

Fourth Edition

CONTEMPORARY NUTRITION

ISSUES

AND

INSIGHTS

**FREE
NutriQuest**
available with purchase
of new text

Gordon M.
Wardlaw

Fourth Edition

CONTEMPORARY NUTRITION

ISSUES AND INSIGHTS

Gordon M. Wardlaw,

Ph.D., R.D., I.N.S.D., C.N.S.D.

Division
School of
Therapeutics

ethics
professions
society

SOLANO COLLEGE BOOKSTORE

USED BOOK

SELL YOUR BOOKS DURING FINALS



Boston Burr Ridge, IL Dubuque, IA Madison, WI New York San Francisco St. Louis
Bangkok Bogotá Caracas Lisbon London Madrid
Mexico City Milan New Delhi Seoul Singapore Sydney Taipei Toronto

McGraw-Hill Higher Education

A Division of The McGraw-Hill Companies

Contemporary Nutrition: Issues and Insights, Fourth Edition

Copyright © 2000, 1997, 1994, 1991 by The McGraw-Hill Companies, Inc. All rights reserved. Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a data base or retrieval system, without the prior written permission of the publisher.



This book is printed on recycled, acid-free paper containing 10% postconsumer waste.

1 2 3 4 5 6 7 8 9 0 QPD/QPD 0 9 8 7 6 5 4 3 2 1 0

ISBN 0-07-109368-0

Vice president and editorial director: *Kevin T. Kane*

Publisher: *Colin H. Wheatley*

Senior developmental editor: *Lynne M. Meyers*

Senior marketing manager: *Pamela S. Cooper*

Senior project manager: *Marilyn Rothenberger*

Senior production supervisor: *Sandra Hahn*

Coordinator of freelance design: *Michelle D. Whitaker*

Photo research coordinator: *John C. Leland*

Supplement coordinator: *David A. Welsh*

Compositor: *GAC—Indianapolis*

Typeface: *10/12 Giovanni Book*

Printer: *Quebecor Printing Book Group/Dubuque, IA*

Freelance cover/interior design: *Kristyn A. Kalnes*

Cover image: © *Zane B. Williams*

Cover photograph: *Photo taken in mid-August; Dane County Farmer's Market, on the square;*

Cart owned/operated by Kingsfield Gardens in Blue Mounds, WI

The credits section for this book begins on page c-1 and is considered an extension of the copyright page.

Library of Congress Cataloging-in-Publication Data

Wardlaw, Gordon M.

Contemporary nutrition : issues and insights / Gordon M. Wardlaw.
—4th ed.

p. cm.

Includes bibliographical references and index.

ISBN 0-07-109368-0

1. Nutrition. I. Title.

QP141.W378 2000

613.2—dc21

www.mhhe.com

99-18616
CIP



Preface to the Instructor

If you teach nutrition, you undoubtedly already find it a fascinating topic. However, nutrition can also be quite frustrating to teach. Claims and counterclaims abound regarding the need for certain constituents in our diets. Sodium is a good example. One group of researchers promotes a low-sodium diet for the general population as an effective preventive measure for high blood pressure. Other groups state that this is much less of a concern compared to other habits; such as inactivity and adult weight gain.

As an author, I too am aware of conflicting opinions in our field and thus draw on as many sources as possible in the continual updating of this textbook, now in its fourth edition. I have incorporated much new material, especially from recently published articles in major nutrition and medical journals; supplements to the *American Journal of Clinical Nutrition*; the 9th edition of *Modern Nutrition in Health and Disease*, edited by Shils, Olson, Shike; and *Present Knowledge in Nutrition*, edited by Ziegler and Filer. In addition, available information on the latest Dietary Reference Intake revisions to the 1989 RDA are incorporated where appropriate.

In all, the book strives to present many perspectives in current nutrition research so that you and your students can better understand and participate in debates about current nutrition issues.

Personalizing Nutrition

One prominent theme in nutrition research today is *individuality*. Not all of us, for example, find that saturated fat in our diets raises our blood cholesterol values above recommended standards. Each person responds individually, often idiosyncratically, to nutrients, and that is something I continually point out in this textbook.

Moreover, even at this basic level the book discussions do not assume that all nutrition students are alike. Chapter content repeatedly asks students to learn more about themselves and their health status and to use this new knowledge to improve their health. After reading this textbook, students will understand much more clearly how the nutrition information given on the evening news, on cereal box labels, in popular magazines, and by government agencies applies to them. They will become sophisticated consumers of both nutrients and nutrition information. They will understand that their knowledge of nutrition allows them to personalize information, rather than follow every guideline issued for an entire population. After all, a population by definition consists of individuals with varying genetic and cultural backgrounds, and these individuals have varying responses to diet.

In addition, the book covers important questions that students often raise concerning ethnic diets, eating disorders, nutrient supplements, phytochemicals, vegetarianism, diets for athletes, food safety, and fad diets, with an overall emphasis on the importance of understanding one's food choices and changing one's diet as needed.

Audience

This book has been designed for a nonmajors audience. The chemistry has been kept to a minimum, and more so than in previous editions. Health majors, home economics majors, nursing students, physical education students, and students in other health-related areas will also find this text appropriate. Because of the flexible chapter organization and content, this book can be adopted for students of diverse educational backgrounds. Although it is not absolutely necessary, most students will find that having an understanding of basic biological concepts provides a helpful background when using this book.

Organization

The book is most suitable for a semester-length course; it can also be used in a quarter-length course by omitting chapters or by skipping various sections. A useful feature of this text is that it is presented in five segments:

- PART 1 NUTRITION: A Key to Health
- PART 2 NUTRIENTS: The Heart of Nutrition
- PART 3 ENERGY: Balance and Imbalance
- PART 4 NUTRITION: A Focus on Life Stages
- PART 5 NUTRITION: Beyond the Nutrients

This organization makes it easy to tailor the text to specific course needs.

New to This Edition

The changes I've made to the fourth edition of *Contemporary Nutrition: Issues and Insights* are designed to enhance student learning and understanding; many of them are a direct result of the feedback I received from instructors who team the introductory nutrition course.

Updated Content

To give students an accurate picture of nutrition today, it's important to provide the most up-to-date information available. So I've gone carefully through recent research and updated the text throughout.

