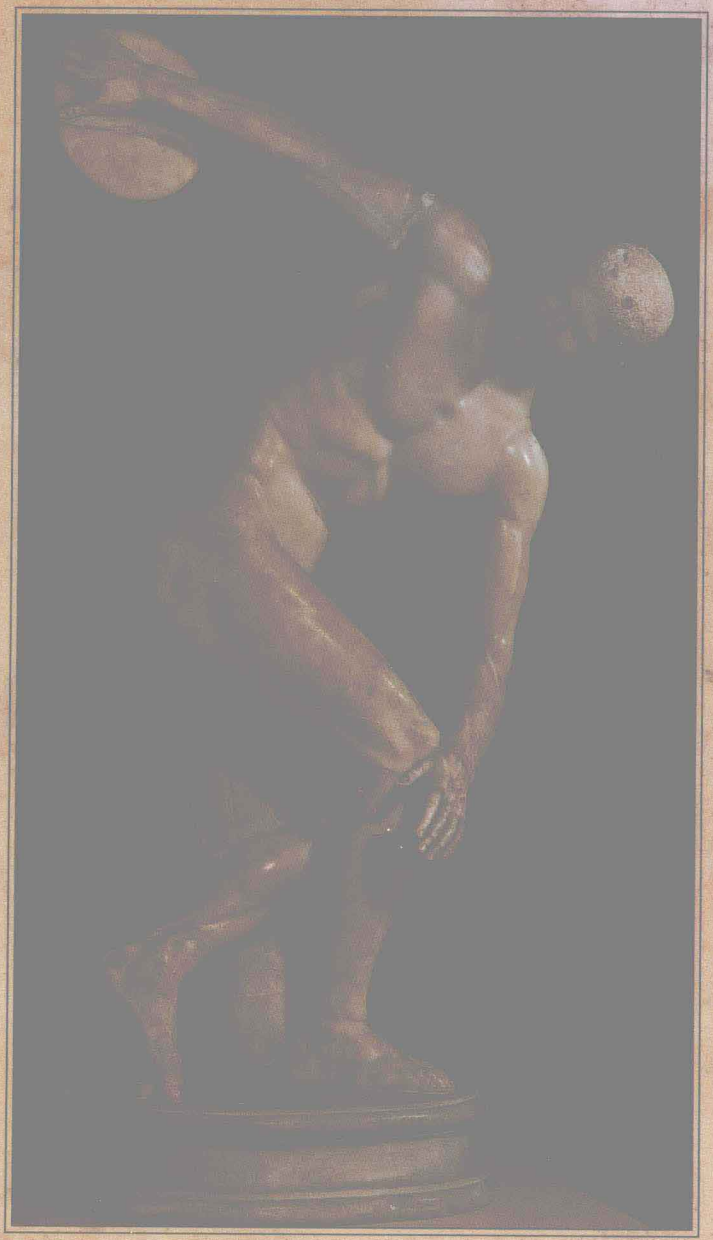
FOURTH EDITION

Human Anatomy and Physiology



Alexander P. Spence Elliott B. Mason

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Human Anatomy and Physiology

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STATE UNIVERSITY OF NEW YORK COLLEGE AT CORTLAND

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To my wife Marion
and our children Mark, Carol, and Cindy
ALEXANDER P. SPENCE

To my wife Marsha
and our children Jennifer, Julie, and Jessica
ELLIOTT B. MASON

Their love, patience, encouragement, and understanding made this book possible

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PREFACE

Working on a new edition of a textbook is always a rewarding experience. A new edition provides the opportunity to update information and revise the manner in which it is presented. This fourth edition of *Human Anatomy and Physiology* is especially exciting because we are working with a new publisher. West Publishing Company has committed themselves to a major upgrading of our book and stimulated a renewed vigor for the project.

Our major goal for this edition remains the same as in previous editions: To provide a textbook that is written at the introductory level and yet is comprehensive enough to meet the needs of diverse groups of human anatomy and physiology students. We have found that courses in human anatomy and physiology vary considerably in length, depth, and objectives. However, we believe our book provides enough information, without being overwhelming, to make it suitable for most courses.

Our book is written primarily for students who are preparing for careers in physical education, nursing, or various health-related professions. The book is also well suited for students majoring in the liberal arts. Because students taking anatomy and physiology courses have such diverse backgrounds and goals, we have assumed that the students using our text will have only a general familiarity with science. All the information needed to understand anatomy and physiology at the introductory level is presented in the text. In some instances we have placed certain topics in special boxes (entitled "A Closer Look") and examined them in greater detail than is generally done in anatomy and physiology texts. We consider this in-depth information to be optional, but believe it will be of interest to the more motivated students.

