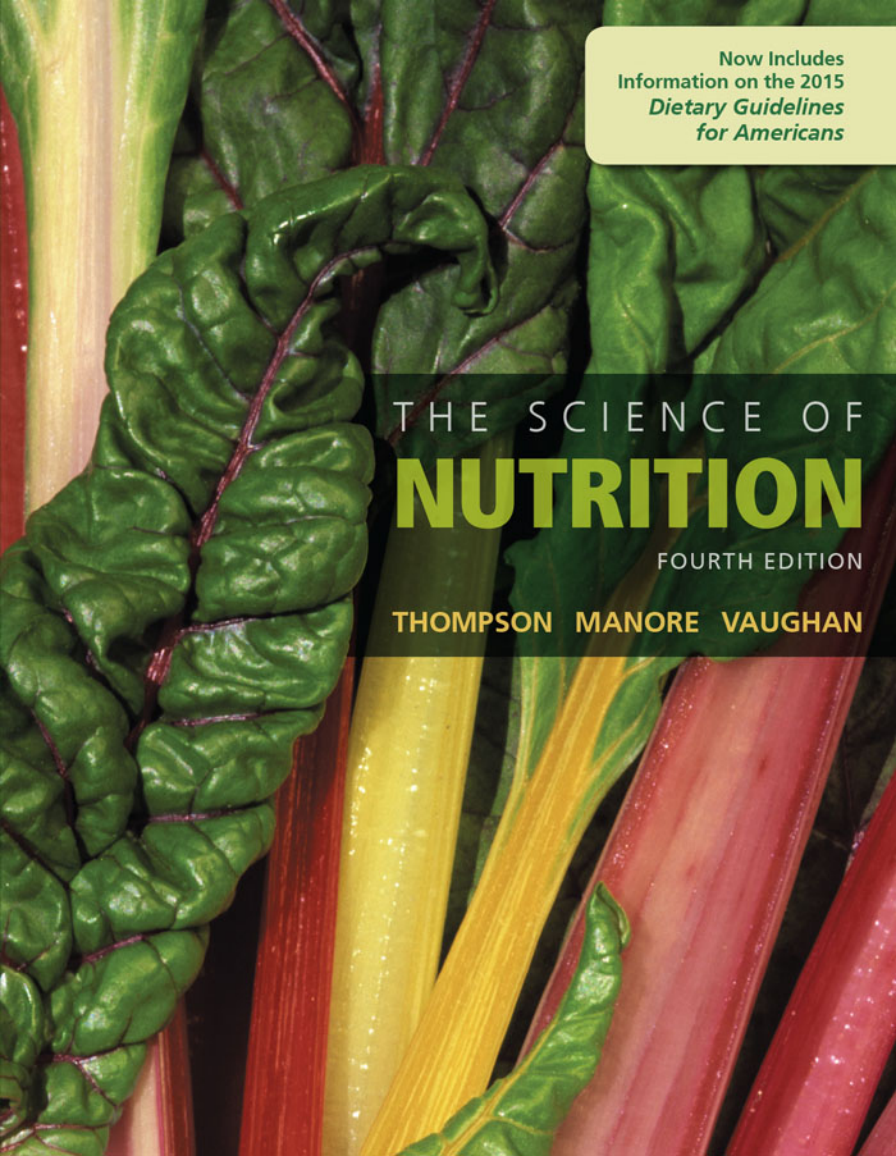
Now Includes
Information on the 2015
Dietary Guidelines
for Americans
THE SCIENCE OF
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FOURTH EDITION
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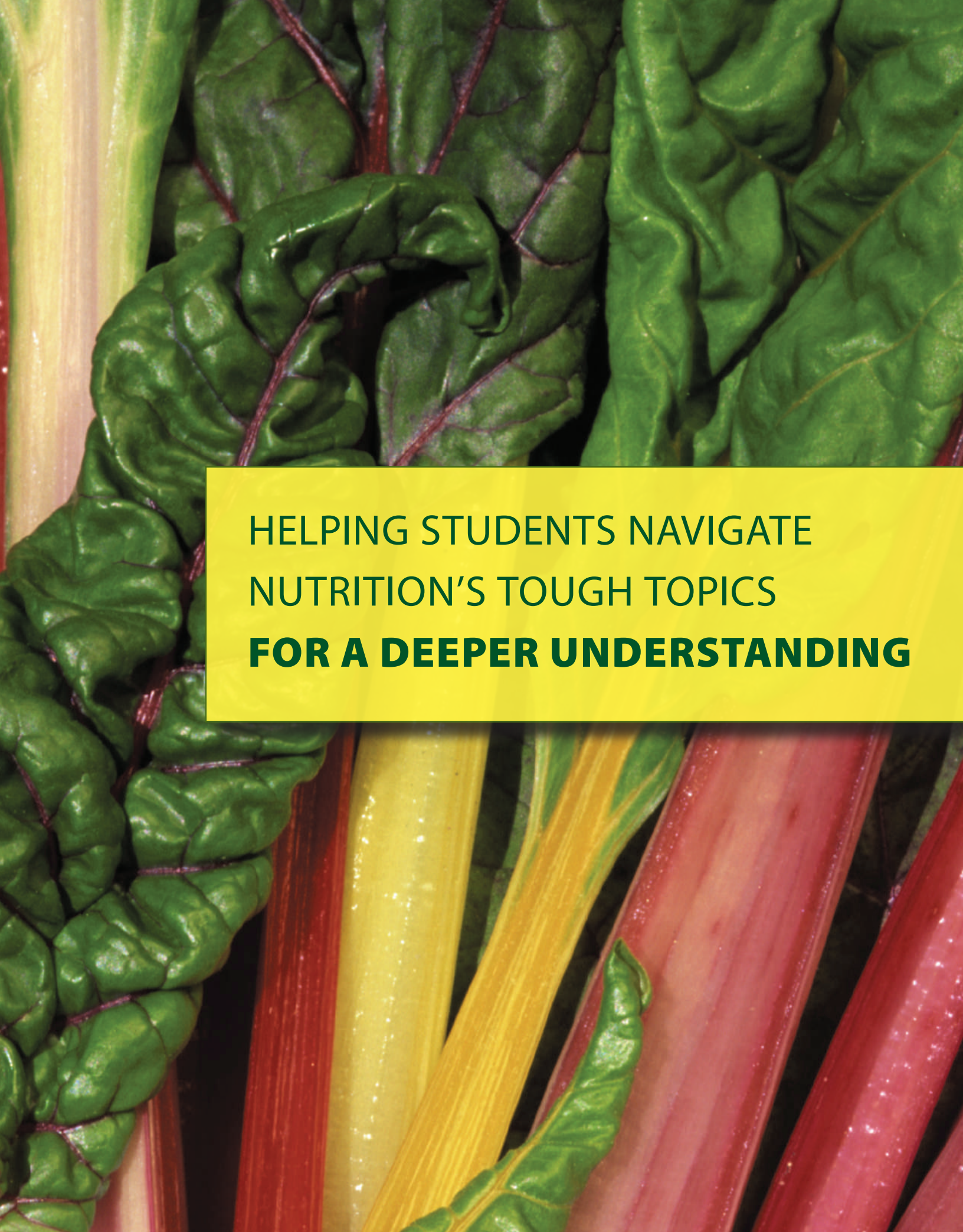


HELPING STUDENTS NAVIGATE NUTRITION'S TOUGH TOPICS **FOR A DEEPER UNDERSTANDING**

Mapping Tough Concepts with a Clear Learning Path

1 The Science of Nutrition: Linking Food, Function, and Health

Learning Outcomes

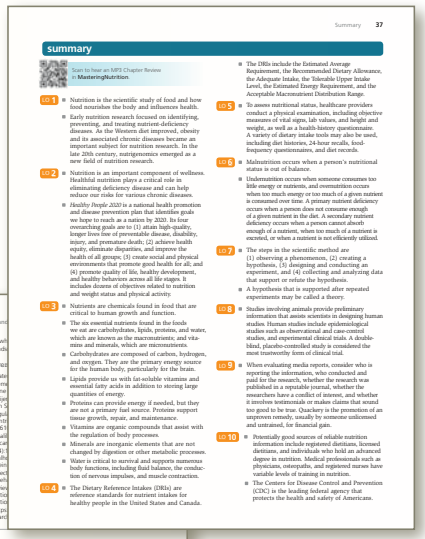
After studying this chapter, you should be able to:

1. Define the term *nutrition* and describe the history of nutrition science, *pp. 4–6.*
2. Discuss why nutrition is important to health, *pp. 6–9.*
3. Identify the six classes of nutrients essential for health and describe their functions, *pp. 9–15.*
4. Distinguish among the six types of Dietary Reference Intakes for nutrients, *pp. 15–18.*
5. Describe the tools nutritional professionals and other healthcare providers use for gathering data related to an individual's nutritional status and diet, *pp. 18–21.*
6. Explain how nutrition professionals classify malnutrition, *pp. 21–22.*
7. Discuss the four steps of the scientific method, *pp. 22–26.*
8. Compare and contrast the various types of research studies used in establishing nutrition guidelines, *pp. 26–27.*
9. Describe various approaches you can use to evaluate the truth and reliability of media reports, websites, and other sources of nutrition information, *pp. 28–30.*
10. List at least four sources of reliable and accurate nutrition information and state why they are trustworthy, *pp. 30–33.*

TEST YOURSELF

True or False?

1. A Calorie is a measure of the amount of fat in a food. T or F
2. Proteins are not a primary source of energy for our body. T or F
3. All vitamins must be consumed daily to support optimal health. T or F
4. The Recommended



summary

Scan to hear an MP3 Chapter Review in MasteringNutrition

LO 1
- Nutrition is the scientific study of food and how food nourishes the body and influences health.
- Early nutrition research focused on identifying, preventing, and treating nutrient-deficiency diseases. As the Western diet improved, obesity and its associated chronic diseases became an important subject for nutrition research. In the late 20th century, nutrigenomics emerged as a new field of nutrition research.

LO 2
- Nutrition is an important component of wellness. Healthful nutrition plays a critical role in eliminating deficiency disease and can help reduce our risks for various chronic diseases.
- *Healthy People 2020* is a national health promotion and disease prevention plan that identifies goals we hope to reach as a nation by 2020. Its four overarching goals are to: (1) attain high-quality, longer lives free of preventable disease, disability, injury, and premature death; (2) achieve health equity, eliminate disparities, and improve the health of all groups; (3) create social and physical environments that promote good health for all; and (4) promote quality of life, healthy development, and healthy behaviors across all life stages. It includes dozens of objectives related to nutrition and weight status and physical activity.

LO 3
- Nutrients are chemicals found in food that are critical to human growth and function.
- The six essential nutrients found in the foods we eat are carbohydrates, lipids, proteins, and water, which are known as the macronutrients; and vitamins and minerals, which are micronutrients.
- Carbohydrates are composed of carbon, hydrogen, and oxygen. They are the primary energy source for the human body, particularly for the brain.
- Lipids provide us with fat-soluble vitamins and essential fatty acids in addition to storing large quantities of energy.
- Proteins can provide energy if needed, but they are not a primary fuel source. Proteins support tissue growth, repair, and maintenance.
- Vitamins are organic compounds that assist with the regulation of body processes.
- Minerals are inorganic elements that are not changed by digestion or other metabolic processes.
- Water is critical to survival and supports numerous body functions, including fluid balance, the conduction of nervous impulses, and muscle contraction.

LO 4
- The Dietary Reference Intakes (DRIs) are reference standards for nutrient intakes for healthy people in the United States and Canada.
- The DRIs include the Estimated Average Requirement, the Recommended Dietary Allowance, the Adequate Intake, the Tolerable Upper Intake Level, the Estimated Energy Requirement, and the Acceptable Macronutrient Distribution Range.

LO 5
- To assess nutritional status, healthcare providers conduct a physical examination, including objective measures of vital signs, lab values, and height and weight, as well as a health-history questionnaire. A variety of dietary intake tools may also be used, including diet histories, 24-hour recalls, food-frequency questionnaires, and diet records.

