

PATHOPHYSIOLOGY

The Biologic Basis for Disease
in Adults and Children



Kathryn L. McCance

Sue E. Huether

S E C O N D E D I T I O N

PATHOPHYSIOLOGY

The Biologic Basis for Disease
in Adults and Children

S E C O N D E D I T I O N

Kathryn L. McCance, RN, PhD

Professor, College of Nursing,
University of Utah, Salt Lake City, Utah

Sue E. Huether, RN, PhD

Associate Professor, College of Nursing,
University of Utah, Salt Lake City, Utah

with 1030 illustrations

 **Mosby**

St. Louis Baltimore Boston Chicago London Madrid Philadelphia Sydney Toronto



Editor: Sally Schrefer
Developmental Editor: Penny Rudolph
Project Manager: Karen Edwards
Production Editor: Gail Brower
Designer: Elizabeth Fett
Manufacturing Supervisor: Karen Lewis

SECOND EDITION

Copyright © 1994 by Mosby-Year Book, Inc.

Previous edition copyrighted 1990

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher.

Permission to photocopy or reproduce solely for internal or personal use is permitted for libraries or other users registered with the Copyright Clearance Center, provided that the base fee of \$4.00 per chapter plus \$.10 per page is paid directly to the Copyright Clearance Center, 27 Congress Street, Salem, MA 01970. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collected works, or for resale.

Printed in the United States of America
Composition by The Clarinda Company
Printing/binding by Von Hoffmann Press, Inc.

Mosby—Year Book, Inc.
11830 Westline Industrial Drive
St. Louis, Missouri 63146

Library of Congress Cataloging in Publication Data

McCance, Kathryn L.

Pathophysiology: the biologic basis for diseases in adults and children / Kathryn L. McCance, Sue E. Huether. —2nd ed.
p. cm.

Includes bibliographical references and index.

ISBN 0-8016-6902-2

1. Physiology, Pathological. 2. Nursing. I. Huether, Sue E.

II. Title.

[DNLM: 1. Disease—nurses' instruction. 2. Pathology—nurses' instruction. 3. Physiology—nurses' instruction. QZ 4 M478p 1993]
RB113.M35 1993

616.07—dc20

DNLM/DLC

for Library of Congress

93-31475
CIP

96 97 98 9 8 7 6 5 4 3

Contributors

Margaret M. Andrews, RN, PhD
Chair, Department of Nursing,
Nazareth College of Rochester,
Rochester, New York

Barbara J. Boss, PhD, RN
Professor of Nursing,
School of Nursing,
University of Mississippi Medical Center,
Jackson, Mississippi

Marjorie Cengiz Budd, RN, MS
Clinical Associate Professor,
College of Nursing,
University of Utah,
Salt Lake City, Utah

Pamela F. Cipriano, PhD, RN, FAAN
Medical University of South Carolina,
Hollings Oncology Center,
Charleston, South Carolina

Gale D. Danek, RN, MSN
Clinical Nurse Specialist, Children's Health,
Shands Hospital at the University of Florida,
Gainesville, Florida

Sheryl S. Davey, RN, MS
Clinical Assistant Professor,
College of Nursing,
University of Utah,
Salt Lake City, Utah

Katherine M. Donohoe, RN, MS
Doctoral Candidate, School of Nursing,
Clinician, Department of Neurology,
University of Rochester,
Rochester, New York

Judith A. Farley, MSN, RN, CNRN
Clinical Nurse Specialist,
Pediatric Neuroscience,
Children's Hospital,
Boston, Massachusetts

Rosemary B. Field, RN, MS, OCN
Oncology/Bone Marrow Transplant Clinical Nurse
Specialist,
Assistant Professor, Clinical,
University Hospital,
College of Nursing,
University of Utah Health Sciences Center,
Salt Lake City, Utah

Cyrena M. Gilman, RN, MN, CNN
Unit Director, Pediatric Dialysis,
Riley Hospital for Children,
Indiana University Medical Center,
Indianapolis, Indiana

D. Patricia Gray, RN, PhD
Associate Professor of Adult Health Nursing,
Georgia State University,
Atlanta, Georgia

Deborah L. Greener, CNM, PhD
Assistant Professor,
Johns Hopkins,
Department of Obstetrics and Gynecology,
Baltimore, Maryland