As the book's title indicates, it is designed for courses that teach anatomy and physiology at the same time. Consequently, we have made a concerted effort to integrate structure and function throughout the text. In addition, we emphasize that structure and function complement one another. It is important for students to realize that the structures of the various organs and other components of the body are specifically suited to contribute to their optimal functioning.

New in This Edition

New Art Program

This edition contains an entirely new art program. Every figure has been redrawn, and most photomicrographs are new. The art program from the previous three editions has been carefully modified so that each illustration depicts precisely what it is designed to show. In many cases, the new figures closely follow the detail shown in the figures in previous editions, which were generally well received. Retaining the detail of these proven figures while presenting them in an entirely new style has been a rare opportunity.

Increased Use of Color

The art program has been expanded to full color throughout the book. We have chosen pastel colors to avoid the rather garish appearance of some recent textbooks. We have also worked closely with the artists to ensure that color is used in a functional manner that serves as a learning aid—that is, to focus attention, differentiate related structures, or guide the viewer through a complex illustration—rather than simply for its own sake.

The use of color is consistent throughout the book. The color used to illustrate a particular structure in early chapters is used to illustrate the same structure in later chapters.

Updated Physiology

The sections of the text dealing with physiology have been extensively rewritten and updated. Many of the sections have been modified to make them more easily understood by students in an introductory course.

Aspects of Exercise Physiology

Many students enrolled in human anatomy and physiology courses are preparing for careers in physical education. In addition, the general public is increasingly aware of the value of exercise for the maintenance of health. To provide some interesting and pertinent information about the effects of exercise on specific body systems, we have included *Aspects of Exercise Physiology* boxes in most chapters. Each box discusses an effect of exercise that is probably familiar to most people and explains why the body responds to the exercise in the manner that it does.

Special Features

This edition retains several special features that were well received in the previous editions. These features enhance the text's usefulness as a teaching tool and increase student interest.

Integration of Embryology

We have found that structural and functional relationships within the body are understood better when students have some knowledge of embryonic development. For this reason, the discussion of each body system begins with a brief consideration of the embryonic development of the system. These discussions are self-contained and, if the instructor chooses, may be omitted without detracting from the remainder of the text.

Conditions of Clinical Significance

The emphasis throughout the text is on normal human anatomy and physiology. However, brief discussions of diseases, dysfunctions, and aging are included when they enhance and reinforce an understanding of normal structure and function. These discussions appear in separate *Conditions of Clinical Significance* boxes. This special treatment allows instructors to emphasize or deemphasize these discussions according to the objectives of their particular courses.

Clinical Correlations

In several chapters, we have included *Clinical Correlation* boxes that are of special interest to students majoring in nursing, premedicine, and the allied health sciences. Each box presents an actual case history of a patient suffering from a condition that illustrates basic physiological principles.

Regional Anatomy Appendix

Regional relationships are a significant aspect of human anatomy. Consequently, a regional anatomy appendix composed of full-color, labeled photographs of dissected cadavers appears at the end of the book (Appendix 1, page A1). This appendix will be valuable to anyone wishing to study regional anatomy, especially those with access to a cadaver in the laboratory.

In-Text Learning Aids

Different students learn in different ways. We have, therefore, provided various pedagogical aids to assist the diverse groups of students who take courses in human anatomy and physiology.

Learning Objectives

Each chapter begins with a list of learning objectives that direct the student toward significant aspects of the chapter.

Chapter Contents

Chapter contents placed at the beginning of each chapter list the major topics included in the chapter.

In-Text Pronunciations

When a scientific or technical term is first used in the text, it is accompanied by a phonetic pronunciation.

Study Outline

A study outline at the end of each chapter provides a summary of the chapter. Page references are included in the outline to help students locate information they may want to review.

Self-Quiz

A list of questions in the form of a self-quiz is included at the end of each chapter to help students determine how well they have learned the information in the chapter. The answers to the questions are listed in Appendix 2 (page A26).

Glossary

A glossary, which provides phonetic pronunciations and definitions for over 1,500 terms, is located on page G1.

Metric Appendix

A metric appendix, on page A34, provides metric/English conversion constants.

Supplements

Instructor's Manual/Test Bank

This supplement includes an extensive testing program to accompany *Human Anatomy and Physiology,* fourth edition. Each chapter includes 75 multiple choice, fill-in-the-blank, or true-false questions, some with anatomical line art, and at least five essay/thought questions, all arranged by level of difficulty. Also included is an extensive and newly updated guide to resources for teaching the course and course related media. This supplement is prepared by Professor Beth Howard of Rutgers University.