Updated Readings for Further Study

Of course, as the content throughout the text has been updated, so too has the list of readings at the end of each chapter. Current texts and journal articles are contained in a list of relevant citations at the end of each chapter, as well as discussions from leading nutrition newsletters. Should you or your students want additional information about a particular topic, these lists will point you in the right direction. I decided not to directly cite references in the body of the text because of the basic level of content. Much of the discussions are very introductory in nature. If you would like a specific literature citation to support text material, please contact me and I will provide the reference.

Fewer Chapters

Now with 16 chapters instead of 18, I consider this to be a more streamlined edition. Many instructors told me that while Chapter 2 and 12 from the third edition contained useful information, it was not necessary to devote entire chapters to them. As a result these chapters have

been deleted, and most of the information from them has been shifted to other chapters.

Nutrition Web

Key chapter concepts at the beginning of each chapter are now in a web format. Unlike the list of key concepts in the previous edition, this new format allows students to see how one concept is related to another, and because it is more visually interesting, it is more likely to pique students' interest.

Expanded Rate Your Plate Activities

Each Rate Your Plate activity at the end of each chapter is now in a two-part format. This provides the student with more opportunities to put their acquisition of nutrition knowledge into practice.

Addresses for Nutrition-Related Web Sites

Because of the abundance of information contained on the World Wide Web today, addresses (URLs) for a variety of credible nutrition-related web sites are now included in each chapter. These URLs will also be included as hot links from the text's web site. I've also included toll-free telephone numbers and other resources whenever available.

Richest Source of Each Nutrient in the Margins

To make this information more easily accessible, the richest sources of each nutrient discussed in Chapters 7 and 8 are now listed in numerical format in the margins.

Updated Illustration Program

New photos and illustrations help to better convey important concepts, and also help to keep the text current and fresh.

Pedagogy

The following pedagogical features continually reinforce the learning process—enhancing students' learning and understanding.

Nutrition Web

This new format for illustrating key chapter concepts allows students to see how one concept is related to another, and because it is more visually interesting, it is more likely to pique students' interest.

Margin Notes

Margin notes throughout the book clarify concepts and provide further details about them; they also provide interesting examples and references to other chapters.

Margin Definitions

Important terms are set in boldface type at first mention and, when possible, they are defined in the text's margins (all are defined in the glossary at the end of the book).

Concept Check Boxes

These boxes provide a summary of chapter content every few pages, which reinforces students' understanding of the material.

Nutrition Insight Boxes

Short essays, often on controversial topics in nutrition, are located in each chapter.

Summary

At the end of each chapter is an overall summary of the chapter's main points.

Study Questions

Approximately 10 questions at the end of each chapter encourages students to probe deeper into the chapter content.

Further Readings

Each chapter contains an up-to-date list of readings that will direct you and your students to resources for further information about a particular topic.

Critical Thinking Questions

Within each chapter are two questions found in the margins of the text, which allow students to apply information to practical situations.

Rate Your Plate

Similar to the Critical Thinking Questions, these activities at the end of each chapter allow students to put theory into practice. The suggested assignments are usually proactive, and sometimes ask students to carefully analyze part of their current diet or lifestyle.

Nutrition Issue Boxes

These essays at the end of each chapter take a more detailed look at a specific topic relevant to the chapter.

Glossary

Located at the end of the text, this comprehensive glossary of key terms is included for students' reference, and includes pronunciation keys for unfamiliar words.

Supplementary Materials

Numerous supplementary materials are available to you and your students, which will expand on the concepts presented in this text, and increase the overall value of this text.

Instructor's Manual and Test Bank

This comprehensive teaching aid is available to adopters of the book. It includes chapter summaries with suggestions for teaching difficult material: activities; suggested readings; activities to use with *NutriQuest*™ 2.0, and a "survival" section that discusses class organization, scheduling, and problem areas such as cheating. The test bank features multiple-choice, short-answer, and matching test questions.

Microtest III Computerized Test Bank

Instructors who adopt this text can receive the computerized test bank for Windows or Macintosh. This software allows the instructor to select, edit, delete, or add questions, and print tests and answer keys.

Transparency Acetates

Text adopters may receive a package of 185 full-color transparency acetates featuring key illustrations from this text, and others.

Visual Resource Library (VRL)

This CD-ROM for Windows and Macintosh contains a PowerPoint presentation based on *Contemporary Nutrition*, fourth edition, as well as a separate section of key illustrations, photographs, and animations. The PowerPoint presentation can be used as is, or portions can be imported into instructor's own PowerPoint presentation. Illustrations can also be imported into another program.

Student Study Guide

This student aid is prepared by Gordon Wardlaw, and was developed in consultation with a learning theory expert. This comprehensive guide reinforces concepts presented in the text and integrates them with study activities to emphasize key concepts. It features vocabulary review and sample examinations structured to reflect the actual examinations students will face in the classroom.

NutriQuest™ 2.0—Dietary Analysis Software

Students will learn more about their own personal health habits with this upgraded dietary analysis software program that allows users to track energy intake and expenditure, set weight goals, and more. Improvements to this version includes more foods (approximately 4000), better printing options for reports, and the ability to save data to another disk. The software is available on CD-ROM for Macintosh and Windows, disks for Windows, or you can purchase a site license so you can place it on your school's network. NutriQuest 2.0 also has its own web site for related on-line information—<http://www.mhhe.com/hper/nutrition/nutriquest/>.

INNOVATIONS Newsletter

This newsletter, produced in partnership with Novartis Pharmaceuticals, offers students an in-depth look at important issues in nutritional science.

NutriNews

Upon request, adopters are given the password to this electronic newsletter made up of nutrition-related articles. You'll find the newsletter, as well as several other features, on WCB/McGraw-Hill's nutrition web site at <http://www.mhhe.com/hper/nutrition/>.

Annual Editions: Nutrition

Supplement any of your nutrition texts with this annually updated compilation of carefully selected nutrition-related articles from magazines, newspapers, and journals.

Diet and Fitness Log

This convenient paper-and-pencil system allows students to keep a handwritten record of their diet and exercise program so they can assess their eating and physical activity habits.

Nutrition Videos

Two 10- to 12-minute videotapes are available to qualified adopters: *Issues in Nutrition: Eating Disorders* and *Issues in Nutrition: Obesity and Weight Control*. Both videos incorporate interviews with professionals in their respective fields.

Web Resources

This text is supported by a variety of on-line resources, such as the McGraw-Hill Nutrition web site (<http://www.mhhe.com/hper/nutrition>) and a web site designed specifically for CONTEMPORARY NUTRITION (<http://www.mhhe.com/hper/nutrition/wardlaw>). See p. xix–xx for more information on the on-line resources available from McGraw-Hill.