Sandra W. Haak, MS, PhD
Associate Professor, Clinical,
College of Nursing,
University of Utah,
Salt Lake City, Utah

Joleen Heath, RN, MS
Neurological Clinical Specialist,
Veteran's Administration Medical Center,
Salt Lake City, Utah

Katherine Hoare, RN, DNSC
Assistant Director of Nursing,
Nursing Systems,
Quality Assurance and Research,
Santa Clara Valley Medical Center,
San Jose, California

Lynn B. Jorde, PhD
Associate Professor,
Department of Human Genetics,
University of Utah School of Medicine,
Salt Lake City, Utah

Melva Kravitz, RN, PhD, CCRN
Associate Chief, Nursing Service/Research,
Veterans Administration Medical Center,
Albuquerque, New Mexico

Patti Ludwig-Beymer, PhD, RN
Nursing Research and Affiliation Coordinator,
Lutheran General Hospital,
Park Ridge, Illinois

Thom J. Mansen, RN, PhD
Assistant Professor,
College of Nursing,
University of Utah,
Salt Lake City, Utah

Frances Lynn McCullough, MN, Sc, RNP, ONC
Orthopaedic Nurse Specialist,
Arkansas Spine Center,
Little Rock, Arkansas

Kathleen Hardin Mooney, RN, PhD, FAAN
Professor,
College of Nursing,
University of Utah,
Salt Lake City, Utah

Leona A. Mourad, MS, RN, ONC
Associate Professor, Emeritus,
Ohio State University;
Nursing Consultant,
Mourad Consultant Associates,
Columbus, Ohio

Noreen Heer Nicol, MS, RN, FNP
Dermatology Clinical Specialist/Nurse Practitioner,
National Jewish Center for Immunology and Respiratory
Medicine;
Clinical Senior Instructor,
University of Colorado Health Sciences Center, School of
Nursing,
Denver, Colorado

Pamela D. Parker-Cohen, MD, RN, MS, FNPc
Thomas Jefferson Medical College,
Philadelphia, Pennsylvania

Stephanie J. Richardson, RN, PhD(c), MS
Instructor and Doctoral Student,
College of Nursing,
University of Utah,
Salt Lake City, Utah

Lee K. Roberts, PhD
Associate Research Fellow,
Advanced Product Research,
Schering/Phough HealthCare Products,
Memphis, Tennessee

Kristynia M. Robinson, PhD(c), RN, FNPc
Family Nurse Practitioner/Associate Professor of
Nursing,
St. Mark's—Westminster School of Nursing,
Westminster College,
Salt Lake City, Utah

Neal S. Rote, PhD
Professor and Chair, Microbiology and Immunology,
Professor, Obstetrics and Gynecology,
Wright State University School of Medicine,
Dayton, Ohio

Mary Schoessler, RN, MS
Assistant Director, Education,
Providence Medical Center,
Portland, Oregon

Jane Shelby, BS, MS, PhD
Research Associate,
Department of Surgery,
College of Medicine,
University of Utah,
Salt Lake City, Utah

Sharon L. Sims, RN, PhD
Assistant Professor,
Indiana University School of Nursing,
Indianapolis, Indiana

Peter M. Sunderland, PhD, RN
Assistant Professor,
Director of Clinical Research,
Department of Neurosurgery,
University of Utah,
Salt Lake City, Utah

Mary Suzanne Tarmina, RN, PhD
Associate Clinical Professor,
College of Nursing,
University of Utah,
Salt Lake City, Utah

Roger R. Williams, MD
Professor of Medicine,
Director, Cardiovascular Genetics Research Clinic,
University of Utah,
Salt Lake City, Utah

Reviewers

Sr. Rose Terese Bahr, RN, PhD, FAAN*
Professor of Nursing and Chair,
Division of Community Health Nursing,
School of Nursing,
Catholic University of America,
Washington, DC

Jane Ball, RN, CPNP, DrPH*
Trauma Services,
Children's Hospital National Medical Center,
Washington, DC

