NEW TO THIS EDITION

- A new chapter on methodology (Chapter 2) in Part I, in which some of the latest molecular techniques are discussed and illustrated, along with traditional methods.
- This emphasis on molecular coverage continues throughout the book; Chapters 5, 6, and 7, for example, are updated with recent insights into the cellular and molecular underpinnings of membrane excitation, synaptic transmission, and sensory transduction.
- Part II features a new chapter (Chapter 8, Glands: Mechanisms and Costs of Secretion), which brings together information on an important, but frequently neglected, effector system.
- In Part II, Chapter 11 (Behavior: Initiation, Patterns, and Control) preserves and expands the descriptions of vertebrate and invertebrate nervous systems found in previous editions, presenting an up-to-date view of systems neurobiology, one of the fastest-growing areas of neurobiology. Several concepts from neuroethology, which bridges the gap between the pure study of behavior and the study of cellular function in the nervous system, are introduced, along with examples of important recent neuroethological studies.
- The role of the nervous system in maintaining homeostasis through the modulation of all systems has been incorporated into Part III, which further advances the integrated approach of the book.
- There is an increased emphasis throughout the book on environmental adaptations, and specific examples of environmental adaptation (such as water balance in elephant seals in Chapter 14) illustrate the general principles of comparative physiology.
- Some of the new topics introduced in the fourth edition include a section on the immune response in Chapter 12 (Circulation), and a section on biorhythms in Chapter 13 (Using Energy: Meeting Environmental Challenges).

PEDAGOGY

- The ideas developed in the text are illuminated and augmented by liberal use of illustrations and figure

legends. For the first time, full color drawings have been added, creating a high quality visual program to further motivate students.

- Spotlights provide in-depth information about the experiments and individuals associated with important advances in the subject matter, the derivation of some equations, or simply historical background on a topic under discussion.
- Thought questions within chapter text (look for the ) encourage problem-based learning and stimulate discussion on various aspects of the material presented.

The text narrative includes effective, integrated examples to support principles; while presenting information, it provides consistent thematic coverage and a feeling for methods of investigation. References to the literature within the body of the text and in figure legends are made unobtrusively, but with sufficient frequency that students can become aware of the role of scientists and their literature as a subject is developed. Further pedagogical aids include key terms that are explained and appear in boldface type at their first mention in the text, and that are formally defined in a useful, comprehensive glossary. End of chapter materials include a summary, which provides the student with a quick review of important points covered in the chapter, review questions, and an annotated list of suggested further readings. Students will find the following resources at the back of the book: appendixes that provide information on units, equations, and formulas; the glossary; and a bibliography that includes the full citations of all references cited in the chapters. Our goal has been to produce a balanced, up-to-date treatment of animal function that is characterized by its clarity of exposition. We hope that readers will find *Eckert Animal Physiology* valuable, and we welcome your constructive criticism and suggestions.

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