Text Web Site and Online Learning Center

This textbook is supported by a specially developed web site, designed to help students get the most out of their first nutrition course. One component of the web site, the Online Learning Center, contains a variety of chapter-correlated resources from web links to on-line quizzes and flash cards. <http://www.mhhe.com/hper/nutrition/wardlawcon/>

Questions About These Supplements?

If you have questions about these supplements, please contact your McGraw-Hill sales representative, or call Customer Service at (800) 338-3987.

Special Acknowledgments

I would like to personally thank those individuals who contributed their expertise to the project. Janet Haworth, R.D., and Sally Smith, R.D., participated in key phases of the revision, as well as Regina Stachowiak, who helped with proofreading and preparing the final manuscript. My editors, Kassi Radomski and Lynne Meyers, supported and assisted me through the revision, and facilitated the difficult decisions that frequently arose. Beatrice Sussman and Marilyn Rothenberger did excellent copyediting and production work.

Reviewers

As with earlier editions, my goal is to provide the most accurate, up-to-date, and useful introductory nutrition text available. I, along with my editors, would like to

recognize and thank those people whose direction and insight guided this fourth edition:

Wendy Hunt
American River College

Kaye Stanek
University of Nebraska, Omaha

Robert D. Reynolds
University of Illinois, Chicago

Joelle E. Romanchik
Georgia Southern University

Marlene McCall
Community College of Allegheny County

Rao V. Ivaturi
Indiana State University

Cherie Moore
Cuesta College

Prisca Nemapare
Ohio University

Bahram Faraji
University of Texas, Pan American

Sofi Boutros
Western Illinois University

Richard P. Dowdy
University of Missouri, Columbia

John S. Avens
Colorado State University

Marjorie T. Hagerman
Ohio University

LuAnn Soliah
Baylor University

Amelia Finan
Anne Arundel Community College

Laura Nihan
Eastern Kentucky University

Richard D. Mattes
Purdue University

William Helfrich
University of Illinois, Urbana-Campaign

Millicent Owens
College of the Sequoias

David Gee
Central Washington University

Marcia C. Miller
Queens College, CUNY

C. Alan Titchenal
University of Hawaii

Beverly A. Benes
University of Nebraska, Lincoln

Michael Olpin
Concord College

Pat Brown
Cuesta College

Cindy Beck
The Evergreen State College

Ethan A. Bergman
Central Washington University

Cynthia Gossage
Prince George's Community College

Nancy Harris
East Carolina University

Carmen L. Nochera
Grand Valley State University

Janet Colson
Middle Tennessee State University

Marie A. Caudill
California State Polytechnic University

Marilyn Mook
Michigan State University

Carol A. Higginbotham
Barat College

Richard A. Ahrens
University of Maryland

Janice K. Goodwin
University of North Dakota

Marsha H. Read
University of Nevada, Reno

Sharlene Holladay
George Mason University

Liz Applegate
University of California, Davis

Judith D. Fraser Arsenault
Mount Saint Vincent University, Halifax

Carolyn Lara-Braud
University of Iowa

Thaddeus Osmolski
University of Massachusetts, Lowell

The dietary analysis software, NutriQuest 2.0, is a valuable extension to this text. We would also like to thank those individuals whose feedback and suggestions have made NutriQuest 2.0 an even more effective and reliable nutrition assessment tool:

Sara Long Anderson
Southern Illinois University

Rosalie Barretta
Charles County Community College

Beverly Benes
University of Nebraska—Lincoln

Louise Berner
California Polytechnic and State University

Blakley Brown
University of Minnesota

Pat Brown
Cuesta College

Dorothy Cope
Phoenix College

Denise Eagan
Marshall University

Jill Golden
Orange Coast College

Michael Hamrick
University of Memphis

Annamarie Herndon
Purdue University

Patti Marincic
College of St. Benedict/
St. John's University

Judy Paisley
Ryerson Polytechnic University

Stephanie Raach
Rock Valley College

Barbara Reynolds
College of the Sequoias

Thaxton Springfield
St. Petersburg Junior College

Kathryn Timmons
Murray State University

Elaine Turner
University of Florida

Jane Vincent
Indiana University

Dana Wassmer
California State University, Sacramento

This book began with a dream. Each new edition is fostered by the excitement that improvements bring, and ends with the revision of an innovative textbook that continues to set a standard for introductory nutrition textbooks.

Gordon M. Wardlaw



Preface to the Student

Cholesterol, sports drinks, food labeling, bulimia nervosa, alternative sweeteners, vegetarianism, and *Salmonella* foodborne illness—I suspect you have heard about these topics. Which of them are important enough to be a consideration in your life or in the life of someone you know?

Americans pride themselves on their individuality. Nutritional advice should be given accordingly. For example, not all of us have high blood cholesterol and other significant risk factors for premature development of heart disease. The need to tailor dietary advice to each person's individual nature is the basic approach of this book. First you are given a brief introduction to the study of nutrition; then, how to be a knowledgeable consumer is discussed. With so much information floating around—both accurate and inaccurate—you should know how to make informed decisions about your nutritional well-being. Then you are encouraged to learn the basic principles of nutrition and to discover how to apply the concepts in this book that pertain specifically to you.

The text discusses some of the most interesting and important elements of nutrition and food consumption to help you understand both how your body works and how your food choices affect your health.

Features

Planning a New Way of Eating

Early in the text, many of the basic guidelines for planning a healthy diet are presented, including a description of the USDA Food Guide Pyramid, in Chapter 2. Later in Chapter 9, the steps involved in setting nutritional goals and designing a diet plan to attain those goals are reviewed.

Understanding the World Around Us

In a college environment, it is often difficult to envision how real the problem of world hunger is. Chapter 16 examines the problem of undernutrition and the conditions that created it. The chapter allows you to explore possible solutions that offer hope for the future of our world.

Pedagogy

The fourth edition of *Contemporary Nutrition: Issues and Insights* incorporates some important tools (called pedagogy) to help you learn the nutrition concepts in this text. Following is a guide to those tools:

1. Each chapter begins with a Nutrition Web. This will help you focus your attention on key ideas in the chapter.
2. Throughout each chapter are **boldfaced key terms**, many of which are defined in the margin. All boldfaced terms appear with their definitions and pronunciations in the glossary at the end of the text.
3. Also throughout each chapter are **margin notes**, which further explain ideas, provide references to other chapters, and provide the URLs to nutrition-related web sites.
4. The numerous **tables** throughout the text summarize major points.
5. The **Concept Checks** that follow the major sections within each chapter summarize key points. If you don't understand the material in the Concept Check, you should reread the preceding section.
6. Each chapter ends with a **summary**, which conveys the main ideas in the chapter, and **study questions**—both provide excellent review for examinations.