Beverly Bartlett, RN, PhD*
Assistant Professor,
College of Nursing,
University of Rhode Island,
Kingston, Rhode Island

Carroll Conner Bouman, RN, MS*
Clinical Nurse Specialist in Cardiopulmonary Nursing;
Faculty Member and Doctoral Candidate,
School of Nursing,
University of Rochester,
Rochester, New York

John Carey, MD, MPH*
Associate Professor,
Chief, Division of Medical Genetics,
School of Medicine,
University of Utah,
Salt Lake City, Utah

Miguel da Cunha, PhD*
Associate Professor,
University of Texas Health Sciences Center at Houston,
Houston, Texas

Joyce Dains, RN, DrPH*
Assistant Professor,
School of Nursing,
University of Texas Health Sciences Center at Houston,
Houston, Texas

Carol DeMoss, RN, MN, CS*
Clinical Nurse Specialist,
Visiting Nurse Association of Allegheny County,
Pittsburgh, Pennsylvania

Dennis M. DePace, PhD
Department of Anatomy,
Hahnemann University,
Philadelphia, Pennsylvania

Dorothy Doughty, RN, MN, CETN*
Program Director,
Emory University,
Enterostomal Therapy Nursing Education Program,
Atlanta, Georgia

Harmon J. Eyre, MD*
Professor of Medicine,
Division of Hematology/Oncology,
School of Medicine,
University of Utah,
Salt Lake City, Utah

*First edition reviewer.

Nancy Gibson, RN, FNP
Salt Lake City, Utah

Mikel Gray, PhD, PNP, CURN*
Clinical Urodynamics,
Henrietta Eggleston Hospital for Children,
Scottish Rite Children's Hospital,
Shepherd Spinal Center;
Adjunct Professor,
Georgia State University School of Nursing,
Atlanta, Georgia

Judith Hall, RN, PhD*
Assistant Professor,
School of Nursing,
University of Texas at Arlington,
Arlington, Texas

Laurel Halloran, RN, MSN*
Assistant Professor;
Clinical Nurse Specialist, Doctoral Candidate,
Department of Nursing,
Western Connecticut State University,
Danbury, Connecticut

K.C. Hayes, DVM, PhD*
Director, Foster Biomedical Research Center;
Professor and Chairman, Biology Department,
Brandeis University,
Waltham, Massachusetts

Mary Beth Hayward, RN, MSN*
Associate Professor,
School of Nursing,
Medical College of Ohio,
Toledo, Ohio

Ruthellyn Hinton, RN, MS, MN*
Associate Professor,
Department of Nursing,
Pittsburg State University,
Pittsburg, Kansas

Marilyn Humphrey, RN, MA
Coordinator, Nursing Program,
Chabot College,
Hayward, California

Linda Jones, RN, MS, CS, OCN*
Assistant to the Associate Director for Nursing Oncology,
University of Rochester Cancer Center;
Assistant Professor of Clinical Nursing,
University of Rochester School of Nursing,
Rochester, New York

Sr. Joan Klemballa, RN, MA*
Associate Professor,
Division of Nursing Education,
University of District of Columbia,
Washington, DC

Helene J. Krouse, RN, C, PhD*
Assistant Professor,
School of Nursing,
Boston College,
Chestnut Hill, Massachusetts

Renee Leasure, PhD, RN, CCRN
Assistant Professor,
University of Oklahoma,
College of Nursing,
Oklahoma City, Oklahoma

Mary Lentz, RN, PhD*
Assistant Professor,
School of Nursing,
University of Pittsburgh,
Pittsburgh, Pennsylvania

Stacey Levine, RN, PhD*
Associate Professor,
University of Alberta,
Clinical Sciences Department,
Edmonton, Alberta, Canada

Leslie Marshall, PhD, RN
Associate Professor,
University of Iowa College of Nursing,
Iowa City, Iowa

Patricia Maybee, RN, MS, CCRN*
College of Nursing,
Clemson University,
Department of Instruction,
Clemson, South Carolina

Mary Beth McDowell, RN, MN*
Assistant Professor,
College of Allied Health and Nursing,
Eastern Kentucky University,
Richmond, Kentucky