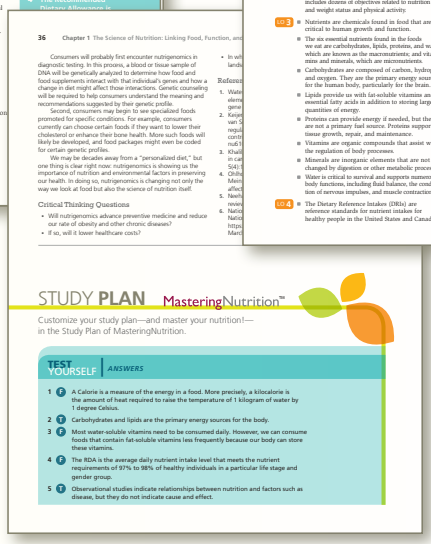
LO 6
- Malnutrition occurs when a person's nutritional status is out of balance.
- Undernutrition occurs when someone consumes too little energy or nutrients, and overnutrition occurs when too much energy or too much of a given nutrient is consumed over time. A primary nutrient deficiency occurs when a person does not consume enough of a given nutrient in the diet. A secondary nutrient deficiency occurs when a person cannot absorb enough of a nutrient, when too much of a nutrient is excreted, or when a nutrient is not efficiently utilized.

LO 7
- The steps in the scientific method are (1) observing a phenomenon, (2) creating a hypothesis, (3) designing and conducting an experiment, and (4) collecting and analyzing data that support or refute the hypothesis.
- A hypothesis that is supported after repeated experiments may be called a theory.

LO 8
- Studies involving animals provide preliminary information that assists scientists in designing human studies. Human studies include epidemiological studies such as observational and case-control studies, and experimental clinical trials. A double-blind, placebo-controlled study is considered the most trustworthy form of clinical trial.

LO 9
- When evaluating media reports, consider who is reporting the information, who conducted and paid for the research, whether the research was published in a reputable journal, whether the researchers have a conflict of interest, and whether it involves testimonials or makes claims that sound too good to be true. Quackery is the promotion of an unproven remedy, usually by someone unlicensed and untrained, for financial gain.

LO 10
- Potentially good sources of reliable nutrition information include registered dietitians, licensed dietitians, and individuals who hold an advanced degree in nutrition. Medical professionals such as physicians, osteopaths, and registered nurses have variable levels of training in nutrition.
- The Centers for Disease Control and Prevention (CDC) is the leading federal agency that protects the health and safety of Americans.



36 Chapter 1 The Science of Nutrition: Linking Food, Function, and

Consumers will probably first encounter nutrigenomics in diagnostic testing. In this process, a blood or tissue sample of DNA will be genetically analyzed to determine how food and food supplements interact with that individual's genes and how a change in diet might affect those interactions. Genetic counseling will be required to help consumers understand the meaning and recommendations suggested by their genetic profile.

Second, consumers may begin to see specialized foods promoted for specific conditions. For example, consumers currently can choose certain foods if they want to lower their cholesterol or enhance their bone health. More such foods will likely be developed, and food packages might even be coded for certain genetic profiles.

We may be decades away from a "personalized diet," but one thing is clear right now: nutrigenomics is showing us the importance of nutrition and environmental factors in preserving our health. In doing so, nutrigenomics is changing not only the way we look at food but also the science of nutrition itself.

Critical Thinking Questions

- Will nutrigenomics advance preventive medicine and reduce our rate of obesity and other chronic diseases?
- If so, will it lower healthcare costs?

STUDY PLAN MasteringNutrition™

Customize your study plan—and master your nutrition!—in the Study Plan of MasteringNutrition.

TEST YOURSELF | ANSWERS

1. F A Calorie is a measure of the energy in a food. More precisely, a kilocalorie is the amount of heat required to raise the temperature of 1 kilogram of water by 1 degree Celsius.
2. T Carbohydrates and lipids are the primary energy sources for the body.
3. F Most water-soluble vitamins need to be consumed daily. However, we can consume foods that contain fat-soluble vitamins less frequently because our body can store these vitamins.
4. F The RDA is the average daily nutrient intake level that meets the nutrient requirements of 97% to 98% of healthy individuals in a particular life stage and gender group.
5. T Observational studies indicate relationships between nutrition and factors such as disease, but they do not indicate cause and effect.

UPDATED! Study Plan tied to Learning Outcomes

All chapters, including In Depth chapters, now include numbered learning outcomes that link to the end-of-chapter Study Plan. Within the Study Plan, each summary point and review question is tied to a learning outcome, helping students to identify areas that they need to review. These Study Plans are further enhanced with activities within MasteringNutrition.

16 Food Equity, Sustainability, and Quality: The Challenge of "Good" Food

Learning Outcomes

After studying this chapter, you should be able to:

1. Compare and contrast levels of food insecurity globally and in the United States, *pp. 628–630.*
2. Discuss several ways in which human behavior contributes to food insecurity, *pp. 630–632.*
3. Explain what climate change is and how it is affecting the world's food supply, *pp. 632–633.*
4. Describe the health and societal problems associated with undernourishment, *pp. 633–635.*
5. Explain how obesity can result from limited access to nourishing food, *pp. 635–638.*
6. Identify inequities in agricultural and food-service labor, and their effects on workers and the consumers they serve, *pp. 638–639.*
7. Discuss the effects of industrial agriculture on food security and the environment, *pp. 639–641.*
8. Explain how the food industry has influenced the quality and diversity of our food supply, *p. 641.*
9. Discuss international, governmental, philanthropic, corporate, and local initiatives aimed at increasing the world's supply of and access to "good" food, *pp. 642–644.*
10. Identify several steps you can take to promote production of and access to "good" food, *pp. 645–646.*

TEST YOURSELF

True or False?

1. Because of insufficient money or other resources, people in more than 5% of U.S. households go without food. T or F
2. A person can be both obese and undernourished. T or F
3. In the United States, as compared to workers in other industries, a farm worker has nearly twice the risk of dying from an on-the-job injury. T or F
4. More than half of cash revenues for all U.S. farmers come from just two crops, corn and soybeans. T or F
5. Methane, a greenhouse gas emitted during livestock production, has nearly double the atmospheric warming effect of carbon dioxide. T or F

Test Yourself answers are located in the Study Plan.

MasteringNutrition™

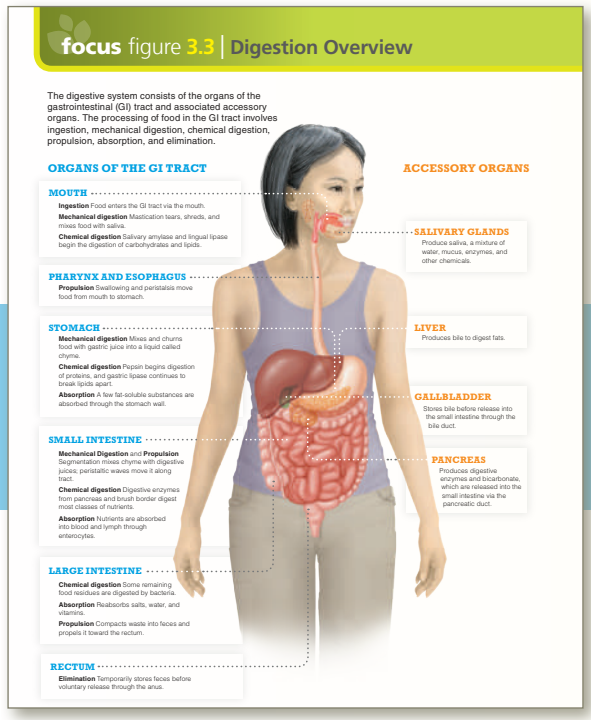
Go online for chapter quizzes, pre-tests, interactive activities, and more!

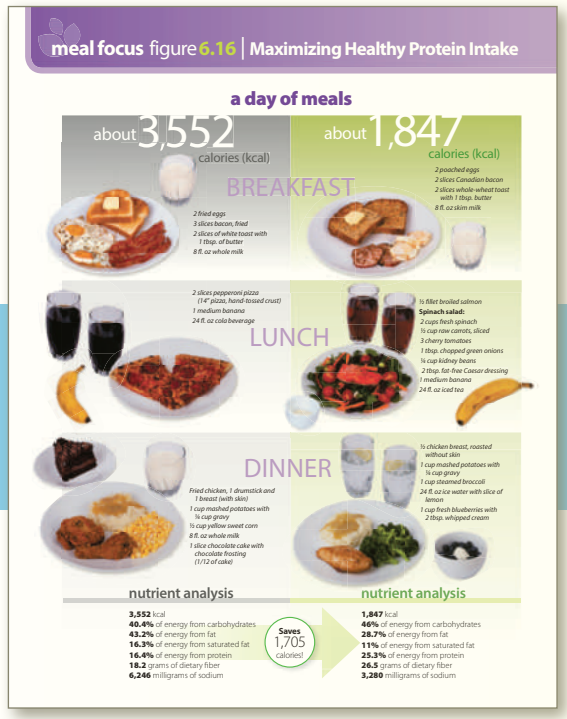
627

UPDATED!

Food Equity, Sustainability, and Quality chapter

Recognizing new research and emerging topics, the chapter formerly titled Global Hunger has been recast to cover food security, equity, and the environment, giving it a timely new approach. In addition, the chapter now follows the food safety chapter, with the text then ending with the three lifecycle chapters.





UPDATED! Additional Focus Figures

New Focus Figures on tough topics have been added, including the scientific method, Vitamin D and calcium regulation, and hormonal control of appetite. These colorful full-page figures teach key concepts in nutrition through bold, clear and detailed visual presentations. These dynamic figures also have corresponding coaching activities in Mastering Nutrition.

Focus Figures include introductory text that explains how the figure is central to concepts that students will cover throughout the text.

- Students get clear directions via text and stepped-out art that guide the eye through complex processes, breaking them down into manageable pieces that are easy to teach and understand.
- Focus Figures provide dynamic illustrations—often paired with photographs—that make topics come alive.
- Full-page format enables micro-to-macro levels of explanation for complex topics.

Meal Focus Figures

Students get a visual comparison of possible meal choices, ranging from high- and low-density meals to meals high in refined carbohydrates vs fiber-rich meals. Each figure offers an easy-to-understand comparison of the key nutrients for that topic as well as clear images of the foods being assessed. New coaching activities complement each figure in MasteringNutrition.

Continuous Learning
Before, During & After Class with
MasteringNutrition™ with MyDietAnalysis

The MasteringNutrition online homework, tutorial, and assessment system includes content specific to introductory nutrition courses, delivering self-paced tutorials that focus on your course objectives, provide individualized coaching, and respond to each student's progress.

MyDietAnalysis is now available as single sign on to MasteringNutrition. For smartphone users, a new mobile website version of MyDietAnalysis is available. Students can track their diet and activity intake accurately, anytime and anywhere, from their mobile devices.

BEFORE CLASS

Dynamic Study Modules and eText 2.0 provide students with a preview of what's to come.

NEW! Dynamic Study Modules enable students to study effectively on their own in an adaptive format. Students receive an initial set of questions with a unique answer format asking them to indicate their confidence.

Once completed, Dynamic Study Modules include explanations using material taken directly from the text.

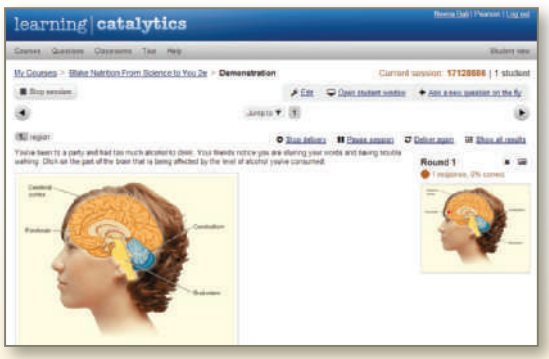
NEW! Interactive eText 2.0 complete with embedded media is mobile friendly and ADA accessible.

- Now available on smartphones and tablets.
- Seamlessly integrated videos and other rich media.
- Accessible (screen-reader ready).
- Configurable reading settings, including resizable type and night reading mode.
- Instructor and student note-taking, highlighting, bookmarking, and search.