7. **Further Readings** are provided to support material presented in the chapter. Much of this has been published since the last edition of the text. If you are preparing a research paper for your class, or would just like more information on specific topics, consult these sources.
8. Also at the end of each chapter is a **Rate Your Plate box** that makes major concepts presented in the chapter relevant to your own life. For example, you may be asked to look more carefully at your own diet, examine your family history, or apply information you've learned to friends or family.
9. **Nutrition Insight boxes** allow you to explore current topics that your instructor may not have time to cover but that may be of interest to you.
10. **Critical Thinking questions** ask you to apply information as you learn it. This fosters understanding of the material.
11. **Nutrition Issue essays** at the end of each chapter develop current topics in nutrition, often covered earlier in the chapter, in greater detail.
12. A variety of supplements to this text, including **Student Study Guide**, and **NutriQuest™ 2.0**, dietary analysis software, are available to you. These instructional aids are designed to help you learn the major concepts developed in the text and prepare for class examinations.

Student Study Guide

The valuable Student Study Guide, written by your textbook author, reinforces concepts presented in the text and integrates them with activities to facilitate learning. Sample examinations reflect the actual tests you will face in the classroom. Vocabulary reviews increase your knowledge of the terminology. Activities include fill-in tables, labeling, and matching terms. These activities follow the text discussion and are anchored with quotations and page citations from the text.

NutriQuest™ 2.0—Dietary Analysis Software

This user-friendly dietary analysis program provides a variety of useful features, which allow you to track daily food intake, energy expenditure, and establish weight or body mass index (BMI) goals. Several different reports and pie charts allow users to see how calories from a specific food, meal, day, or daily average break out. For example, you can click on the USDA Pyramid to determine how many servings from the fruit or grain group you have consumed on a given day; or on the fat pie chart to see what percentage of calories from saturated, monounsaturated, or polyunsaturated fat were in this morning's breakfast.

Features

- **NutriQuest's 2.0** database of nearly 4000 foods allows you to accurately record their intake, and analyze a specific food, meal, day or average.
- **NutriQuest 2.0** calculates recommended daily calories and body mass index (BMI) based on height, weight, and other information entered in the Personal Profile.
- You can track your daily activities—from sleeping to jogging—and **NutriQuest 2.0** will calculate daily energy expenditure.
- You can view a “personalized” food label in standard food label format for a given food.
- This colorful program is intuitively designed, making it easy to maneuver from one screen to another.
- Additional features include: an easily accessible “Help” function; and an Explore Center with recipes, how to read standard food labels, answers to common dietary myths, a link to the **NutriQuest 2.0** web site, and so on.

A Request to Professors and Students Who Use This Book

As you might imagine, it is difficult to range across the vast areas of nutrition science, following all of the various controversies and new developments. I try my best but realize that sometimes I miss a side of an argument that deserves attention. If as you read this book you find content that you question or believe warrants a more detailed or broader look, feel free to contact me.

Dr. Gordon M. Wardlaw
The Ohio State University
516H School of Allied Medical Professions
1583 Perry Street
Columbus, OH 43210
Phone: (614) 292-8142
Fax: (614) 292-0210
E-mail: wardlaw.1@osu.edu

generally reliable. However, an in-depth examination of nutritional health is impossible without the rather expensive process of biochemical assessment. This involves the measurement of specific blood enzyme activities and of the concentrations of nutrients and nutrient by-products in the blood.

A clinical examination would follow, during which a health professional would search for any physical evidence of diet-related diseases. Last, a diet history, documenting at least the previous few days' intake, is an invaluable tool for insight into possible problem areas. Together these activities form the ABCDs of nutritional assessment: anthropometric measurements, biochemical assessment, clinical examination, and diet history.

Recognizing the Limitations of Nutritional Assessment

As mentioned, a long time may elapse between the initial development of poor nutritional health and the first clinical evidence of a problem. Recall that a diet high in saturated (typically solid) fat often increases blood cholesterol concentration, but without producing any clinical evidence for years. However, when the blood vessels become sufficiently blocked by cholesterol and other materials, chest pain during physical activity or a heart attack may occur. Much current nutrition research aims to develop better methods for early detection of nutrition-related problems such as this.

Another example in the delay of evidence that serious consequences are occurring is with a calcium deficiency, a particularly relevant issue for adolescent females. Many young women consume well below the needed amount of calcium but often suffer no ill effects in their younger years. However, women whose bone structures do not reach full potential during the years of growth are likely to face an increased risk for osteoporosis later in life.

Furthermore, clinical evidence of nutritional deficiencies is often not very specific, such as diarrhea, an irregular walk, and facial sores. These may have different causes. Long lag times and vague evidence often make it difficult to establish a link between an individual's current diet and nutritional state.

Table 1-4 in Chapter 1 showed the close relationship of nutrition and health. The rest of this current chapter helps you plan a diet to maximize your health and minimize the development of nutrition-related diseases.

Concept Check

Variety, balance, and moderation are the foundations of a healthy diet. A desirable nutritional state results when the body has enough nutrients to function fully and contains stores to use in times of increased needs. When nutrient intake fails to meet body needs, undernutrition develops. Symptoms of such an inadequate nutrient intake can take months or years to develop. Overloading the body with nutrients, leading to overnutrition, is another potential problem to avoid. Nutritional state can be assessed by using anthropometric measurements, biochemical evidence, clinical evaluation, and diet history.

The Food Guide Pyramid—A Menu-Planning Tool

Since the early twentieth century, researchers have worked on various food plans to simplify nutrition science into practical terms so that people with no special training could estimate whether their nutritional needs were being met. In recent years

Cholesterol

A waxy lipid found in all body cells. It has a structure containing multiple chemical rings that is found only in foods that contain animal products (see Chapter 5).