Mary Ellen McMorrow, RN, EdD, CCRN*
College of Staten Island,
School of Nursing,
Staten Island, New York

Diane Melancon, RN, MSN*
Associate Professor of Nursing Education,
San Antonio College,
San Antonio, Texas

Kenneth Morgan, PhD*
Associate Professor,
Department of Epidemiology and Biostatistics,
McGill University,
Montreal, Canada

Leona Mourad, RN, MS*
Associate Professor Emeritus,
College of Nursing,
Ohio State University,
Columbus, Ohio

Christine Mudge-Grout, RN, MS*
Clinical Nurse Specialist, Nephrology/Transplant,
Department of Nursing,
University of California at San Francisco,
San Francisco, California

*First edition reviewer.

Virginia J. Neelon, RN, PhD*
Associate Professor,
School of Nursing,
University of North Carolina at Chapel Hill,
Chapel Hill, North Carolina

Donna Patterson, RN, MSN*
Assistant Professor,
Villanova University,
College of Nursing,
Villanova, Pennsylvania

Ann Peterson, RN, BS, BSN*
Endocrine Clinical Nurse Specialist,
Nursing Department,
National Institutes of Health,
Bethesda, Maryland

Karen A. Pfeifer, MSN, RN, CNA, ONC
Director of Nursing Resources,
Zale Lipshy University Hospital,
Dallas, Texas

Nancy Redeker, RN, C, MSN, PhD*
Instructor,
Rutgers University,
College of Nursing,
Newark, New Jersey

Gayle Reiber, RN, PhD*
Associate Professor,
School of Public Health,
University of Washington
Seattle, Washington

Linda L. Robertson, RN, PhD*
Assistant Professor,
School of Nursing,
University of Pittsburgh,
Pittsburgh, Pennsylvania

Connie Robinson, RN, MN*
Assistant Professor,
School of Nursing,
University of California at San Francisco,
San Francisco, California

David B. Roll, PhD*
Professor of Medicinal Chemistry,
College of Pharmacy,
University of Utah,
Salt Lake City, Utah

Amy Perrin Ross, RN, MSN, CNRN*
Neuroscience Clinical Nurse Specialist,
Loyola University Medical Center,
Maywood, Illinois;
Triton College,
Continuing Education Center for Health Professionals,
River Grove, Illinois

Phyllis Russo, RN, EdD*
Chairperson, Undergraduate Nursing,
College of Nursing,
Seton Hall University,
South Orange, New Jersey

Ann Sedore, RN, PhD*
Associate Professor,
College of Nursing,
Syracuse University,
Syracuse, New York

Janice Selekman, RN, DNSc*
Associate Professor,
Generic Baccalaureate Program Director,
Department of Nursing,
Thomas Jefferson University,
Philadelphia, Pennsylvania

Mary Ann Siefert, RN, MS*
Primary Childrens Hospital,
Salt Lake City, Utah

Barbara Peterson Sinclair, RN, MN*
Director, OB/GYN Nurse Practitioner Program,
School of Nursing,
California State University,
Los Angeles, California

Patricia A. Stuckey, MSN, RN, OCN
Assistant Professor, Medical-Surgical Nursing,
Virginia Commonwealth University,
Medical College of Virginia School of Nursing,
Richmond, Virginia

Lydia DeCastro-Svetich, RN, MS*
Associate Professor,
Orvis School of Nursing,
University of Nevada, Reno,
Reno, Nevada

Patricia J. Thompson, PhD, RN
Associate Professor,
University of Arkansas for Medical Sciences,
College of Nursing,
Little Rock, Arkansas

Arthur Vander, PhD*
Department of Physiology,
University of Michigan,
Ann Arbor, Michigan

Filomena Varvaro, RN, PhD*
Assistant Professor,
School of Nursing,
University of Pittsburgh,
Pittsburgh, Pennsylvania

Sharon Wahl, RN, MSN, EdDc*
Assistant Professor,
Department of Nursing,
San Jose State University,
San Jose, California

Eleanor A. Walker, BSN, MS*
Assistant Professor,
School of Nursing,
Catholic University of America,
Washington, DC

Connie A. Walleck, RN, MS, FCCM
Senior Associate Director of Nursing,
University Hospital,
SUNY Health Science Center,
Syracuse, New York

*First edition reviewer.