Computerized Testing

WESTEST is a full-featured microcomputer implementation of the test bank, which is available to qualified adopters. Available on both the Macintosh and IBM formats, WESTEST for Spence and Mason, fourth edition is fully editable, and is accompanied by clip art of line drawings based on anatomical illustrations in the text.

Study Guide

Newly developed for this edition by Alease Bruce of the University of Massachusetts at Lowell, this book is an interactive ancillary for sale to students, providing them with skills for self-study, drill exercises with answers, and "coloring exercises" to reinforce comprehension of the textual material.

Transparencies

This edition includes 200 full-color acetates based on art and tables from the text, with type reset for effective in-class use. It is available to qualified adopters.

Laboratory Manuals

Two versions of the laboratory manuals are available. Designed to parallel the text, they can be used independently with *any* book. Each of the laboratory manuals is accompanied by an instructor's manual outlining procedures, equipment, and suggested answers to exercises.

Laboratory Manual for Anatomy and Physiology with Dissection Guide for the Cat, by Katherine Malone and Jane Schneider, is a comprehensive manual designed to cover all aspects of the course. Qualified adopters can also receive a 20-minute videotape of a cat dissection, produced by Carolina Biological Supply Company.

Laboratory Manual for Anatomy and Physiology with Dissection Guide for the Fetal Pig, by Katherine Malone, Jane Schneider, and Eileen Walsh, is a comprehensive manual designed to cover all aspects of the course. Qualified adopters can also receive a 20-minute videotape of a pig dissection, produced by Carolina Biological Supply Company.

Video Library for Class Use

Qualified adopters have access to the extensive library of the film series: "The Human Body," developed by Films for the Humanities and Sciences.

Videodisc

Developed specifically for the fourth edition of Spence and Mason, this videodisc contains extensive visual resources to allow instructors to draw together all aspects of this course into coherent and integrated presentations. Included on the disc are all the images from the parent text, human cadaver dissection photos, all the images from the lab manuals, images from "The Human Body" produced by Films for the Humanities and Sciences, Mayo Clinic images utilizing the ANALYZE system, highly animated sequences of anatomical and physiological processes, histology slides, and more. To facilitate ease of use, the videodisc is accompanied by a guide to its use and bar code labels. It is available to qualified adopters.

Acknowledgments

We believe that one reason our text has been so successful for the past twelve years is that each edition has been extensively reviewed, and we have taken the reviewers' suggestions seriously. More than 45 people read all or part of the manuscript for this fourth edition, and their suggestions have been extensively incorporated into it. We are very grateful to the following for their thorough reviews and their many helpful suggestions;

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One improvement in this edition that will be noticed immediately by anyone familiar with our previous editions is the beautiful full-color art program. We are delighted with the work done by Rolin Graphics, and we appreciate the patience shown by their artists as we made, what must have seemed to them, endless revisions in the artwork.

We also want to express our appreciation to Dr. Rachel Yeater, professor, Sports Exercise Program, and director, Human Performance Laboratory, School of Physical Education, West Virginia University for providing the Aspects of Exercise Physiology boxes used in the text. They indeed add a new dimension to the study of anatomy and physiology.

It has been our good fortune to work with West Publishing Company, a truly outstanding publisher. The people at West are enthusiastic, energetic, and full of ideas. We are particularly indebted to Ron Pullins, acquiring editor, for professionally and expertly overseeing all aspects of the preparation of this fourth edition. We thank Denise Bayko, developmental editor, for organizing the most effective reviewing process we have ever encountered, and Pat Lewis, freelance copyeditor, for her efficient editing of the manuscript. We are grateful to Laura Nelson, who conducted the photo research, for finding just the right photos to complement the text, and to Kristen Weber, freelance interior designer, for giving the book such a pleasing and effective appearance. We extend our very special thanks to the production editor, Deanna Quinn. We stand in awe of her ability to handle the many details and difficulties involved in the preparation of this book and still keep the project on schedule. To all these people, it seems inadequate to merely say thanks. Each one has contributed in a significant way to this text.

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CHAPTER 1

Introduction to Anatomy and Physiology

CONTENTS IN BRIEF

CONTENTS

◆ CHAPTER 3 ◆
The Cell 58

◆ CHAPTER 4 ◆
Tissues 108

◆ CHAPTER 5 ◆
The Integumentary System 132

◆ CHAPTER 13 ◆
The Peripheral Nervous System 426

◆ CHAPTER 14 ◆
The Autonomic Nervous System 454

◆ CHAPTER 15 ◆
Integrative Functions of the Nervous System 468