DURING CLASS

Learning Catalytics and Engaging Media

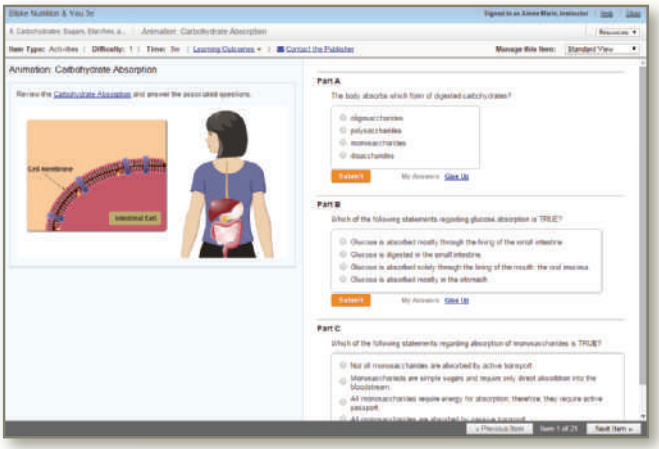
Learning Catalytics, a "bring your own device" student engagement, assessment, and classroom intelligence system, allows students to use their smartphone, tablet, or laptop to respond to questions in class.



AFTER CLASS

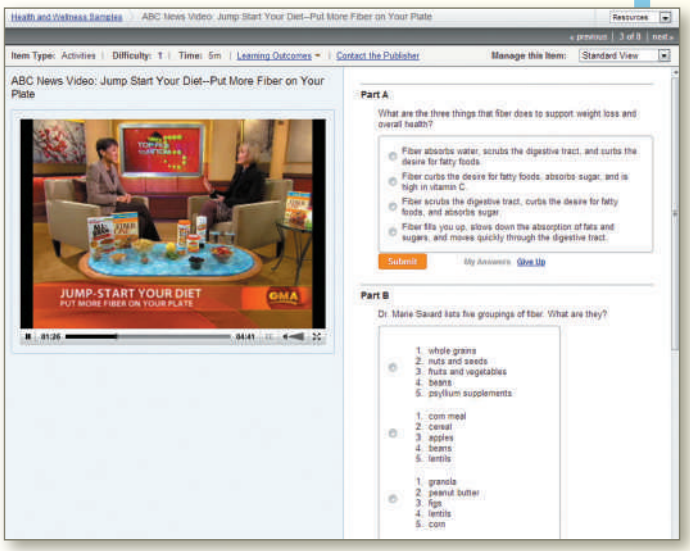
Easy-to-Assign, Customize, and Automatically Graded Assignments

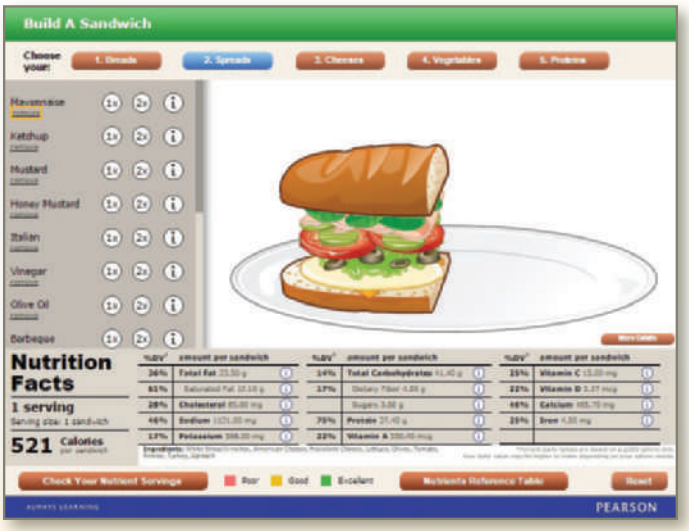
The breadth and depth of content available to you to assign in Mastering is unparalleled, allowing you to quickly and easily assign homework to reinforce key concepts.



UPDATED! Nutrition Animations have been updated and made compatible for Mastering and mobile devices. These animations address tough topics and common misconceptions and feature a more contemporary look to appeal to today's students. Corresponding activities within Mastering with wrong-answer feedback have also been updated.

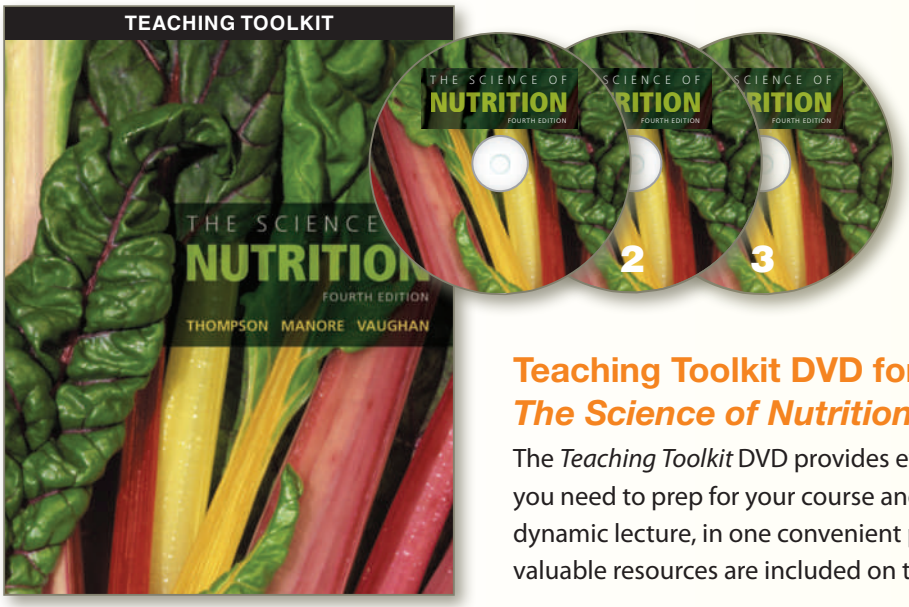
NEW! *ABC News* Lecture Launcher videos cover up-to-date hot topics that occur in the nutrition field that bring nutrition to life and spark discussion. These are accompanied by multiple-choice questions with wrong-answer feedback.





UPDATED! 18 NutriTools Build-A-Meal Coaching Activities allow students to apply nutrition concepts to improve their health through interactive mini-lessons that provide hints and feedback. The Build a Meal, Build a Pizza, Build A Salad, and Build A Sandwich tools have been carefully rethought to improve the user experience, making them easier to use. They are now HTML5 compatible.

Everything You Need to Teach
In One Place



Teaching Toolkit DVD for *The Science of Nutrition*

The *Teaching Toolkit* DVD provides everything that you need to prep for your course and deliver a dynamic lecture, in one convenient place. These valuable resources are included on three disks:

DISK 1

Robust Media Assets for Each Chapter

- *ABC News* Lecture Launcher videos
- Nutrition Animations
- PowerPoint Lecture Outlines
- Media-Only PowerPoint® slides for easy importing of videos and animations
- PowerPoint clicker questions and Jeopardy-style quiz show questions
- Files for all illustrations and tables and selected photos from the text

DISK 2

Comprehensive Test Bank

- Test Bank in Microsoft Word, PDF, and RTF formats
- Computerized Test Bank, which includes all the questions from the test bank in a format that allows you to easily and intuitively build exams and quizzes

DISK 3

Additional Innovative Supplements for Instructors and Students

For Instructors

- Instructor Resource and Support Manual in Microsoft Word and PDF formats
- Step-by-step MasteringNutrition tutorials
- Video introduction to Learning Catalytics™
- *Great Ideas in Teaching Nutrition*

For Students

- *Eat Right! Healthy Eating in College and Beyond*
- Food Composition Table

User's Quick Guide for *The Science of Nutrition*

This easy-to-use printed supplement accompanies the Teaching Toolkit and offers easy instructions for both experienced and new faculty members to get started with the rich Toolkit content and MasteringNutrition.

THE SCIENCE OF NUTRITION

FOURTH EDITION

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University of Birmingham | University of New Mexico

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Oregon State University

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Cover Photo Credit: Wally Eberhart/ Getty Images

Library of Congress Cataloging-in-Publication Data

Thompson, Janice L., author.
The science of nutrition / Janice L. Thompson, PhD, FACSM, University of Birmingham | University of New Mexico, Melinda M. Manore, PhD, RD, CSSD, FACSM, Oregon State University, Linda A. Vaughan, PhD, RD, Arizona State University. —Fourth edition.
pages cm
Includes bibliographical references and index.
ISBN 978-0-13-417509-6 (pbk.)
1. Nutrition—Textbooks. I. Manore, Melinda, 1951- author. II. Vaughan, Linda A. (Linda Ann) author. III. Title.
TX354.T47 2015
363.8—dc23

2015033058

1 2 3 4 5 6 7 8 9 10—V382—20 19 18 17 16

ISBN 10: 0-13-417509-3;
ISBN 13: 978-0-13-417509-6 (Student edition)
ISBN 10: 0-13-439335-X;
ISBN 13: 978-0-13-439335-3 (Instructor's Review Copy)

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Dedication

This book is dedicated to my amazing family, friends, and colleagues—you provide constant support, encouragement, and unconditional love. It is also dedicated to my students and the communities with which I work—you continue to inspire me, challenge me, and teach me. —**JLT**

This book is dedicated to my wonderful colleagues, friends, and family—your guidance, support, and understanding have allowed this book to happen. —**MMM**

This book is dedicated to my strong circle of family, friends, and colleagues. Year after year, your support and encouragement sustain me. —**LAV**

About the Authors

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Janice Thompson earned a doctorate in exercise physiology and nutrition at Arizona State University. She is currently Professor of Public Health Nutrition and Exercise at the University of Birmingham in the School of Sport and Exercise Sciences. Her research focuses on designing and assessing the impact of nutrition and physical activity interventions to reduce the risks for obesity, cardiovascular disease, and type 2 diabetes in high-risk populations. She also teaches nutrition and research methods courses and mentors graduate research students.

Janice is a Fellow of the American College of Sports Medicine (ACSM), a member of the Scientific Committee of the European College of Sports Science, and a member of the American Society for Nutrition (ASN), the British Association of Sport and Exercise Science (BASES), and the Nutrition Society. Janice won an undergraduate teaching award while at the University of North Carolina, Charlotte, a Community Engagement Award while at the University of Bristol, and the ACSM Citation Award for her contributions to research, education, and service to the Exercise Sciences. In addition to *The Science of Nutrition*, Janice coauthored the Pearson textbooks *Nutrition: An Applied Approach* and *Nutrition for Life* with Melinda Manore.

Janice loves hiking, yoga, traveling, and cooking and eating delicious food. She likes almost every vegetable except fennel and believes chocolate should be listed as a food group.

Melinda M. Manore, PhD, RD, CSSD, FACSM Oregon State University

Melinda Manore earned a doctorate in human nutrition with minors in exercise physiology and health at Oregon State University (OSU). She is the past chair of the Department of Nutrition and Food Management and is currently a professor of nutrition at OSU. Prior to her move there, she was a professor at Arizona State University. Melinda's area of expertise is nutrition and exercise, particularly the role of diet and exercise in health and prevention of chronic disease, exercise performance, and weight control. She has a special focus on the energy and nutritional needs of active women and girls across the life cycle.

Melinda is an active member of the Academy of Nutrition and Dietetics (AND) and the American College of Sports Medicine (ACSM). She is the past chair of the AND Research Dietetic Practice Group; served on the AND Obesity Steering Committee; and is an active member of the Sports, Cardiovascular, and Wellness Nutrition Practice Group. She is a fellow of ACSM and has served as vice president and on the Board of Trustees.

Melinda is also a member of the American Society of Nutrition (ASN) and the North American Association for the Study of Obesity (NAASO). She is the past chair of the U.S. Department of Agriculture (USDA) Nutrition and Health Committee for Program Guidance and Planning and currently is chair of the USDA, ACSM, AND Expert Panel Meeting, *Energy Balance at the Crossroads: Translating Science into Action*. She serves on the editorial board of numerous research journals and has won awards for excellence in research and teaching. Melinda also coauthored the Pearson textbooks *Nutrition: An Applied Approach* and *Nutrition for Life* with Janice Thompson.

Melinda is an avid walker, hiker, and former runner who loves to garden, cook, and eat great food. She is also an amateur birder.

Linda A. Vaughan, PhD, RD Arizona State University

Linda Vaughan is a professor and the director of the School of Nutrition and Health Promotion at Arizona State University. Linda earned a doctorate in agricultural biochemistry and nutrition at the University of Arizona. She currently teaches, advises graduate students, and remains involved in research as time permits. Her area of specialization is older adults and life cycle nutrition.

Linda is an active member of the Academy of Nutrition and Dietetics (AND), the American Society of Nutrition (ASN), and the Arizona Dietetic Association. She has served as chair of the Research and Dietetic Educators of Practitioners practice groups of the AND. Linda has received numerous awards, including the Arizona Dietetic Association Outstanding Educator Award (1997) and the Arizona State University Supervisor of the Year award (2004). In addition to being a coauthor of *The Science of Nutrition*, Linda is also a key contributor to the Pearson textbooks *Nutrition: An Applied Approach* and *Nutrition for Life* by Janice Thompson and Melinda Manore.