Lin C. Weeks, RN, MS, CNAA*
Administrative Director,
Hospital Education,
Hermann Hospital,
Houston, Texas

Pamela B. Weilitz, RN, MSN
Pulmonary Clinical Nurse Specialist,
Barnes Hospital,
St. Louis, Missouri

Raymond L. White, PhD*
Professor and Co-Chairman, Human Genetics Department,
Investigator of Howard Hughes Medical Institute,
School of Medicine,
University of Utah,
Salt Lake City, Utah

*First edition reviewer.

Gail M. Wilkes, RN, MS, OCN*
Clinical Nurse Specialist in Oncology,
Boston City Hospital,
Boston, Massachusetts

Elizabeth Hahn Winslow, PhD, RN, FAAN
Associate Professor,
School of Nursing,
University of Texas at Arlington,
Arlington, Texas

Maxwell Wintrobe, MD, BSc (Med), PhD, DSc (Hon.
Manitoba), DSc (Hon. Utah), DSc (Hon. Wisc.), MACP,
MD (Hon. Athens)*

Late Distinguished Professor of Internal Medicine,
School of Medicine,
University of Utah,
Salt Lake City, Utah

*To Kallie, Margot, and their parents,
Beth and Greg,
their aunt and uncles,
Anne, Eric, and Mark,
and their grandfather,
Papa John
. . . all Wolfers
“Here’s lookin at all the kids!”*

KLM

*To the many wonderful
teachers and students who have
taught me through the years.*

SEH

Preface

Spectacular advances in modern biology are revolutionizing our understanding of pathophysiology. Although the knowledge explosion—so overwhelming—is comprehensive and progressing rapidly, we have made every effort to stay current. Each chapter has been updated and in several instances revised extensively. Yet, we have retained our initial three broad objectives in offering this second edition:

- We have continued to provide comprehensive presentations of underlying principles common to all disease processes.
- We have retained, updated, and consistently revised coverage of disease processes in all age groups.
- We have paid scrupulous attention to making this edition an even more effective learning tool.

Specifically, we have added new two-color illustrations and updated and revised first edition illustrations appropriately. Algorithms have been added, and many have been revised to facilitate ease of learning.

ORGANIZATION OF THE BOOK

The basic organization has not changed from the first edition. The book is divided into two parts: *Part One, Central Concepts of Pathophysiology: Cells and Tissues*,

and *Part Two, Pathophysiologic Alterations: Organs and Systems*.

Part One: Central Concepts of Pathophysiology: Cells and Tissues

PART ONE: CENTRAL CONCEPTS OF PATHOPHYSIOLOGY: CELLS AND TISSUES

The Cell
Genes and Gene-Environment Interaction
Mechanisms of Self-Defense
Cellular Proliferation—Cancer

As before, Part One begins with an in-depth study of the cell, its workings, and other processes related to cells, but now has the addition of new areas of study:

- Completely revised chapters on cancer
- Cell signaling and cell communication processes
- Cytokines and their biologic activities
- Updated information on the identification of the genome and gene therapy
- Gender and life expectancy and cellular aging
- Mechanisms of immune defense

- Significantly revised content on AIDS and psychoneuroimmunologic regulation
- Concepts of stress, coping, and illness

Part One lays the foundation for organ system diseases and disorders that are presented in Part Two. Physical laws and principles, for example, fluid movement, energy expenditures, and electrical conductances, are emphasized to increase student awareness of how these laws and principles can be applied to understanding mechanisms and complications of disease. Cells of the immune system and inflammatory responses are activated with every type of trauma or disease. Understanding these mechanisms of protection and healing provides a powerful source of knowledge that can be generalized to disorders of many organ systems. Once the normal responses are understood, students can more easily comprehend the consequences of both immune deficiencies or hyperactive responses.

Knowledge of the rapidly expanding information on the genetic basis of disease and gene-environment interaction is critical to understanding developmental alterations, cancer, cardiovascular disease, diabetes, cystic fibrosis, degenerative neural diseases, and other common disorders. Therefore both cellular and population genetics have been updated to provide the student the necessary knowledge base for appreciating the importance of risk factors, diagnostic procedures, and treatments that are influenced by genetics.

