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# THE PRINCIPLES OF PHYSIOLOGY

SECOND EDITION

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Illustrated by Barbara Jensen



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Dedicated to  
Dr. Leslie L. Bennett  
Professor of Physiology, Emeritus  
and  
Vice Chancellor Academic Affairs, Emeritus  
University of California, San Francisco  
Mentor and Friend,  
who introduced the author to the science of  
Physiology

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## PREFACE

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THIS WORK is an introductory textbook of physiology. As such, it presents the basic concepts of this science so the student can achieve a clear understanding of the subject as rapidly as possible. The subject matter has been presented in depth, but without excessive minutiae.

As a teaching device, this book is intended for a diverse group of students, including those enrolled in schools of medicine, dentistry, veterinary medicine, and nursing as well as those registered in a variety of allied health programs. This book also is intended for use by upper division undergraduates and by graduate students in the life sciences.

In preparing this second edition it has been assumed that the student has some knowledge of the basic sciences, particularly inorganic and organic chemistry, physics, and biology. As this book is primarily a teaching instrument, however, brief reviews or discussions of pertinent chemical, physical, and biologic laws and principles are included to introduce their specific application in understanding physiologic mechanisms and processes.

Mammalian (specifically human) physiology has been stressed wherever possible, although data from lower organisms necessarily have been included, because in many instances such animals have provided biologic "model systems" vital to the solution of many fundamental problems.

In all living organisms, structure and function are inseparable. Sufficient morphologic information is included to understand readily the physiology of specific cells, tissues, organs, and organ systems in terms of their gross, microscopic, and ultramicroscopic anatomy.

Numerous examples of pathophysiology are cited to emphasize the relationship between normal functions and clinically encountered derangements thereof. These clinical correlates also serve as important teaching aids, because they provide another dimension from which to interpret physiologic mechanisms.

This edition of *The Principles of Physiology* differs in several important respects from the first.

These differences are:

1. The entire text has been revised and rewritten. The length of the entire book has been shortened by roughly one-fourth, chiefly by deleting material of less relevance to contemporary students of physiology.

2. The basic material has been divided into eleven major headings that in turn are subdivided into 70 chapters (see Contents). This has been done with the realization that shorter chapters are far less intimidating. Within every chapter each general subject is discussed under a greater number of headings and subheadings. Thus, specific topics can be located more easily.

3. An ascending scale of morphologic and physiologic complexity is followed, insofar as possible, in the sequence of chapters within each section and in each chapter per se. Thereby the reader will acquire the necessary background of basic information and concepts before proceeding to more advanced material.

4. Every effort has been made to update the subject matter of topics on the forefront of active research. Discussions of behavioral neurochemistry have been included in Section III because of the major significance of this field to understanding several important functional properties of the human nervous system.

5. Many of the line drawings have been revised or updated, and a number of new figures added. All of the illustrations have been designed with the goal of clarifying and supplementing the text proper.

Technical words and terms that may be unfamiliar are printed in *italics* and defined in context, as are words in everyday usage that have been adopted and given special technical meanings by physiologists.

References are listed at the end of each major section (see Contents). The titles will give the interested reader entree to the more extensive literature of that field, as it is impossible in a book of this intent and length to do more than set forth fundamental principles.

Controversial topics, theories, and speculative interpretations of experimental data have been indicated, but not discussed at great length, as it was essential to use a didactic approach to presenting the material. The reader should consult the references cited for more information on particular subjects.

Units of the International System (SI) have been employed throughout to insure consistency and precision.

In conclusion, the author welcomes specific comments and criticisms directed toward the goal of improving the accuracy and usefulness of this book. Such remarks can be addressed to him in care of the publisher, Appleton-Century-Crofts, Medical/Nursing Publishers, 292 Madison Avenue, New York, N.Y. 10017.

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Denver, Colorado

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Joan W. Hamilton has typed the entire manuscript of this book, as well as assisted the author in securing a number of the references included herein. Her unfailing patience during the many months required for these tasks deserves special mention.

Barbara Jensen has spent many hours drawing and revising the figures presented in this edition and in readying them for publication. Their final appearance is a tribute to her skill and devotion.

Finally, it is a pleasure to acknowledge the contributions made by the publisher of this book, Appleton-Century-Crofts. Without the cooperation and support of a number of individuals in this organization, it would have been impossible to complete this work. Specifically, the author wishes to thank David W. Stires, President; Richard H. Lampert, Medical Editor; Laurie Wilkowski, Production Editor; and Alan Gold, Director of Production.

**THE PRINCIPLES OF PHYSIOLOGY**  
**SECOND EDITION**



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