Linda enjoys swimming, cycling, and baking bread in her free time.

Welcome to The Science of Nutrition, Fourth Edition!

As nutrition researchers and educators, we know that the science of nutrition is constantly evolving. Our goal as authors is to provide students and instructors with the most recent and scientifically accurate nutrition information available.

Learning to Avoid Nutrition Confusion

What should I eat? In this age of information saturation, many different answers to that question are available 24 hours a day, from multiple sources: via the Internet, social media, television, and radio; in books, newspapers, and magazines; and on billboards, posters, and the sides of vending machines—even food packages offer nutrition advice. From research studies with contradictory findings to marketing claims for competing products, potential sources of confusion abound.

You're probably not fooled by the ads for diets and supplements in your e-mail inbox, but what kinds of nutrition messages *can* you trust? Which claims are backed up by scientific evidence, and of those, which are relevant to you? How can you evaluate the various sources of nutrition information and find out whether the advice they provide is accurate and reliable? How can you navigate the Internet to find reliable nutrition facts and avoid nutrition myths? How can you develop a way of eating that's right for you—one that supports your physical activity, allows you to maintain a healthful weight, and helps you avoid chronic disease? And if you're pursuing a career in nutrition or another healthcare field, how can you continue to obtain the most current and valid information about food and physical activity as you work with individual clients?

Why We Wrote This Book

The Science of Nutrition began with the conviction that both students and instructors would benefit from an accurate, clear, and engaging textbook that links nutrients with their functional benefits. As instructors, we recognized that students have a natural interest in their bodies, their health, their weight, and their success in sports and other activities. We developed this text to demonstrate how nutrition relates to these interests. ***The Science of Nutrition*** empowers you to reach your personal health and fitness goals while teaching you about the scientific evidence linking nutrition with disease. This information will be vital to your success as you build a career in nutrition or another health-related discipline.

You'll also learn how to debunk nutrition myths and how to distinguish nutrition fact from fiction. Throughout the chapters, material is presented in lively narrative that is scientifically sound and that continually links the evidence with these goals. Information on current events, and recent and ongoing research, keeps the inquisitive spark alive, illustrating how nutrition is very much a "living" science and a source of spirited ongoing debate.

The content of this text is designed for nutrition and other science and healthcare majors, but is also applicable and accessible to students in the liberal arts. We present the *science* of nutrition in a conversational style with engaging features that encourage you to apply the material to your own life and to the lives of your future clients, patients, or students. To support visual learning, the writing is supplemented by illustrations and photos that are attractive, effective, and level-appropriate. As teachers, we are familiar with the myriad challenges of presenting nutrition information in the classroom. We have therefore developed an exceptional ancillary package with a variety of tools to assist instructors in successfully meeting these challenges. We hope to contribute to the excitement of teaching and learning about nutrition: A subject that affects every one of us, a subject so important and relevant that correct and timely information can make the difference between health and disease.

Hallmark Text Features

A multitude of popular features have been updated throughout this new edition, challenging you to think about how the recommendations of different nutritional experts (and others who may be less than expert, such as some media sources) apply to your unique health issues, activity level, energy requirements, food preferences, and lifestyle. **Nutrition Myth or Fact?** boxes, which now appear near the end of each chapter preceeding the Study Plan section, explore the science supporting or challenging common beliefs about foods, while the **Highlight** boxes explore research across a range of important, specific nutritional issues. **Nutrition Label Activity** feature boxes help you understand how to interpret food label information, so that you can make better nutritional choices. **You Do the Math** feature boxes give you a hands-on chance to practice important calculations that reveal key nutrition information.

Four visually vibrant **In Depth** "mini chapters" cover the key areas of alcohol, vitamins and minerals, phytochemicals, and disordered eating, and offer instructors flexibility in incorporating them into their course. The Vitamins and Minerals In Depth specifically provides an overview of micronutrient basics prior to the first functional chapter.

In providing these features, in addition to the new features listed in a later section, we hope that by the time you finish this book you'll feel more confident and engaged in making decisions about your diet and physical activity.

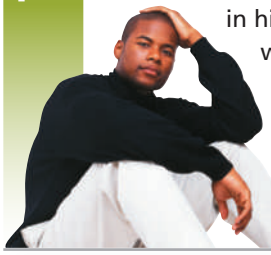
*Nutri-*Case | You Play the Expert!

In addition to the aforementioned features, our **Nutri-Case** scenarios provide you with the opportunity to evaluate the nutrition-related beliefs and behaviors of five people representing a range of backgrounds and nutritional challenges. As you encounter them, keep in mind that these case scenarios are for instructional purposes, not intended to suggest that students using this text are qualified to offer nutritional advice to others. In the real world, only properly trained and licensed health professionals are qualified to provide nutritional counseling. Take a moment to get acquainted with our Nutri-Case characters here.

Hannah

Hi, I'm Hannah. I'm 18 years old and in my first year at Valley Community College. I'm 5' 6" and right now I weigh 171 lbs. I haven't made up my mind yet about my major. All I know for sure is that I don't want to work in a hospital like my mom! I got good grades in high school, but I'm a little freaked out by college so far. There's so much homework, plus one of my courses has a lab, plus I have to work part-time because my mom doesn't have the money to put me through school. Sometimes I feel like I just can't handle it all. And when I get stressed out, I eat. I've already gained 10 pounds and I haven't even finished my first semester!

Theo



Hi, I'm Theo. Let's see, I'm 21, and my parents moved to the Midwest from Nigeria 11 years ago. I'm 6' 8" tall and weigh in at 200 lbs. The first time I ever played basketball, in middle school, I was hooked. I won lots of awards in high school and then got a full scholarship to the state university, where I'm a junior studying political science. I decided to take a nutrition course because, last year, I had a hard time making it through the playing season, plus keeping up with my classes and homework. I want to have more energy, so I thought maybe I'm not eating right. Anyway, I want to figure out this food thing before basketball season starts again.

Liz

I'm Liz, I'm 20, and I'm a dance major at the School for Performing Arts. I'm 5'4" and currently weigh about 103 lbs. Last year, two other dancers from my class and I won a state championship and got to dance in the New Year's Eve celebration at the governor's mansion. This spring, I'm going to audition for the City Ballet, so I have to be in top condition. I wish I had time to take a nutrition course, but I'm too busy with dance classes, rehearsals, and teaching a dance class for kids. But it's okay, because I get lots of tips from other dancers and from the Internet. Like last week, I found a website especially for dancers that explained how to get rid of bloating before an audition. I'm going to try it for my audition with the City Ballet!

Judy

I'm Judy, Hannah's mother. I'm 38 years old and a nurse's aide at Valley Hospital. I'm 5'5" and weigh 200 lbs. Back when Hannah was a baby, I dreamed of going to college so I could be a registered nurse. But then my ex and I split up, and Hannah and me, we've been in survival mode ever since. I'm proud to have raised my daughter without any handouts, and I do good work, but the pay never goes far enough and it's exhausting. I guess that's partly because I'm out of shape, and my blood sugar's high. Most nights, I'm so tired at the end of my shift that I just pick up some fast food for supper. I know I should be making home-cooked meals, but like I said, I'm in survival mode.

Gustavo

Hello. My name is Gustavo. I'm 69 years young at the moment, but when I was 13 years old I came to the United States from Mexico with my parents and three sisters to pick crops in California. Now I manage a large vineyard. They ask me when I'm going to retire, but I can still work as hard as a man half my age. Health problems? None. Well, maybe my doctor tells me my blood pressure is high, but that's normal for my age! I guess what keeps me going is thinking about how my father died 6 months after he retired. He had colon cancer, but he never knew it until it was too late. Anyway, I watch the nightly news and read the papers, so I keep up on what's good for me, "Eat less salt" and all that stuff. I'm doing great! I'm 5'5" tall and weigh 166 lbs.

Throughout this text, you'll read about these five characters as they grapple with various nutrition-related challenges in their lives. As you do, you might find that they remind you of people you know, and you may discover you have something in common with one or more of them. Our hope is that by applying the information you learn in this course to their situations, you will deepen your understanding of the importance of nutrition in your own life.

New in the Fourth Edition

The Fourth Edition of *The Science of Nutrition* includes a wealth of dynamic new features and innovations. Key among these is the **MasteringNutrition™** online homework, tutorial, and assessment system, which delivers self-paced tutorials and activities that

provide individualized coaching, focus on course objectives, and offer tools enabling instructors to respond individually to each student's progress. The proven Mastering system provides instructors with customizable, easy-to-assign, automatically graded assessments that motivate students to learn outside of class and arrive prepared for lecture. Key MasteringNutrition features include the following:

- **Interactive eText 2.0—**now available on smartphones and tablets—is Americans with Disabilities Act (ADA) accessible (screen-reader ready). This new eText 2.0 seamlessly integrates videos and animations, offers configurable reading settings (including resizable type and night reading mode), and allows instructor and student note-taking, highlighting, bookmarking, and search.
- **Focus Figure** and **Meal Focus Figure Coaching Activities** that guide students through key nutrition concepts with interactive mini-lessons.
- **Nutrition Animations** have been updated and made compatible for Mastering and mobile devices. Corresponding activities with wrong-answer feedback have also been updated.
- ***ABC News* Videos** with quizzing bring nutrition to life and spark discussion with up-to-date hot topics that occur in the nutrition field. Multiple-choice questions provide wrong-answer feedback to redirect students to the correct answer.
- **18 NutriTools Coaching Activities** allow students to apply nutrition concepts to improve their health through interactive mini-lessons that provide hints and feedback. The Build a Meal, Build a Pizza, Build a Salad, and Build a Sandwich tools have been carefully rethought to improve the user experience, making them easier to use. They are now HTML5 compatible.
- **Single sign-on for MyDietAnalysis**, a software system that allows students to complete a diet assignment. Students keep track of their food intake and exercise and enter the information to create a variety of reports (e.g., the balance between fats, carbohydrates, and proteins in their diet; how many calories they're eating; whether they're meeting the Recommended Dietary Allowances [RDAs] for vitamins and minerals; etc.). **MyDietAnalysis activities** have been added within Mastering that incorporate the use of MyDietAnalysis. A mobile version gives students 24/7 access via their smartphones to easily track food, drink, and activity on the go.
- **Dynamic Study Modules** enable students to study effectively on their own in an adaptive format. Students receive an initial set of questions with a unique answer format asking them to indicate their confidence level.
- **Learning Catalytics™** is an interactive, student response tool that uses students' smartphones, tablets, or laptops to engage them in more sophisticated tasks and thinking. Now included with **MasteringNutrition™** with eText, Learning Catalytics enables you to generate classroom discussion, guide your lecture, and promote peer-to-peer learning with real-time analytics.
- **MP3s** related to chapter content, with multiple-choice questions that provide wrong-answer feedback.
- **Access to *Get Ready for Nutrition,*** providing students with extra math and chemistry study assistance.
- **A Study Area** that is broken down into learning areas and includes videos, animations, MP3s, and other resources.

Focus Figures illuminate some of the toughest topics for students to learn and understand. New topics for these full-page figures include the scientific method, Vitamin D and calcium regulation, and hormonal control of appetite. New to this edition, **Meal Focus Figures** graphically depict the differences in sets of meals, such as a comparison of nutrient density or a comparison of two high-carbohydrate meals, to engage students with useful information.

Each chapter now offers students a **Study Plan** to guide them through the chapter. Each chapter begins with numbered learning outcomes, which are then referenced in the relevant section of the chapter. At the end of each chapter, the relevant learning outcome is again referenced in the chapter summary and review questions, offering students a clear learning

path through the chapter. Corresponding activities in Mastering reinforce the connections. The end-of-chapter study plan also now repeats the Test Yourself questions from the chapter opener while providing the answers.

Chapter 16, now titled Food Equity, Sustainability, and Quality: The Challenge of "Good" Food, is a major revision of the previous global hunger chapter. This timely new approach focuses on issues most relevant to students today. The chapter is now earlier in the book following the food safety chapter, with the text concluding with the three chapters covering nutrition throughout the life cycle.