Part Two: Pathophysiologic Alterations: Organs and Systems

PART TWO: PATHOPHYSIOLOGIC ALTERATIONS: ORGANS AND SYSTEMS

The Neurologic System
 The Endocrine System
 The Reproductive System
 The Hematologic System
 The Cardiovascular and Lymphatic Systems
 The Pulmonary System
 The Renal and Urologic Systems
 The Digestive System
 The Musculoskeletal System
 The Integumentary System

Part Two is still a survey of specific diseases from the traditional systems organization but adds new information and some strategic changes in pedagogy. Because student and faculty response to the format of this text has been overwhelmingly enthusiastic, each system unit still begins with a chapter on the normal anatomy and physiology of the system. We have paid scrupulous at-

tention to updating these chapters, knowing that normal function *directly* informs the discussion of the specific diseases that follow. These chapters have been extensively edited to include new diagnostic tests and updated information on the normal aging process unique to each system.

Throughout Part Two updated or new content has been added, including:

- Reorganization of the alterations of neurologic function chapter to include new information on head trauma and diffuse axonal injury
- Neurologic complications of AIDS and a new section on HIV infection in children
- Expansion of content on sexual dysfunction and cancer of the reproductive organs
- New information on tuberculosis and lung cancer
- New algorithms on conditions such as multiple organ system dysfunction, septic shock, disseminated intravascular coagulation, asthma, adult respiratory distress syndrome, and glomerulonephritis
- More tables to increase clarity of content on topics such as croup syndromes, glomerulonephritis, pneumonia in children, cancer of the GI tract, and hepatitis
- Application of cytokine function from Part One to pathophysiologic processes in Part Two, including the role of colony-stimulating factor (CSF) in hematopoiesis, leukemia, and leukopenia
- Pathologic effects of interleukins and tumor necrosis factor
- Cellular mechanisms of atherosclerosis leading to myocardial infarction and Kawasaki disease in children

Many features of the first edition have been retained for most of the disorders, including:

- Epidemiology and risk factors
- Pathogenesis and clinical manifestations
- Evaluation and treatment
- Clinical commentaries (listed on p. xvii)
- Use of physical laws to aid students in understanding pathophysiologic alterations
- Extensive integration of cancer research data

New features that enhance the second edition include revised historical openers with new art, new two-color illustrations, figure titles in boldface type, updated and easily retrieved content on aging, detailed chapter outlines with page numbers, updated and revised key terms, and complete updated summary reviews. The reference lists have been divided into cited references and references for additional reading to aid further study.

Although major emphasis is devoted to pathophysiology and clinical manifestations, significant attention is also paid to epidemiology and risk factors. Throughout the book, we have continued to extensively cross-reference to fully integrate the two parts of the book. Rather than delete controversial material, for example

the role of estrogens in breast cancer, we have summarized theoretical positions and identified gaps in current understanding. Sensitivity to gender differences in the development and manifestations of various diseases and disorders has been included as appropriate.

LIFESPAN CONTENT

Aging Content

Beginning in Chapter 2, theories of aging are presented. Reference is made to this content throughout Part Two as the normal changes associated with aging are presented in the normal anatomy and physiology chapter of each system unit. The pathophysiology of diseases associated with advanced age is discussed in the alterations chapters. In this way, we attempt to make it clear to students that there are physiologic changes related to aging that are normal and healthy, and that old age should not be considered synonymous with sickness and death.

Pediatric Content

In the same fashion, content related to alterations in children is firmly rooted in Part One of the book, and frequent reference is made to cellular content during the discussion of specific diseases of childhood presented in the systems units in Part Two. Material in Part One includes considerations related to childhood, such as congenital immune deficiencies, genetic disorders, familial diseases, and cancer in children. We take the opportunity in the systems chapters on children in Part Two to summarize, when appropriate, the differences between diseases in adults and children, such as differences in tumors.