Heart attack

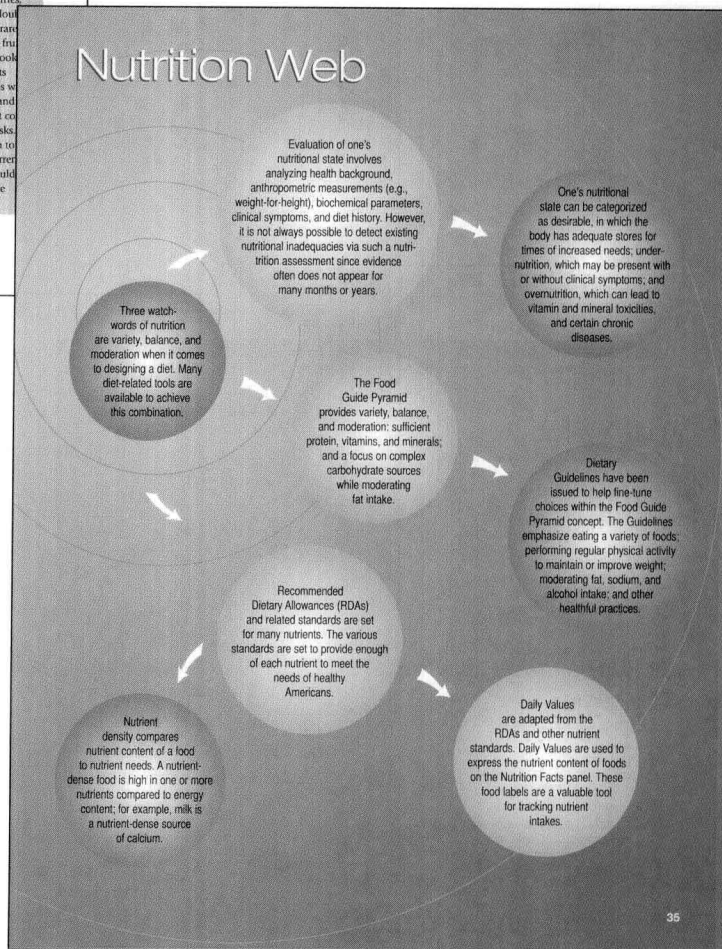
Rapid fall in heart function caused by reduced blood flow through the heart's blood vessels. Often part of the heart dies in the process (see Chapter 5). Technically called a myocardial infarction.

Throughout each chapter are **bold-faced key terms**. These are terms you will need to be familiar with throughout your study. The more difficult terms include a **definition in the text's margins**. All boldfaced terms appear with their definitions and pronunciations in the glossary at the end of the text.

Nutrition Webs help you visualize a mental map of the relationship between key nutrition concepts.

Tom loves to eat hamburgers, fries, and lots of pizza with double amounts of cheese. He rarely eats any vegetables and fruit but instead snacks on cookies and ice cream. He insists that he has no problems with his health, is rarely ill, and doesn't see how his diet could cause him any health risks. How would you explain to Tom that despite his current good health, his diet could predispose him to future health problems?

Nutrition Web



You'll find that the numerous full-color, 3-dimensional illustrations almost jump off the page and will help nutrition "come alive" for you.

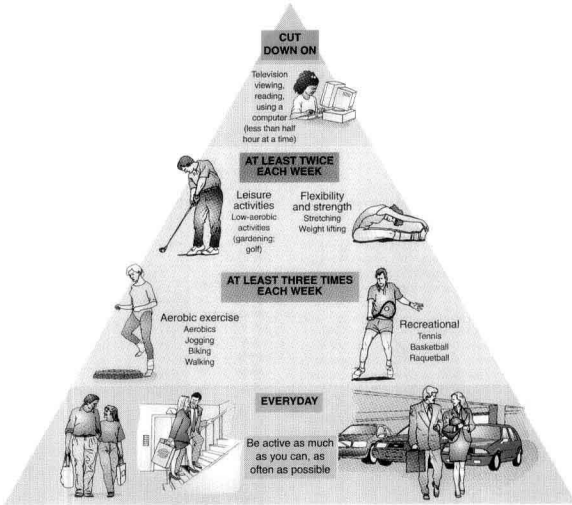


Figure 10-2 Using the concept of the Food Guide Pyramid, health educators at Park Nicollet Medical Foundation in Minneapolis have created an easy reference—the Physical Activity Pyramid. The recommendations in the pyramid are based on American College of Sports Medicine guidelines.

into each day's tasks. If there is not much time for activity, one can go for more intensity in the activities that can fit in to get the same benefits (Figure 10-2). Note that only about 1 in 10 adults practices vigorous activities daily, and about half of all adults quit their exercise plan within 3 months of the onset.

The easiest way to increase physical activity is to make it part of a daily routine, similar to other regular activities, such as eating. One does not need to join a gym or attend aerobic classes. Daily activities can meet the Phase 1 goal. Many people find that the best time to exercise is when they need an energy pick-me-up or a break from work. Rather than abandon an exercise program entirely when obstacles impede, one can strive to use any small periods of available time. Once reaping the benefits of exercise, a person will tend to spend more time at it.

Clearly, many of the activities recommended for Phase 1 are not very vigorous. By recommending Phase 1 for those starting an exercise program, fitness experts have not given up on the value of more vigorous physical activity. They're just making concessions to human nature.

TABLE 8-2 Questionnaire for Evaluating Your Sodium Habits with Respect to Typically Rich Sources

HOW OFTEN DO YOU:	Rarely	Occasionally	Often	Regularly (daily)
1. Eat cured or processed meats, such as ham, bacon, sausage, frankfurters, and other luncheon meats?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Choose canned or frozen vegetables with sauce?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Use commercially prepared meals, main dishes, or canned or dehydrated soups?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Eat cheese, especially processed cheese?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Eat salted nuts, popcorn, pretzels, corn chips, or potato chips?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Add salt to cooking water for vegetables, rice, or pasta?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Add salt, seasoning mixes, salad dressings, or condiments—such as soy sauce, steak sauce, catsup, and mustard—to foods during preparation or at the table?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Salt your food before tasting it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Ignore labels for sodium content when buying foods?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. When dining out, choose foods at restaurants with sauces, or foods that are obviously salty?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The more checks you have in the last two columns, the higher your dietary sodium intake.

Adapted from USDA Home and Garden Bulletin No. 232-6, April 1986.

Concept Check

Sodium is the major positive ion of extracellular fluid. It is important for maintaining fluid balance and conducting nerve impulses. Sodium depletion is unlikely, since the typical American's diet has abundant sources of sodium and most of it gets absorbed. The more foods we prepare at home, the more control we have over our sodium intake. The minimum sodium requirement for adults is 500 milligrams per day. The average adult consumes 3000 to 6000 milligrams or more daily. About 10% to 15% of the population is sensitive to sodium. In these people, high blood pressure can develop as a result of high-sodium diets, but many other lifestyle habits are more important. Many scientific groups suggest that for all adults sodium intake should be limited to about 3 grams (3000 milligrams). Sodium in the American diet is provided predominantly through processed foods and salt added in cooking and at the table.