The visual walkthrough at the front of the book provides additional information on the new features in the Fourth Edition. Specific changes to each chapter include the following:

Chapter 1

- Highlight on the concept of a kilocalorie now incorporated into the narrative text.
- Added a new Focus Figure on Dietary Reference Intakes (Focus Figure 1.9).
- Added a new Focus Figure on the scientific method (Focus Figure 1.10).
- Updated Nutrition Myth or Fact? (previously Nutrition Debate) on nutrigenomics.
- Added a new figure on epigenetics in the nutrigenomics Nutrition Myth or Fact?.
- Updated all applicable references.

Chapter 2

- Added definitions and distinguished between whole foods, processed foods, and functional foods.
- Added a new section on "Other Eating Plans," which includes a brief overview of the Exchange Lists and the Dietary Approaches to Stop Hypertension (DASH) diet, including adding web links at the end of the chapter.
- Added a new section, "High-Tech Tools," to help students analyze their diets. This section includes information on various web-based tools and apps.
- Added a new paragraph on grocery store nutrition guidance systems, including a nutrition online link to the Nu-Val system.
- Added a new section discussing the recent Food and Drug Administration (FDA) requirements that all restaurants, movie theatres, and vending machines include calorie counts and basic nutrition information by 2016.
- Replaced previous Figure 2.4 on nutrient density with a new Focus Figure 2.4, "Optimizing Nutrient Density.."
- Retired all of the ethnic diet pyramids and revised the Mediterranean eating plan within the plate design (now Figure 2.6).
- Incorporated updated information on the Mediterranean diet as part of the text narrative.
- Introduced MiPlato as a Spanish-language alternative to MyPlate (now Figure 2.10).
- Updated and expanded the Nutrition Myth or Fact? (previously Nutrition Debate) on the DGAs and MyPlate, including updated research examining whether people are using them, discussing existing conflicts of interest that may be influencing the recommendations, and including a discussion and figure of two alternative graphics, the Healthy Eating Plate and the Power Plate.
- Updated all applicable references.

Chapter 3

- Expanded discussion of hormones involved in hunger/satiety responses.
- Moved Figure 6.12 of enzymes from Chapter 6, Proteins, in previous edition, to this chapter (now Figure 3.5).
- Added content on role of lingual lipase in chemical digestion.
- Updated information on mechanisms of gastroesophageal reflux disease (GERD) and slightly revised figure.
- Addressed current status of research on non-celiac gluten sensitivity.

- Added a brief discussion of colon cancer.
- Replaced Nutri-Case on Liz and food allergies with Nutri-Case on Judy and eating cues.
- Replaced Nutrition Debate on screening for celiac disease with a Nutrition Myth or Fact? on the microbiome, probiotics, and prebiotics.
- Updated all applicable references.

Chapter 4

- Added information on fructans (including inulin) within the section discussing fiber.
- Expanded Highlight examining the question, "Are All Forms of Sugar the Same?."
- Added new Meal Focus Figure 4.15 on maximizing fiber intake.
- Updated section on the effect of high sugar intake on risks for obesity and diabetes.
- Updated section on the recent evidence examining consumption of diet soft drinks and weight loss/gain.
- Expanded the section on diabetes, including damage caused to blood vessels, discussion of prediabetes, discussion and table with values for normal glucose, impaired fasting glucose, and diabetes (including HbA1c values).
- Added new Focus Figure 4.18 on diabetes.
- Nutrition Myth or Fact? (formerly Nutrition Debate) was expanded to explore the role of sugar more broadly (and not just high-fructose corn syrup) in the obesity epidemic.
- Updated all applicable references.

Chapter 4.5

- Updated all statistics regarding alcohol-related deaths, complications, and other related issues.
- Added a link to help students calculate Calorie content of alcoholic beverages.
- Expanded section "Taking Control of Your Alcohol Intake."
- New Figure 3 on calculating Calorie content of alcoholic beverages.
- Updated all applicable references.

Chapter 5

- Updated Highlight, "Is Margarine More Healthful Than Butter?"
- Updated Figures 5.1, 5.5, 5.9, 5.15.
- Updated discussion of the role of dietary fat in chronic disease, including trans fats and cholesterol.
- Added new Focus Figure 5.16 on atherosclerosis.
- Added new Focus figure 5.18 on lipoprotein transport and distribution.
- Added new Nutrition Myth or Fact? (formerly Nutrition Debate), "Are Saturated Fats Bad or Benign?"
- Added discussion on eating more sustainably when selecting fish.
- • Added new figure 5.9, part a, on bile emulsifying fats.
- Added new Meals Focus Figure 5.14 on reducing saturated fats.
- Expanded the Nutrition Label Activity on how much fat in food so that it is more comprehensive.
- Updated references.

Chapter 6

- Updated sections on the effect of consuming excess protein on heart disease, kidney function, and bone loss.
- Updated section on the role of nuts in lowering risk for type 2 diabetes and heart disease.
- Expanded section on whether amino acid supplements help build muscle mass and increase muscle strength.

- Enhanced list of ways to increase legume intake.
- Added new Focus Figure 6.16 on meals high and low in healthy protein sources.
- Added new Nutrition Myth or Fact? (formerly Nutrition Debate) on whether there is a need to increase current protein recommendations.
- Updated all applicable references.

Chapter 7

- Added new introductory story for the chapter.
- Added a brief overview of cholesterol synthesis.
- Updated Figures 7.10 and 7.25.
- Updated Highlight on carnitine.
- Updated the Nutrition Myth or Fact? (formerly Nutrition Debate) on dietary thermogenics.
- Updated the Highlight on carnitine.
- Updated all applicable references.

Chapter 7.5

- Added section on ultra-trace minerals.
- Added discussion on nutrient competition for absorption.
- Changed vitamin D guidelines from IU to µg.
- Updated all applicable references.

Chapter 8

- Revised learning objectives.
- Updated figures.
- Updated Highlight, "Can Chromium Supplements Enhance Body Composition?"
- Updated Nutrition Myth or Fact? (formerly Nutrition Debate), "Treating PMS with Vitamin B_6 and Folic Acid: Does It Work? Is it Risky?"

Chapter 9

- Added new chapter-opening story.
- Added new discussion of alkaline water.
- Updated Figure 9.2.
- Added new Focus Figure 9.5 on fluid and electrolyte balance.
- Added cashew milk to discussion of (cow's) milk alternatives.
- Added discussion of ultra-trace minerals.
- Added new Nutrition Myth or Fact? (formerly Nutrition Debate) on the sodium controversy.
- Updated all applicable references.

Chapter 10

- Restructured chapter headings to more closely link the learning outcomes with textual information and review questions.
- Added new Focus Figure 10.5 on vitamin A's role in vision.
- Updated Highlight feature on vitamin C and the common cold.
- Moved disorders linked to tobacco use from Highlight box to text.
- Expanded section on the link between free radicals, antioxidants, and cardiovascular disease.
- Updated and expanded Nutrition Myth or Fact? (formerly Nutrition Debate) on multivitamins and mineral supplements and added information on botanicals and herbs.
- Updated all applicable references.

Chapter 10.5

- Half of this In Depth chapter was updated and rewritten so that it focuses on four main ideas, reflected in the four learning outcomes.
- All of the research studies cited have been updated (except for the acknowledged classics), including the Highlight box on peanut butter and jelly sandwiches.

Chapter 11

- Reorganized all section headings to improve flow and enable linkage with learning objectives.
- Clarified that it is red bone marrow that is involved in the production of most blood cells.
- Revised the sections discussing the roles of parathyroid hormone (PTH) and vitamin D on calcium absorption from the kidney and the role of the sarcoplasmic reticulum in releasing calcium to stimulate muscle contraction.
- Added new Focus Figure 11.5 on vitamin D and calcium regulation.
- Revised Figure 11.9 to include evidence that vitamin D conversion is inhibited in the winter months in geographic areas above the 37 degree latitude line.
- Expanded and moved content on calcium supplements to the new Nutrition Myth or Fact? (formerly Nutrition Debate), "Preserving Bone Mass: Are Supplements the Solution?"
- Incorporated new research on the role of exercise in osteoporosis prevention and treatment and on the risks and benefits of medications currently used to treat osteoporosis.
- Updated all applicable references.

Chapter 12

- Updated information on iron absorption from mixed diets.
- Added new information on vitamin K and its various forms.
- Updated information on anemia worldwide and World Health Organization (WHO) 2025 plans for a 50% reduction of anemia in women of reproductive age.
- Updated section on the role of nutrients in immune response.
- Added new information on the worldwide problem of child malnutrition and its impact on the immune system.
- Updated information on the role of zinc in human health.
- Expanded the discussion of the components of blood.
- Updated Nutrition Myth or Fact? (formerly Nutrition Debate), "Zinc and the Common Cold."
- Updated all applicable references.

Chapter 13

- Substantially reorganized the chapter, revised chapter headings and learning objectives, and deleted repetitive information to improve flow and readability.
- Added new Focus Figure 13.5 on energy balance.
- Expanded information on complications of bariatric surgery.
- Updated and expanded information on weight loss medications.
- Added information on mindful eating.
- Expanded sections on the associations of environmental factors and poverty with obesity.
- Expanded section on the multifactorial nature of obesity.
- Added new Focus Figure 13.9 on the complex factors contributing to obesity.
- Revised obesity surgery figure (Figure 13.10) to include sleeve gastrectomy.
- Added new Meal Focus Figure 13.11 on managing calorie intake.
- Moved Nutrition Debate on whether it costs more to eat right to Chapter 16 where it is now a Highlight box.

- Updated Nutrition Myth or Fact? (formerly Nutrition Debate) on whether higher carbohydrate, lower fat diets have been overrated, and added information on the Paleo Diet to this feature and also to the chapter text.
- Updated all applicable references.

Chapter 13.5

- Added learning outcomes.
- Updated Highlight, "Muscle Dysmorphia: The Male Eating Disorder?"
- Updated segment on various types of disordered eating that can be part of a syndrome.
- Updated new DSM-5.

Chapter 14

- Revised phrasing of section headings to make them more direct and applicable to the content being covered.
- Added new Figure 14.1 on health benefits of physical activity.
- Updated Figure 14.3 to include examples of activities, providing a more complete illustration of the Frequency, Intensity, Time, and Type (FITT) principle.
- Added new Focus Figure 14.7 on what fuels our activities.
- Added new Meal Focus Figure 14.10 on maximizing carbohydrates to support activity.
- Added new information and references related to intrinsic and extrinsic motivation to being active, high-intensity interval training (HIT), recent evidence to support the benefits of the 2008 Physical Activity Guidelines, and the benefits of consuming food sources high in carbohydrate and protein to enhance muscle glycogen storage and performance.
- Updated and tightened up the Nutrition Myth or Fact? (formerly Nutrition Debate) on ergogenic aids.

Chapter 15

- Updated all research throughout.
- Added brief discussions of hepatitis A virus (HAV) and *Toxoplasma gondii.*
- Moved discussion of bovine spongiform encephalopathy (BSE)/variant Creutzfeldt–Jakob disease (vCJD) from box to narrative and updated and condensed.
- Expanded discussion of STECs.
- Replaced FightBac figure with Foodsafety.gov logo.
- Replaced table of cooking temperatures with narrative bullets, updated.
- Discussed FDA preliminary determination on partially hydrogenated oils (PHOs) as no longer generally recognized as safe.
- Added discussion of the top five reasons for genetic modification of crops, including herbicide tolerance and insect resistance.
- Added separate discussion of the health risks of POPs and expanded the discussion of plasticizers, dioxins, and concerns about the carcinogenicity of glyphosate.
- Added brief discussion of the FDA's imposition of a voluntary ban on the use of antibiotics in livestock for other than medical purposes.
- Updated the USDA's definition and description of organic foods, and added a brief discussion of the issue of their higher cost.
- Moved discussion of environmental food issues such as sustainability to Chapter 16.
- Revised and updated Tables 15.1 on government agencies, Table 15.2 on bacteria, and Table 15.4 on the Environmental Working Group's dirty dozen and clean fifteen.
- Entirely revised and expanded the Nutrition Myth or Fact? (formerly Nutrition Debate) on genetically modified organisms (GMOs).
- Updated all applicable references.