ADDITIONAL LEARNING AIDS

Study Guide and Workbook

A most exciting addition to the second edition is a new Study Guide and Workbook for students written by Dr. Clayton Parkinson. Dr. Parkinson has designed the study guide to help students learn pathophysiology by

reinforcing key concepts and integrating workbook-like exercises. To this end, he has designed the anatomy and physiology chapters to have review objectives keyed to the text and keyed to practice examinations with answers. The pathophysiology chapters have prerequisite objectives with review assignments referenced to the text. The pathophysiology objectives are in boldface type and are keyed to study assignments and have an abbreviated outline narrative with summary charts. A practice examination with answers and a case study follow the narrative for application of concepts.

Instructor's Resource Manual and Test Bank

The instructor's manual has been significantly revised and updated. The revisions include updated chapter objectives; new sections on difficult concepts, with suggested teaching and learning approaches; and integrative content questions (i.e., critical thinking exercises). The integrative questions are designed to reinforce the application of physical laws and principles for problem solving. For example, students are asked to apply the concepts of osmotic gradient to the clinical problem of dehydration and to Starling's forces for understanding edema formation in an individual with hypertension.

A 1200-item test bank is available in the instructor's manual. Questions include multiple choice, true/false, matching, and short answer. Answers and page references to the text are provided.

Transparency Acetates

A new package of transparency acetates is available. This includes 150 transparencies, primarily of disorders. A legend booklet is included, and the acetates have been 3-hole punched so they can be stored in a binder.



With the revisions, updated material, and new student learning aids, we believe this new edition offers a *state of the art and science* approach to learning pathophysiology.

Kathryn L. McCance
Sue E. Huether

Acknowledgments

Many people worked on this book! Most significant was Sue Meeks, who generated the manuscript. Sue's astute and scrupulous approach kept us consistently on target. Thanks again, Sue, for your energy and remarkable attention to detail.

Again, we thank our colleagues and friends at the University of Utah College of Nursing. Special thanks to Debbie Bachan and Molly Berigan-Spira for their critical assistance with many details related to the revision and transmittal of the manuscript. Thanks to Mary Youngkin and Jeanne La Ber for their generous and skilled attention as reference librarians in Eccles Health Sciences Library. In addition, retrieving and securing hundreds of references was facilitated by Cheryl Mansen. Thank you, Cheryl. We acknowledge the librarians at the National Library of Medicine for their very helpful assistance in retrieving illustrations for the historical unit openers.

To our outstanding editors—thank you. Sally Schreffer, our editor, inherited us part way through revision. Sally got us focused and kept us on track and managed

the entire project with “grit and grace.” To Sally, thank you, and we'll have you in cowboy boots yet!

Penny Rudolph was our developmental editor. Penny is quick, thorough, and gently persistent. Thank you, Penny, for managing such detail completely and confidently. To Brian Dennison, thanks for all the administrative help and kindness, especially when we lost or forgot things.

Gail Brower was our chief production editor. Gail's ability to orchestrate thousands of details easily and accurately was astonishing. Thank you, Gail.

Again, we had the great fortune of having two extremely talented artists—Donald O'Connor and George Wassilchenko. Thanks, not only from us, but from many faculty and students who have written to tell us how the art program made the book!

Reviewers for this edition included faculty, students, clinicians, and investigators. Many comments and suggestions were essential and notably consistent—saving us invaluable time and energy. To all of the reviewers, thank you.

Contents

PART ONE Central Concepts of Pathophysiology: Cells and Tissues

UNIT I The Cell

- 1 Cellular Biology, 5
Kathryn L. McCance
- 2 Altered Cellular and Tissue Biology, 53
Kathryn L. McCance
- 3 The Cellular Environment: Fluids and Electrolytes, Acids and Bases, 91
Sue E. Huether

UNIT II Genes and Gene-Environment Interaction

- 4 Genes and Genetic Diseases, 126
Lyne B. Jorde
- 5 Genes and Environmental Interaction: Familial Diseases, 166
Roger R. Williams

UNIT III Mechanisms of Self-Defense

- 6 Immunity, 205
Neal S. Rote
- 7 Inflammation, 234
Neal S. Rote
- 8 Alterations in Immunity and Inflammation, 268
Neal S. Rote
- 9 Stress and Disease, 299
Kathryn L. McCance and Jane Shelby