Potassium (K)

Potassium performs many of the same functions as sodium, such as fluid balance and nerve impulse transmission. However, it operates inside, rather than outside, cells. Intracellular fluids—those inside cells—contain 95% of the potassium in the body. Also, unlike sodium, potassium is associated with lower rather than higher blood pressure values. We absorb about 90% of the potassium we eat.

The numerous tables throughout the text provide convenient capsules of information for your reference.

The CONCEPT CHECKS appear every few pages and summarize content. If you don't understand what the Concept Check says, you should reread the preceding section in the textbook.

Vitamin A in Foods and Needs

Preformed vitamin A is found in liver, fish oils, vitamin A-fortified milk and breakfast cereals, and eggs. Butter and margarine are also sources because they are fortified with vitamin A. Provitamin A is found mainly in dark green and orange vegetables and some fruits. Carrots, spinach, winter squash, broccoli, papayas, and apricots are examples of sources. Consuming a varied diet rich in green vegetables and carrots ensures sufficient sources for meeting vitamin A needs (Figure 7-2). About half of the vitamin A in the American diet comes from animal sources, the other half from plants.

NO BITE Most nutrient amounts in foods, including vitamin A, were formerly expressed in less precise international units (IU). Some supplement labels still show the older IU values for vitamin A. For vitamin A the current unit of measurement is the retinol equivalent (RE). In this system, all potential forms of vitamin A are scaled based on their activity. Based on a mixture of preformed and provitamin A, 1 RE of vitamin A is equivalent to 5 IU of vitamin A.

Recently, derivatives of vitamin A have been put into creams (Renova) that reduce some effects of aging on the skin. Note that if the skin is already deeply wrinkled, these creams are ineffective.

International unit (IU) A crude measure of vitamin activity, often based on the growth rate of animals. Today these units have largely been replaced by more precise milligram and microgram measures.

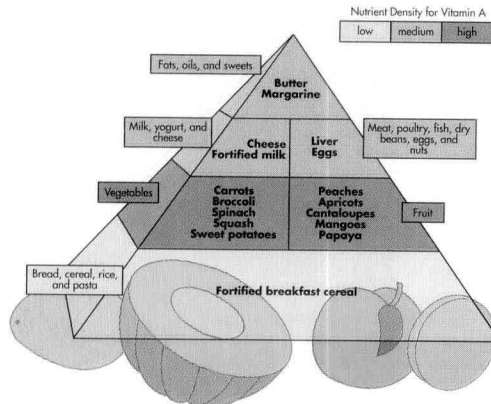
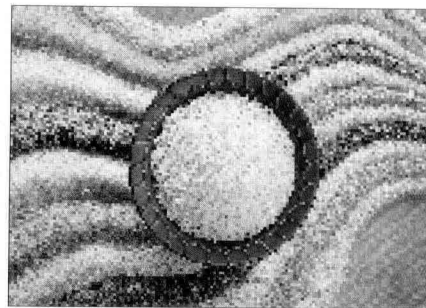


Figure 7-2 Food sources of vitamin A from the Food Guide Pyramid. The fruit and vegetable groups supply abundant carotenoids if they have an intense yellow-orange or green color. Some of these carotenoids yield vitamin A. Liver is the richest source of preformed vitamin A, because that is the major site of vitamin A storage in animals. Milk is often fortified with vitamin A. The background color of each food group indicates the average nutrient density (RE per kcal) for vitamin A in that group.

Leading food sources for major nutrients are identified in 20 colorful variations of the USDA Food Guide Pyramid. These illustrations will enable you to gain a further understanding of the distribution of nutrients among food groups.



Rice is a rich source of carbohydrates.

Pyramid—fat intake should automatically decrease, as long as added fat is kept to a minimum and foods are prepared and served without additional fat.

Only in cases where a person's blood triglycerides are high is a carbohydrate-rich diet not recommended. (This will be covered further in Chapter 5.) Actually the chief culprits in this case are excessively large meals full of foods both rich in simple sugars and low in dietary fiber, and these aren't practices that should form the basis of a diet. But unfortunately, they often do.

Keep in mind, however, that any nutrient can lead to health problems when consumed in excess, including complex carbohydrate and dietary fiber. The contribution of high-carbohydrate foods to total energy intake still needs to be watched. Generally speaking, though, Americans are becoming fatter not because they are eating too much bread and pasta but because they are physically inactive and their diets are high in fat and simple sugars. In fact, added sugars, such as those in soft drinks, comprise about 16% of energy intake of adults. That corresponds to about 20 teaspoons (85 grams) per day. Recall from Chapter 2 that the Food Guide Pyramid suggests considerably lower intakes for many of us: 1600 kcal, 8 teaspoons; 2200 kcal, 12 teaspoons; 2800 kcal, 18 teaspoons. These allotments work out to 10% or less of total calories, a typical recommendation made by many health authorities. Overall, most adults are not active enough to warrant current use of added sugars (Figure 4-9).

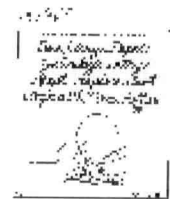


Figure 4-9 ZIGGY © ZIGGY AND FRIENDS, INC. Reprinted with permission of UNIVERSAL PRESS SYNDICATE. All rights reserved.

ANOTHER BITE boxes are short paragraphs within the text designed to provide you with a different perspective on chapter material or more detail. You'll discover new and different ways to apply information.

NO BITE During food processing, the sugar content is often increased. Usually, the more processed the food, the higher the sugar content. An apple has 0 grams of added sugar, canned apples in heavy syrup have 10 to 15 grams, and one sixth of a 9-inch apple pie has 30 grams of added sugar. For comparison purposes, 1 teaspoon of sugar is 4 grams.

To briefly clarify and expand concepts presented, **margin notes** are provided for you. These help reinforce concepts you'll learn in every chapter. **Critical Thinking** questions also appear in the margins to give you the opportunity to apply chapter content to real-life situations. Answers are in the back of the book.