Changes to Chapter 16

- This new chapter, "Food Equity, Sustainability, and Quality: The Challenge of 'Good' Food," replaces the last edition's Chapter 19, "Global Nutrition."
- New topics include disparities in availability of high-quality, nourishing food; factors thought to contribute to the poverty-obesity paradox; the unsafe working conditions on many U.S. farms; and the inequitable wages paid to many farm and food-service workers.
- Updated and significantly expanded the section on food sustainability and the effects of our current system of food production, dominated by industrial agriculture, on food diversity and the environment that had been covered in narrative of the third edition, in Chapter 15.
- Added new discussion of the role of the food industry in shaping nutrition recommendations and consumer choices through lobbying, marketing, etc.
- Expanded discussion of global, national, and local initiatives that are increasing the availability of nourishing food and included a look at some simple steps individuals can take, such as buying fair-trade foods or reducing beef consumption, which can help begin to meet the challenge of "good" food.
- Updated and expanded Nutrition Myth or Fact? (formerly Nutrition Debate in Chapter 6) on meat consumption and global warming, including a new section from a 2014 analysis identifying the resources used and emissions released to produce 1,000 kcal of beef versus 1,000 kcal of food crops (wheat, rice, and potatoes).

Chapter 17

- Added discussion of the effects of obesity on fertility.
- Added discussion of pregnancy concerns for older women.
- Expanded the discussion of *Listeria monocytogenes* infection during pregnancy.
- Changed the Nutri-Case to support the teaching point on the increased risk for type 2 diabetes in children of a mother who had gestational diabetes.
- Added a discussion on the safety of artificial sweeteners in pregnancy.
- Added a discussion of the use of prescription and over-the-counter (OTC) drugs and herbal supplements during pregnancy.
- Added a discussion of lower rates of breastfeeding in obese mothers and contributing factors.
- Added a flow chart on consequences of fetal adaptation to undernourishment to the Nutrition Myth or Fact? (formerly Nutrition Debate) on long-term effects of the fetal environment.
- Updated all applicable reference.

Chapter 18

- Expanded discussion on the responsibilities of parents in supporting healthful diets for their children/families, including their role in the management of their children's weight.
- Replaced MyPyramid graphic with MyPlate Daily Food Plan.
- Updated discussion on the role of breakfast related to nutrient intake and weight management.
- Expanded discussion of the short- and long-term metabolic consequences of obesity.
- Updated information related to School Lunch and Breakfast programs, food insecurity among children.
- Added explanations of "class 2" and "class 3" obesity among children and adolescents.
- Expanded the Nutrition Myth or Fact? (formerly Nutrition Debate) on bariatric surgery in adolescents.
- Updated all applicable references.

Changes to Chapter 19

- Expanded discussion on consequences of inactivity among older adults.
- Updated dietary protein recommendations for older adults.
- Expanded discussion of bariatric surgery in older adults.
- Added a new section on dehydration among older adults.
- Added new dietary recommendations to reduce the risk of Alzheimer's disease.
- Added new discussion on pressure ulcers in elderly.
- Added new discussion on the impact of "crushing" drugs for easier administration of drugs for older adults.
- Updated and expanded discussion of food insecurity among older adults.
- Updated descriptions of federal food assistance programs.
- Added new Centers for Disease Control and Prevention (CDC) guidelines on physical activity for older adults in the "Seniors on the Move" Highlight.
- Updated Nutrition Myth or Fact? (formerly Nutrition Debate) on living longer through a low-energy diet.
- Updated all statistics related to aging.
- Updated all applicable references.

Appendices, Front Matter, and Back Matter

- Appendix A, "The USDA Food Guide Evolution," and Appendix I, "Organizations and Resources," have been moved online. Remaining appendices have been renumbered.

Supplemental Resources for Instructors and Students

For the Instructor

Intructor Review Copy

978-0-13-439335-3 / 0-13-439335-X

Instructor Resource and Support Manual

978-0-13-432699-3 / 0-13-432699-7

This popular and adaptable resource, available on the Teaching Toolkit DVD, enables instructors to create engaging lectures and additional activities via chapter summaries, learning objectives, chapter outlines, key terms, in-class discussion questions, and activity ideas, including a diet analysis activity and a Nutrition Debate activity for each chapter, in addition to a list of all web resources by chapter.

Teaching Toolkit DVD

978-0-13-424386-3 / 0-13-424386-2

This rich teaching resource offers everything you need to create lecture presentations and course materials, including JPEG and PowerPoint® files of the art, tables, and selected photos from the text, and "stepped-out" art for selected figures from the text, as well as animations for the majors nutrition course.

The DVD allows for "click and play" in the classroom—no downloading required—and includes the following:

Media Assets for Each Chapter

- *ABC News* Lecture Launcher videos
- Nutrition Animations
- PowerPoint Lecture Outlines

- Media-Only PowerPoint® slides for easy importing of videos and animations
- PowerPoint clicker questions and Jeopardy-style quiz show questions
- Files for all illustrations and tables and selected photos from the text

Comprehensive Test Bank

- Test Bank in Microsoft Word, PDF, and RTF formats
- Computerized Test Bank, which includes all the questions from the printed test bank in a format that allows you to easily and intuitively build exams and quizzes

Additional Supplements

For Instructors

- Instructor Resource and Support Manual in Microsoft Word and PDF formats
- Step-by-step MasteringNutrition tutorials
- Video introduction to Learning Catalytics™
- *Great Ideas in Teaching Nutrition*

For Students

- *Eat Right! Healthy Eating in College and Beyond*
- Food Composition Table

TestGen® Test Bank

978-0-13-432698-6 / 0-13-432698-9

The Test Bank, provided in MasteringNutrition and the Teaching Toolkit DVD, contains multiple-choice, true/false, and essay questions for content from each chapter, in addition to new Bloom's Taxonomy levels and correlations to the start-of-chapter Learning Objectives.

Great Ideas: Active Ways to Teach Nutrition

978-0-321-59646-8 / 0-321-59646-3

This updated, revised booklet compiles the best ideas from nutrition instructors across the country on innovative ways to teach nutrition topics with an emphasis on active learning. Broken into useful pedagogic areas including targeted and general classroom activities, and an overview of active learning principles, this booklet provides creative ideas for teaching nutrition concepts, along with tips and suggestions for classroom activities that can be used to teach almost any topic.

MyDietAnalysis Website

www.mydietanalysis.com

ISBN: 0-321-73390-8

MyDietAnalysis was developed by the nutrition database experts at ESHA Research, Inc. and is tailored for use in college nutrition courses. It offers an accurate, reliable, and easy-to-use program for your students' diet analysis needs. MyDietAnalysis features a database of nearly 20,000 foods and multiple reports. Available online, the program allows students to track their diet and activity and generate and submit reports electronically. MyDietAnalysis is also available at no additional cost as a single sign-on to MasteringNutrition with all new copies of the textbook.

For online users, a mobile website version of MyDietAnalysis is available, so students can track their diet and activity intake accurately, anytime and anywhere, from their mobile device.

Food Composition Table
978-0-321-66793-9 / 0-321-66793-X

Entries from the USDA Nutrient Database for Standard Reference are provided, offering the nutritional values of over 1,500 separate foods in an easy-to-follow format.

Course Management Options for Instructors

MasteringNutrition™

www.masteringnutrition.pearson.com/www.pearsonmylabandmastering.com
MasteringNutrition™
The MasteringNutrition online homework, tutorial, and assessment system delivers self-paced tutorials and activities that provide individualized coaching, focus on your course objectives, and are responsive to each student's progress. The Mastering system helps instructors maximize class time with customizable, easy-to-assign, and automatically graded assessments that motivate students to learn outside of class and arrive prepared for lecture.

For the Student

Food Composition Table
978-0-321-66793-9 / 0-321-66793-X

Entries from the USDA Nutrient Database for Standard Reference are provided, offering the nutritional values of over 1,500 separate foods in an easy-to-follow format.

MyDietAnalysis Website
www.mydietanalysis.com
MyDietAnalysis was developed by the nutrition database experts at ESHA Research, Inc. and is tailored for use in college nutrition courses. It offers an accurate, reliable, and easy-to-use program for your students' diet analysis needs. MyDietAnalysis features a database of nearly 20,000 foods and multiple reports. Available online, the program allows students to track their diet and activity and generate and submit reports electronically. MyDietAnalysis is also a included at no additional cost as a single sign on to MasteringNutrition with all new copies of the textbook.

For online users, a mobile website version of MyDietAnalysis is available, so students can track their diet and activity intake accurately, anytime and anywhere, from their mobile device.

MasteringNutrition™
www.masteringnutrition.pearson.com/www.pearsonmylabandmastering.com

MasteringNutrition™
The MasteringNutrition online homework, tutorial, and assessment system delivers self-paced tutorials and activities that provide individualized coaching, focus on your course objectives, and are responsive to each student's progress. The Mastering system helps instructors maximize class time with customizable, easy-to-assign, and automatically graded assessments that motivate students to learn outside of class and arrive prepared for lecture.

Eat Right! Healthy Eating in College and Beyond
978-0-805-38288-4 / 0-805-38288-7

This handy, full-color, 80-page booklet provides students with practical guidelines, tips, shopper's guides, and recipes, so that they can start putting healthy eating guidelines into action. Written specifically for students, topics include healthy eating in the cafeteria, dorm room, and fast-food restaurants; eating on a budget; weight-management tips; vegetarian alternatives; and guidelines on alcohol and health.

Acknowledgments

It is eye-opening to write a textbook and to realize that the work of so many people contributes to the final product. There are numerous people to thank, and we'd like to begin by extending our thanks to the fabulous staff at Pearson for their incredible support and dedication to this book. Publisher Frank Ruggirello committed extensive resources to ensure the quality of each new edition of this text, and his ongoing support and enthusiasm helped us maintain the momentum we need to complete this project. Our acquisitions editor, Michelle Cadden, provided unwavering vision, support, and guidance throughout the process of writing and publishing this book. We could never have completed this text without the exceptional writing and organizational skills of Laura Bonazzoli, our developmental editor and cowriter. In addition to enhancing the quality of this textbook through her enthusiasm and creativity, Laura was responsible for writing the new chapter on food equity, sustainability, and quality. We also express our sincere gratitude to our project manager, Tu-Anh Dang-Tran. We know that managing all the aspects of a textbook is a bit like herding cats. Tu-Anh worked tirelessly to improve the text and steer us on our course, and kept us sane with her patience, sense of humor, and excellent editorial instincts. We are also indebted to art development editor Kim Brucker, who contributed to the art enhancements in this edition. Heidi Arndt, editorial assistant extraordinaire, provided superior editorial and administrative support that we would have been lost without. Our thanks also to Marie Beaugureau, Laura Southworth, and Deirdre Espinoza, for their support and guidance in previous editions.

Multiple talented players helped build this book in the production and design process as well. The resourceful Nancy Kincade and Tracy Duff and their colleagues at Lumina Datamatics kept manuscripts moving throughout the process and expertly tracked the many important details in this complex project. We'd also like to thank Nancy Tabor, project management team lead, for her guidance and assistance; and Mark Ong, design manager, who guided designer Tamara Newnam through the interior and cover designs and selection of the beautiful chapter-opening photos.

We can't go without thanking the marketing and sales teams who have been working so hard to get this book out to those who will benefit most from it, especially executive product marketing manager Neena Bali and the excellent Pearson marketing and market development teams for their enthusiastic support and innovative ideas.

Our goal of meeting instructor and student needs could not have been realized without the team of educators and editorial staff who worked on the substantial supplements package for *The Science of Nutrition*. Aimee Pavy, content producer, expertly supervised all aspects of the media program, including MasteringNutrition. Chelsea Logan expertly guided every aspect of the Teaching Toolkit DVD, and Kirsten Forsberg was our project manager for the Instructor Support Manual. Thanks to our supplements authors and contributors, with special appreciation to Laura Bonazzoli for the Test Bank revisions, and Southern Editorial for their work on the Instructor Resource Manual. Our gratitude to all for their valuable contributions to this edition.

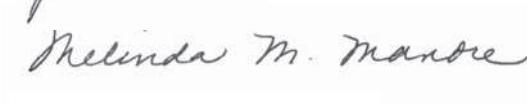
We would also like to thank the many colleagues, friends, and family members who helped us along the way. Janice would specifically like to thank her supportive and hard-working colleagues at the University of Birmingham. "Their encouragement and enthusiasm keep me going through seemingly endless deadlines. My family and friends have been so incredibly wonderful throughout my career. Mom, Dianne, Pam, Steve, Aunt Judy, and cousin Julie are always there for me to offer a sympathetic ear, a shoulder to cry on, and endless

encouragement. Although my Dad is no longer with us, his unwavering love and faith in my abilities inspired me to become who I am. I am always amazed that my friends and family actually read my books to learn more about nutrition—thanks for your never-ending support! You are incredible people who keep me sane and healthy and help me to remember the most important things in life."