UNIT IV Cellular Proliferation: Cancer

- 10 Tumor Biology, 321
Kathryn L. McCance and Lee K. Roberts
- 11 Tumor Metastasis in Adults and Cancer in Children, 366
Kathryn L. McCance, Lee K. Roberts,
and Kathleen Hardin Mooney

PART TWO Pathophysiologic Alterations: Organs and Systems

UNIT V The Neurologic System

- 12 Structure and Function of the Nervous System, 397
Peter M. Sunderland
- 13 Pain, Temperature Regulation, Sleep, and Sensory Function, 437
Patti Ludwig-Beymer, Sue E. Huether, and Mary Schoessler
- 14 Concepts of Neurologic Dysfunction, 477
Barbara J. Boss
- 15 Alterations of Neurologic Function, 527
Barbara J. Boss
- 16 Alterations of Neurologic Function in Children, 587
Judith A. Farley and Kathleen Hardin Mooney

UNIT VI The Endocrine System

- 17 Mechanisms of Hormonal Regulation, 626
Sue E. Huether
- 18 Alterations of Hormonal Regulation, 656
Patti Ludwig-Beymer and Sue E. Huether

UNIT VII The Reproductive System

- 19 Structure and Function of the Reproductive Systems, 711
Kristynia M. Robinson and Sue E. Huether
- 20 Alterations of the Reproductive System, 745
Kristynia M. Robinson and Kathryn L. McCance
- 21 Sexually Transmitted Diseases, 800
Thom J. Mansen

UNIT VIII The Hematologic System

- 22 Structure and Function of the Hematologic System, 830
Kathryn L. McCance and Pamela F. Cipriano
- 23 Alterations of Erythrocyte Function, 860
Thom J. Mansen and Kathryn L. McCance
- 24 Alterations of Leukocyte, Lymphoid, and Hemostatic Function, 878
Thom J. Mansen, Kathryn L. McCance, and Rosemary B. Field
- 25 Alterations in Hematologic Function in Children, 908
Margaret M. Andrews, Kathleen Hardin Mooney, and Kathryn L. McCance

UNIT IX The Cardiovascular and Lymphatic Systems

- 26 Structure and Function of the Cardiovascular and Lymphatic Systems, 943
Kathryn L. McCance and Stephanie J. Richardson
- 27 Alterations of Cardiovascular Function, 1000
Sandra W. Haak, Stephanie J. Richardson, and Sheryl S. Davey

- 28 Alterations of Cardiovascular Function in Children, 1085
Sharon L. Sims

UNIT X The Pulmonary System

- 29 Structure and Function of the Pulmonary System, 1120
Sheryl S. Davey and Sue E. Huether
- 30 Alterations of Pulmonary Function, 1148
Sheryl S. Davey and Kathryn L. McCance
- 31 Alterations of Pulmonary Function in Children, 1191
Sue E. Huether

UNIT XI The Renal and Urologic Systems

- 32 Structure and Function of the Renal and Urologic Systems, 1212
Sue E. Huether
- 33 Alterations of Renal and Urinary Tract Function, 1235
Sue E. Huether
- 34 Alterations of Renal and Urinary Tract Function in Children, 1265
Cyrena M. Gilman and Kathleen Hardin Mooney

UNIT XII The Digestive System

- 35 Structure and Function of the Digestive System, 1282
Sue E. Huether
- 36 Alterations of Digestive Function, 1320
Sue E. Huether and Kathryn L. McCance
- 37 Alterations of Digestive Function in Children, 1376
Gale D. Danek and Sue E. Huether

UNIT XIII The Musculoskeletal System

- 38 Structure and Function of the Musculoskeletal System, 1404
Leona A. Mourad
- 39 Alterations of Musculoskeletal Function, 1434
Leona A. Mourad
- 40 Alterations of Musculoskeletal Function in Children, 1482
Frances Lynn McCullough

UNIT XIV The Integumentary System

- 41 Structure, Function, and Disorders of the Integument, 1512
Sue E. Huether and Melva Kravitz
- 42 Alterations of the Integument in Children, 1561
Noreen Heer Nicol and Sue E. Huether