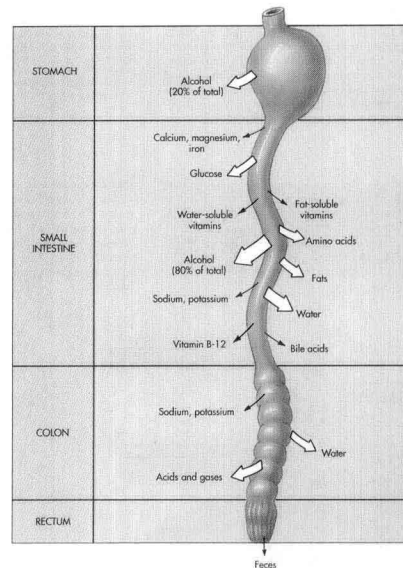


Figure 3-10 Major sites of absorption along the GI tract. The size of the arrow indicates the relative amount of absorption at that site.

The Large Intestine Completes Absorption

When the intestinal contents enter the large intestine, little of the original foodstuff eaten still remains. Only a minor amount (5%) of carbohydrate, protein, and fat has escaped absorption (Figure 3-10). Some water is still present because the small intestine absorbs only 85% to 90% of the fluid it receives, which includes large amounts of GI-tract secretions produced during digestion. The remnants of the meal also include some minerals and what we call dietary fiber.

In the upper half of the large intestine, much of the remaining water and the minerals—mostly sodium and potassium—are absorbed. The unabsorbed water

Nutrient intake also directly influences nutrient absorption. For example, vitamin C in a meal modestly increases iron absorption in the same meal because it changes iron into a more absorbable state.

NUTRITION INSIGHTS are boxes within the text that allow you to learn more about timely topics that should be of interest to you.

376

Insight

Sports Drinks: Most Helpful for Endurance Athletes

A question that often arises is whether to drink water or a sports-type drink, such as All Sport, Exceed Energy Drink, Gatorade, PowerAde, and Amino Force, during competition. For sports that require less than 30 minutes of exertion or when total weight loss is less than 5 to 6 pounds, the primary concern is replacing the water lost in sweat, because losses of body carbohydrate stores and electrolytes (sodium, chloride, potassium, and other minerals) are not usually too great. Although electrolytes are lost in sweat, the quantities lost in exercise of brief to moderate duration can easily be replaced later by consuming normal foods, such as orange juice, potatoes, and tomato juice. Keep in mind that sweat is about 99% water and only 1% electrolytes and other substances.

The use of sports drinks is most critical for athletes engaged in sports events lasting longer than 60 to 90 minutes. Prolonged exercise results in large sweat losses and some of the fluid for sweating comes from the bloodstream. If plain water is used to replace the fluid lost from the blood, the concentration of essential electrolytes in the bloodstream may become too diluted. Thus when sports drinks are used to help maintain blood volume, they must contain small amounts of sodium and potassium to avoid electrolyte imbalance. Generally speaking, beverages for the endurance athlete must provide water for hydration, electrolytes to both enhance water and glucose absorption from the intestine and help maintain blood volume, and carbohydrate to provide energy. Beyond 2 to 4 hours of exertion, electrolyte and carbohydrate replacement become increasingly important, especially in hot weather. In fact, sports drinks that contain carbohydrate have been found to delay fatigue during endurance sports with exercise intensities of a 3-hour marathon pace.

The following is but one possible protocol for using sports drinks as part of fluid replacement:

- About 2 hours before endurance exercise, consume 2 cups of water.
- Once exercise begins, consume $\frac{1}{2}$ to $\frac{3}{4}$ cup of a 6% to 8% carbohydrate solution (14 to 19 grams per cup of fluid) about every 15 minutes. The fluid should be cool to enhance palatability. The carbohydrate concentration of many common sports drinks is 6% to 8%, but check the label to be sure (Figure 10-5). If the

exercise session is to last more than one hour, the goal for fluid replacement is to yield between 2 $\frac{1}{2}$ to 5 cups (1600 to 1200 milliliters) of this fluid per hour.

Comparisons of drinks containing glucose polymers (glucoses linked together, more properly known as maltodextrins), glucose, and sucrose show that all of these carbohydrates have similar positive effects on exercise performance and physiological function as long as the carbohydrate concentration is in the 6% to 8% range. Drinks in which fructose is the only carbohydrate source are the only exception to this rule. Fructose is absorbed from the intestine more slowly than glucose and often causes bloating and diarrhea.

For the most part, then, the decision to use a sports drink depends primarily on the duration of the activity. As the duration of continuous activity approaches 60 minutes or longer, the advantages from use of a sports drink over plain water begin to emerge.



Figure 10-5 Sports drinks for fluid and electrolyte replacement typically contain a form of simple carbohydrate plus sodium and potassium. The various sugars in this product total 14 grams per 1 cup (240 ml) serving. In percentage terms based on weight, the sugar content is about 6% ($14 \text{ grams sugar per serving} \div 240 \text{ grams per serving} \times 100 = 5.8\%$). Sports drinks typically contain about 6% to 8% sugar. This provides ample glucose and other monosaccharides to aid in fueling working muscles, and it is well tolerated. Drinks with a higher sugar content may cause stomach distress.

RATE

your Plate

1. How Physically Active Are You?

How physically active are you really? Here are five activity levels based on primarily aerobic activities: (1) sedentary, (2) mostly inactive, (3) moderately active, (4) active, and (5) superactive. Each category is defined below. Your task is to track your activities for the next 3 weeks (even if this class ends before 3 weeks). Assign yourself an activity level each week. Then average the three values and place yourself (X) in the appropriate place on the ladder. Note that you may end up halfway between two classifications.

5. SUPERACTIVE—

One hour of vigorous activity at least 5 days per week. Examples are full-court basketball, mountain climbing, treadmill work, soccer, and other similar activities.

4. ACTIVE—

Thirty minutes of sustained activity at least 5 days per week. Examples are swimming, tennis singles, cycling, jogging, cross-country skiing, and walking briskly.

3. MODERATELY ACTIVE—

Twenty minutes of sustained activity at least 5 days per week or 10 to 15 minutes of sustained activity at least 4 days a week. Examples include tennis doubles, downhill skiing, skating, aerobic dancing, golf, and similar activities.

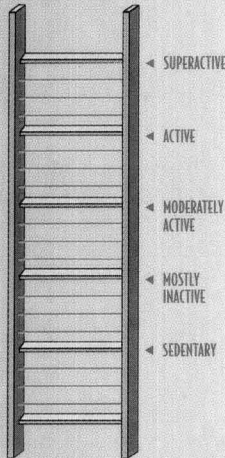
2. MOSTLY INACTIVE—

Sustained activity fewer than 3 days per week that involves mostly walking. Examples include fishing, bowling, and sporadic jogging.