Melinda would specifically like to thank her husband, Steve Carroll, for the patience and understanding he has shown through this process—once again. He has learned that there is always another chapter due! Melinda would also like to thank her family, friends, and professional colleagues for their support and listening ear through this whole process. They have all helped make life a little easier during this incredibly busy time.

Linda would like to acknowledge the unwavering support of her family and friends, a solid network of love and understanding that keeps her afloat. She would also like to thank Janice and Melinda for providing the opportunity to learn and grow through the process of writing this book.

Janice L. Thompson



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Reviewers

We extend our sincere gratitude to the following reviewers for their invaluable assistance in guiding the revision of and improvements in this text.

Lori Zienkewicz
Mesa Community College

Lisa Morse
Arizona State University

Simin Levinson
Arizona State University

Sherri Arthur
Oklahoma City Community College

Wendy Buchan
California State University, Sacramento

Eugene Fenster
Metropolitan Community College

Lisa Blackman
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Christopher Wendtland
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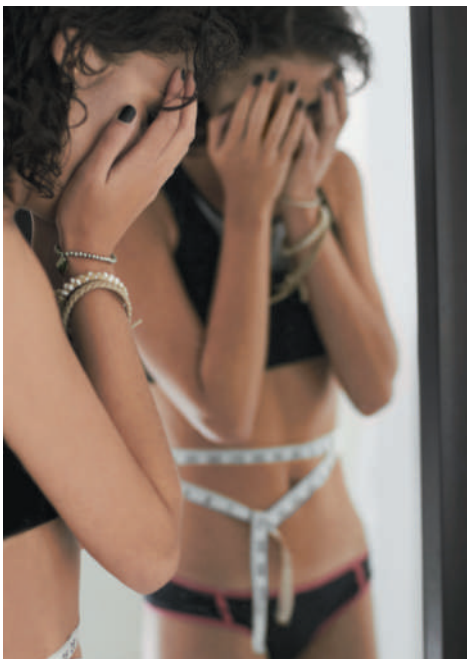
Brief Contents

Contents



Appendices

Special Features

Focus Figures

Meal Focus Figures

YOU DO THE MATH

HIGHLIGHT

Nutri-Case

NUTRITION LABEL ACTIVITY

NUTRITION MYTH OR FACT?

1 The Science of Nutrition: Linking Food, Function, and Health

Learning Outcomes

After studying this chapter, you should be able to:

1. Define the term *nutrition* and describe the history of nutrition science, *pp. 4–6*.
2. Discuss why nutrition is important to health, *pp. 6–9*.
3. Identify the six classes of nutrients essential for health and describe their functions, *pp. 9–15*.
4. Distinguish among the six types of Dietary Reference Intakes for nutrients, *pp. 15–18*.
5. Describe the tools nutritional professionals and other healthcare providers use for gathering data related to an individual's nutritional status and diet, *pp. 18–21*.
6. Explain how nutrition professionals classify malnutrition, *pp. 21–22*.
7. Discuss the four steps of the scientific method, *pp. 22–26*.
8. Compare and contrast the various types of research studies used in establishing nutrition guidelines, *pp. 26–27*.
9. Describe various approaches you can use to evaluate the truth and reliability of media reports, websites, and other sources of nutrition information, *pp. 28–30*.
10. List at least four sources of reliable and accurate nutrition information and state why they are trustworthy, *pp. 30–33*.

TEST YOURSELF

True or False?

1. **A Calorie is a measure of the amount of fat in a food. T *or* F**
2. **Proteins are not a primary source of energy for our body. T *or* F**
3. **All vitamins must be consumed daily to support optimal health. T *or* F**
4. **The Recommended Dietary Allowance is the maximum amount of nutrient that people should consume to support normal body functions. T *or* F**
5. **Results from observational studies do not indicate cause and effect. T *or* F**

Test Yourself answers are located in the Study Plan.

MasteringNutrition™

Go to **www.masteringnutrition.pearson.com** (or **www.pearsonmylabandmastering.com**) for chapter quizzes, pre-tests, interactive activities, and more!

Marilyn is 58 years old and works as a clerk at a small gift shop. During the last year, she has noticed that she is becoming increasingly tired at work and feels short of breath when performing tasks that she used to do easily, such as stocking shelves. This morning, she had her blood pressure checked for free at a local market and was told by the woman conducting the test that the reading was well above average. Assuming the woman's white lab coat meant that she was a healthcare professional, Marilyn asked her whether or not high blood pressure could explain her fatigue. The woman replied that fatigue was certainly a symptom and advised Marilyn to see her physician. When Marilyn explained that she tried to avoid trips to the doctor because her health insurance plan had a high deductible, the woman said, "Well, I'm not a physician, but I *am* a nutritionist, and I can certainly tell you that the best thing you can do to reduce your high blood pressure is to lose weight. We're running a special all month on Fiber Lunch, our most popular weight-loss supplement. You take it 30 minutes after your midday meal and it cleans out your digestive tract, keeping you from absorbing a lot of the food you eat. I can personally recommend it, because it helped me lose 30 pounds."

Marilyn wasn't convinced that she needed to lose weight. Sure, she was stocky, but she'd been that way all her life, and her fatigue had only started in the past year. But then she remembered that lately she'd been having trouble getting her rings on and off and that her shoes were feeling tight. So maybe the nutritionist was right and she should lose a few pounds. And hadn't she seen an ad for Fiber Lunch in her favorite women's magazine, or maybe on their website? Noticing Marilyn wavering, the nutritionist added, "A few weeks after I started taking Fiber Lunch, my blood pressure went from sky-high to perfectly normal." She certainly looked slender and healthy, and her personal testimonial convinced Marilyn to spend $12 of her weekly grocery budget on the smallest bottle of the supplements.

What do you think of the advice Marilyn received? Was the nutritionist's assessment of her nutritional status adequate? Was the treatment plan sound? Just what is a "nutritionist," anyway? In this chapter, we'll begin to answer these questions as we explore the role of nutrition in human health, identify the six classes of nutrients, and describe what constitutes a professional nutritional assessment. You'll also learn how to evaluate nutrition-related research studies, as well as how to distinguish science from scams. But first, let's take a quick look at the evolution of nutrition as a distinct scientific discipline.

The study of nutrition encompasses everything about food.

LO 1 Define the term *nutrition* and describe the history of nutrition science.

What Is the Science of Nutrition and How Did It Evolve?

Although many people think that *food* and *nutrition* mean the same thing, they don't. **Food** refers to the plants and animals we consume. It contains the energy and nutrients our body needs to maintain life and support growth and health. **Nutrition,** in contrast, is a science. Specifically, it is the science that studies food and how food nourishes our body and influences our health. It identifies the processes by which we consume, digest, metabolize, and store the nutrients in foods and how these nutrients affect our body. Nutrition also involves studying the factors that influence our eating patterns, making recommendations about the amount we should eat of each type of food, maintaining food safety, and addressing issues related to the production of food and the global food supply.

When compared with other scientific disciplines, such as chemistry, biology, and physics, nutrition is a relative newcomer. The cultivation, preservation, and preparation of food have played a critical role in the lives of humans for millennia, but in the West, the recognition of nutrition as an important contributor to health has developed slowly only during the past 400 years.

It started when researchers began to observe an association between diet and illness. For instance, in the mid-1700s, long before vitamin C itself had been identified, researchers discovered that the vitamin C–deficiency disease *scurvy,* which causes joint pain, tissue breakdown, and even death, could be prevented by consuming citrus fruits. By the mid-1800s, the three energy-providing nutrients—carbohydrates, lipids, and proteins—had been identified, as well as a number of essential minerals. Nutrition was coming into its own as a developing scientific discipline.

food The plants and animals we consume.

nutrition The scientific study of food and how it nourishes the body and influences health.

Still, vitamins were entirely unrecognized, and some fatal diseases that we now know to be due to vitamin deficiency were then thought to be due to infection. For instance, when Dutch physician Christian Eijkman began studying the fatal nerve disease *beriberi* in the 1880s, he conducted experiments designed to ferret out the causative bacterium. Finally, Eijkman discovered that replacing the polished white rice in a patient's diet with whole-grain brown rice cures the disease. Still, he surmised that something in the brown rice conferred resistance to the beriberi "germ." It was not until the 20th century that the substance missing in polished rice—the B-vitamin *thiamin*—was identified and beriberi was definitively classified as a deficiency disease. Another B-vitamin, niacin, was discovered through the work of Dr. Joseph Goldberger in the early 1900s. The accompanying ***Highlight*** box describes Dr. Goldberger's daring work.

Nutrition research continued to focus on identifying and preventing deficiency diseases through the first half of the 20th century. Then, as the higher standard of living after World War II led to an improvement in the American diet, nutrition research began pursuing a new objective: supporting wellness and preventing and treating **chronic diseases**—that is, diseases that come on slowly and can persist for years, often despite treatment.

chronic disease A disease characterized by a gradual onset and long duration, with signs and symptoms that are difficult to interpret and that respond poorly to medical treatment.

HIGHLIGHT

Solving the Mystery of Pellagra

In the first few years of the 20th century, Dr. Joseph Goldberger successfully controlled outbreaks of several fatal infectious diseases, from yellow fever in Louisiana to typhus in Mexico. So it wasn't surprising that, in 1914, the Surgeon General of the United States chose him to tackle another disease thought to be infectious that was raging throughout the South. Called pellagra, the disease was characterized by a skin rash, diarrhea, and mental impairment. At the time, it afflicted more than 50,000 people each year, and in about 10% of cases it resulted in death.

Goldberger began studying the disease by carefully observing its occurrence in groups of people. He asked, if it is infectious, then why would it strike children in orphanages and prison inmates yet leave their nurses and guards unaffected? Why did it overwhelmingly affect impoverished mill workers and share croppers while leaving their affluent (and well-fed) neighbors healthy? Could a dietary deficiency cause pellagra? To confirm his hunch, he conducted a series of trials in which he fed afflicted orphans and prisoners, who had been consuming a limited, corn-based diet, a variety of nutrient-rich foods, including meats. They recovered. Moreover, orphans and inmates who did not have pellagra and ate the new diet did not develop the disease. Finally, Goldberger recruited 11 healthy prison inmates, who in return for a pardon of their sentence agreed to consume a limited, corn-based diet. After 5 months, six of the 11 developed pellagra.

Pellagra is often characterized by a scaly skin rash.

Still, many skeptics were unable to give up the idea that pellagra was an infectious disease. So to prove that pellagra was not spread by germs, Goldberger, his colleagues, and his wife deliberately injected and ingested patients' scabs, nasal secretions, and other bodily fluids. They remained free of the disease.

Although Goldberger could not identify the precise component in the new diet that cured pellagra, he eventually found an inexpensive and widely available substance, brewer's yeast, that when added to the diet prevented or reversed the disease. Shortly after Goldberger's death in 1937, scientists identified the precise nutrient that was deficient in the diet of pellagra patients: niacin, one of the B-vitamins, which is plentiful in brewer's yeast.

Source: Kraut, A. *Dr. Joseph Goldberger and the War on Pellagra.* National Institutes of Health, Office of NIH History. http://history.nih.gov/exhibits/Goldberger/index.html.

wellness A multidimensional, lifelong process that includes physical, emotional, and spiritual health.

Chronic diseases of particular interest to nutrition researchers include obesity, cardiovascular disease, type 2 diabetes, and various cancers. This new research has raised as many questions as it has answered, and we still have a great deal to learn about the relationship between nutrition and chronic disease.

In the closing decades of the 20th century, an exciting new area of nutrition research began to emerge. Reflecting our growing understanding of genetics and epigenetics, *nutrigenomics* seeks to uncover links among our genes, our environment, and our diet, and to generate nutrition information tailored to our genetic makeup. But is this promise of personalized nutrition ever likely to be fulfilled? Check out the ***Nutrition Myth or Fact?*** at the end of this chapter to find out.

RECAP

Food refers to the plants and animals we consume, whereas *nutrition* is the scientific study of food and how food affects our body and our health. In the past, nutrition research focused on the prevention of nutrient-deficiency diseases, such as scurvy and beriberi; currently, a great deal of nutrition research is dedicated to identifying dietary patterns that can lower the risk for chronic diseases, such as type 2 diabetes and heart disease. Nutrigenomics is an emerging focus of nutrition research.