1. SEDENTARY—

Most activities are limited to sitting or minimal walking.

What kind of program of regular physical activity would allow you to move up the ladder, if appropriate? In addition, some resistance activities a few times a week would add further benefit.



At the end of each chapter is a **RATE YOUR PLATE** section that will help you apply a major concept in each chapter to your own life. The activity encourages you to look more carefully at your diet, examine your family history, or apply information to help other people you know.

NUTRITION ISSUES are boxes at the end of chapters that develop current topics in nutrition in greater detail than can be done in the chapter. Topics include nutrition and alcohol, heart disease, cancer, fad diets, and food labeling.

Nutrition Issue

381

Evaluating Ergogenic Aids to Enhance Athletic Performance

Diet manipulation to improve athletic performance is not a recent innovation. As long as 30 years ago, American football players were encouraged on hot practice days to "toughen up" for competition by liberally consuming salt tablets before and during practice and by not drinking water. Now it is widely recognized that this practice can be fatal. Today's athletes are as likely as their predecessors to experiment; artichoke hearts, bee pollen, dried adrenal glands from cattle, seaweed, freeze-dried liver flakes, gelatin, and ginseng are just some of the ineffective substances now used by athletes in hopes of gaining an ergogenic (work-producing) edge.

Still, today's athletes can benefit from recent scientific evidence documenting the ergogenic properties of a few dietary substances. These ergogenic aids include sufficient water, lots of carbohydrates, and a balanced and varied diet consistent with the Food Guide Pyramid. Protein and amino acid supplements are not among those aids, because athletes can easily meet protein needs from foods, as Table 10-4 demonstrated. Clearly, changing average athletes into champions is not possible simply by altering their diets. The use of nutrient supplements should be designed to meet a specific dietary weakness, such as an inadequate iron intake. These and other aids, which often have dubious benefits and may pose health risks, must be given close scrutiny before use. The risk-benefit ratio of these ergogenic aids especially needs to be examined.

As summarized in Table 10-6, no scientific evidence supports the effectiveness of many substances touted as performance-enhancing aids. Many are useless; some are dangerous. Athletes should be skeptical of any substance until its ergogenic effect is scientifically verified. FDA has a limited ability to regulate these dietary supplements (see the Nutrition Issue in Chapter 1). Even substances whose ergogenic effects have been supported by systematic scientific studies should be used with caution, as the testing conditions may not match those of the intended use. Finally, rather than waiting for a magic bullet to enhance performance, athletes are advised to concentrate their efforts on improving their training routines and sport technique and consuming well-balanced diets as described in this chapter. Adequate fluid and carbohydrate are the primary diet-related ergogenic aids.

Sodium bicarbonate

An alkaline substance basically made of sodium and carbon dioxide (NaHCO_3).

Anabolic steroids

A general term for hormones that stimulate development in male sex organs and such male characteristics as facial hair (for example, testosterone).

Growth hormone

A pituitary hormone that produces body growth and release of fat from storage, among other effects.

Carnitine

A compound used to shuttle fatty acids into the cell mitochondria. This allows for the fatty acids to be burned for energy.



Attention to carbohydrate and fluid needs—along with meeting overall nutrient needs—is the most important ergogenic aid.

Summary

- Regular physical activity is a vital part of a healthy lifestyle, ideally constituting a total of at least 30 minutes per day, including some aerobic and resistance activities. People over 35 years should first discuss plans with a physician. Physically active people show lower risks of heart disease, diabetes, obesity, and other common chronic diseases.
- Adenosine triphosphate (ATP) is the major form of energy used by cells. Human metabolic pathways are able to extract that energy from foodstuffs and store it as ATP energy. Phosphocreatine (PCr) can also provide the energy needed to form ATP in a human cell.
- In carbohydrate fuel use, glucose is broken down into three-carbon compounds, yielding some ATP. The three-carbon compounds can then proceed to an aerobic pathway to form carbon dioxide (CO_2) and water (H_2O) or to an anaerobic pathway to form lactic acid.
- At low workloads, muscle cells use mainly fat for fuel, forming CO_2 and H_2O . For high-output exercise of short duration, muscles use PCr and glucose for energy.
- For endurance exercise, fat and carbohydrate are used as fuels; carbohydrate is used increasingly as activity intensifies. Little protein is used to fuel muscles.
- Anyone who exercises regularly needs to consume a diet that is moderate to high in carbohydrates and consistent with the Food Guide Pyramid. Vitamin and mineral supplements are indicated primarily if a low energy intake makes it difficult to meet nutrient needs or a nutrient deficiency exists.
- Carbohydrate loading can increase usual stores of muscle glycogen. Participants in endurance events that last more than 2 hours benefit most from carbohydrate loading, which basically involves eating a diet very high in carbohydrate for about 3 days before the event.
- Athletes should consume enough fluid both to minimize loss of body weight from fluid loss during exercise and to ultimately restore preexercise weight. A sports-type drink can be helpful for endurance athletes participating in activities lasting more than 60 minutes.

Study Questions

- 1 How does greater physical fitness contribute to greater overall health? Explain the process.
- 2 The store of ATP in muscle is rapidly depleted once contraction begins. For physical activity to continue, ATP must be resupplied immediately. Describe how this occurs after initiation of exercise and at various times thereafter.
- 3 What is the difference between anaerobic and aerobic exercise? Explain why aerobic metabolism is increased by a regular exercise routine.
- 4 What is glycogen? How does the body obtain it? How is it used during exercise?
- 5 Are fat stores used as an energy source during exercise? If so, when?
- 6 What are some typical measures used to assess whether an athlete's energy intake is adequate.
- 7 List five specific nutrients that athletes need and appropriate food sources from which these nutrients can be obtained.
- 8 If an athlete wanted to help meet these needs with supplements, what guidelines could you provide to promote safe use.
- 9 What advice would you give your neighbor, who is planning to run a 50-kilometer (km) race, concerning fluid intake before and during the event?
- 10 One of your friends, a competitive athlete, asks your opinion about a nutritional supplement sold in a local sporting-goods store. She has read that such supplements, which contain amino acids, can help improve athletic performance. What would you tell her about the general effectiveness of such products?

Each chapter ends with a **SUMMARY**. These summary points convey the major ideas of each chapter.

There are approximately ten **STUDY QUESTIONS** per chapter. These provide an excellent review for studying for examinations.