LO 2 Discuss why nutrition is important to health.

How Does Nutrition Contribute to Health?

Proper nutrition can help us improve our health, prevent certain diseases, achieve and maintain a desirable weight, and maintain our energy and vitality. When you consider that most people eat on average three meals per day, this results in more than 1,000 opportunities a year to affect our health through nutrition. The following section provides more detail on how nutrition supports health and wellness.

FIGURE 1.1 Many factors contribute to an individual's wellness. Primary among these are a nutritious diet and regular physical activity.

Nutrition Is One of Several Factors Supporting Wellness

Traditionally, **wellness** was defined simply as the absence of disease. However, as we have learned more about our health and what it means to live a healthful lifestyle, our definition has expanded. Wellness is now considered to be a multidimensional process, one that includes physical, emotional, social, occupational, and spiritual health (Figure 1.1). Wellness is not an end point in our lives but rather is an active process we engage in with every day.

In this book, we focus on two critical aspects of wellness: nutrition and physical activity. These two are so closely related that you can think of them as two sides of the same coin: our overall state of nutrition is influenced by how much energy we expend doing daily activities, and our level of physical activity has a major impact on how we use the nutrients in our food. We can perform more strenuous activities for longer periods of time when we eat a nutritious diet, whereas an inadequate or excessive food intake can make us lethargic. A poor diet, inadequate or excessive physical activity, or a combination of these also can lead to serious health problems. Finally, several studies have suggested that healthful nutrition and regular physical activity can increase feelings of well-being and reduce feelings of anxiety and depression. In other words, wholesome food and physical activity just plain feel good!

A Healthful Diet Can Prevent Some Diseases and Reduce Your Risk for Others

Nutrition appears to play a role—from a direct cause to a mild influence—in the development of many diseases (Figure 1.2). As we noted earlier, poor nutrition is a direct cause of deficiency diseases, such as scurvy

and beriberi. Thus, early nutrition research focused on identifying the causes of nutrient-deficiency diseases and means to prevent them. These discoveries led nutrition experts to develop guidelines for nutrient intakes that are high enough to prevent deficiency diseases, and to lobby for the fortification of foods with nutrients of concern. These measures, along with a more abundant and reliable food supply, have ensured that most nutrient-deficiency diseases are no longer of concern in developed countries. However, they are still major problems in many developing nations.

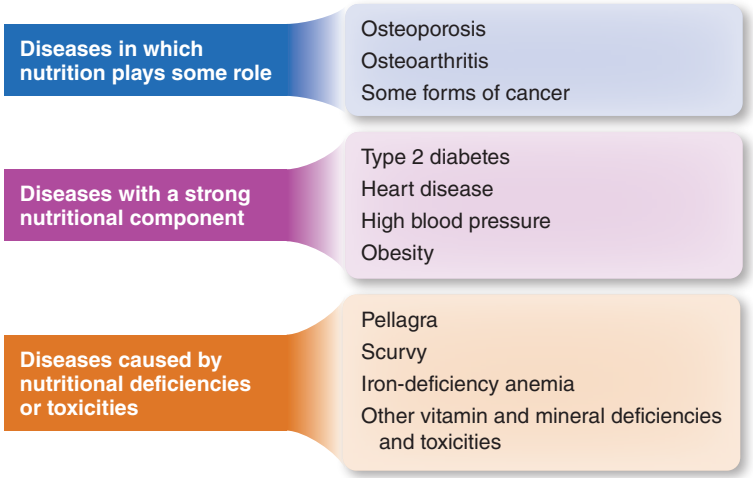


FIGURE 1.2 The relationship between nutrition and human disease. Notice that, whereas nutritional factors are only marginally implicated in the diseases of the top row, they are strongly linked to the development of the diseases in the middle row and truly causative of those in the bottom row.

In addition to directly causing disease, poor nutrition can have a more subtle influence on our health. For instance, it can contribute to the development of brittle bones, a disease called *osteoporosis*, as well as to the progression of some forms of cancer. These associations are considered mild; however, poor nutrition is also strongly associated with three chronic diseases that are among the top ten causes of death in the United States (Figure 1.3).

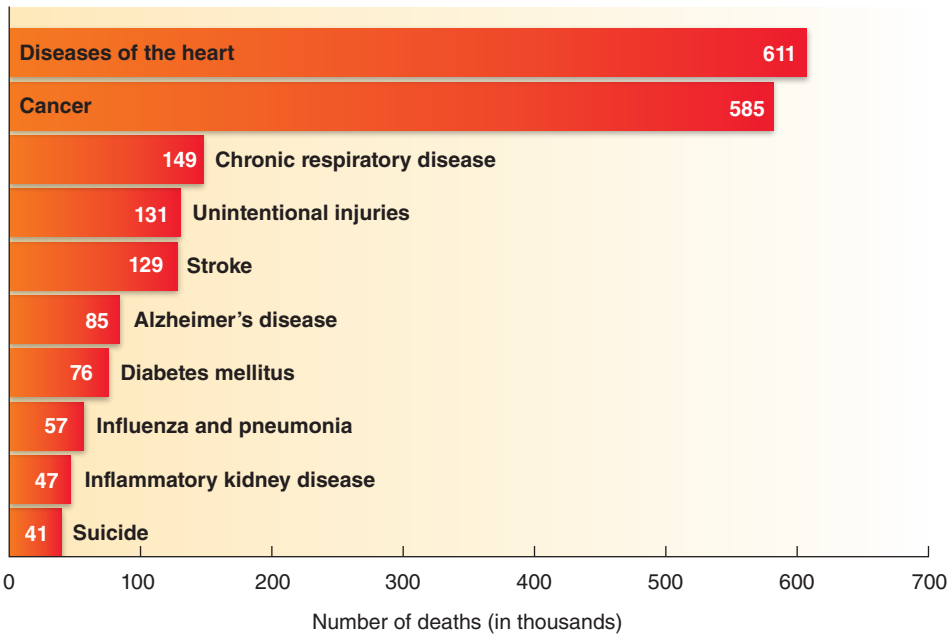


FIGURE 1.3 Of the 10 leading causes of death in the United States in 2012, three—heart disease, stroke, and diabetes—are strongly associated with poor nutrition. (*Source:* K. D. Kochanek, S. L. Murphy, J. Xu, and E. Arias. "Mortality in the United States, 2013," *NCHS Data Brief* No. 178 [December, 2014].)

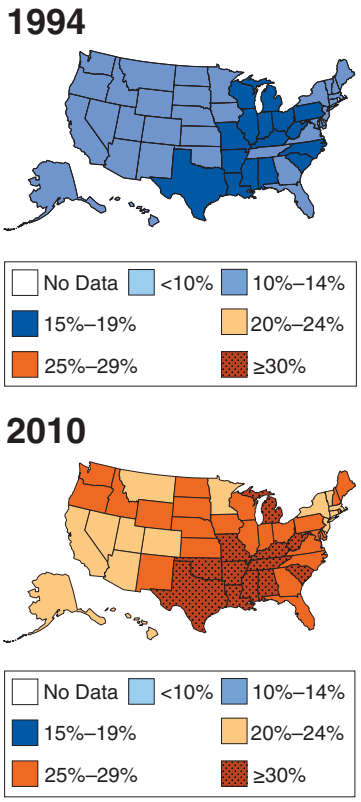


FIGURE 1.4 These diagrams illustrate the increase in obesity prevalence across the United States from 1994 to 2010, the last year during which there was a significant increase in rates. Obesity is defined as a body mass index greater than or equal to 30, or approximately 30 lb overweight for a 5'4" woman. (*Source:* Graphics from Centers for Disease Control and Prevention, Obesity Prevalence Maps 1985 to 2010.)

These are heart disease, stroke, and diabetes. Recent research indicates that poor diets and physical inactivity account for 10% of deaths and disability worldwide.[1]

It probably won't surprise you to learn that the primary link between poor nutrition and mortality is obesity. Fundamentally, obesity is a consequence of consuming more energy than is expended. At the same time, obesity is a well-established risk factor for heart disease, stroke, type 2 diabetes, and some forms of cancer. Unfortunately, the **prevalence** of obesity, or the percentage of the population that is affected with obesity at a given time, has dramatically increased throughout the United States from the 1970s through about 2010 (**Figure 1.4**). Fortunately, over the last few years, the rate has leveled off. Throughout this text, we will discuss in detail how nutrition and physical activity affect the development of obesity and other chronic diseases.

Healthy People 2020 Identifies Nutrition-Related Goals for the United States

Because of its importance to the wellness of all Americans, nutrition has been included in *Healthy People*, the national health promotion and disease prevention plan of the United States. It is revised every decade, and *Healthy People 2020*, launched in January 2010, identifies the goals and objectives that we hope to reach as a nation by the year 2020.[2] This agenda was developed by a team of experts from a variety of federal agencies under the direction of the Department of Health and Human Services. Input was gathered from a large number of individuals and organizations, including hundreds of national and state health organizations and members of the general public.

The four overarching goals of *Healthy People* are to "(1) attain high-quality, longer lives free of preventable disease, disability, injury, and premature death; (2) achieve health equity, eliminate disparities, and improve the health of all groups; (3) create social and physical environments that promote good health for all; and (4) promote quality of life, healthy development, and healthy behaviors across all life stages." These broad goals are supported by hundreds of specific goals and objectives, including 22 related to nutrition and weight status (NWS). There are also 15 objectives addressing physical activity (PA), which is, of course, related to nutrition. **Table 1.1** identifies a few of the nutrition and physical activity objectives from *Healthy People 2020*.

TABLE 1.1 Nutrition and Physical Activity Objectives from *Healthy People 2020*

Topic	Objective Number and Description
Weight status	NWS-8. Increase the proportion of adults who are at a healthy weight from 30.8% to 33.9%. NWS-9. Reduce the proportion of adults who are obese from 34.0% to 30.6%. NWS-10.2. Reduce the proportion of children aged 6 to 11 years who are considered obese from 17.4% to 15.7%.
Food and nutrient composition	NWS-14. Increase the contribution of fruits to the diets of the population aged 2 years and older. NWS-15. Increase the variety and contribution of vegetables to the diets of the population aged 2 years and older. NWS-15. Increase the variety and contribution of vegetables to the diets of the population aged 2 years and older.
Physical activity	PA–1. Reduce the proportion of adults who engage in no leisure-time physical activity from 36.2% to 32.6%. PA–2.1. Increase the proportion of adults who engage in aerobic physical activity of at least moderate intensity for at least 150 minutes per week, or 75 minutes per week of vigorous intensity, or an equivalent combination from 43.5% to 47.9%. PA–2.3. Increase the proportion of adults who perform muscle-strengthening activities on 2 or more days of the week from 21.9% to 24.1%.

Data adapted from: "Healthy People 2020" (U.S. Department of Health and Human Services).

prevalence The percentage of the population that is affected with a particular disease at a given time.

RECAP

Nutrition is an important component of wellness and is strongly associated with physical activity. Nutrition appears to play a role—from a direct cause to a mild influence—in the development of many diseases. *Healthy People 2020* is a health promotion and disease prevention plan for the United States that includes numerous objectives related to nutrition and weight status and physical activity.

nutrients Chemicals found in foods that are critical to human growth and function.

organic A substance or nutrient that contains the elements carbon and hydrogen.

inorganic A substance or nutrient that does not contain carbon and hydrogen.

LO 3 Identify the six classes of nutrients essential for health and describe their functions.

What Are Nutrients?

We enjoy eating food because of its taste, its smell, and the pleasure and comfort it gives us. However, we rarely stop to think about what our food actually contains. Foods are composed of many chemical substances, some of which are not useful to the body and others of which are critical to human growth and function. These latter chemicals are referred to as **nutrients**. The six groups of nutrients found in foods are (Figure 1.5)

- Carbohydrates
- Lipids (including fats and oils)
- Proteins
- Vitamins
- Minerals
- Water

As you may know, the term *organic* is commonly used to describe foods that are grown with little or no use of chemicals. But when scientists describe individual nutrients as **organic,** they mean that these nutrients contain the elements *carbon* and *hydrogen*, which are essential components of all living organisms. Carbohydrates, lipids, proteins, and vitamins are organic. Minerals and water are **inorganic**. Both organic and inorganic nutrients are equally important for sustaining life but differ in their structures, functions, and basic chemistry. You will learn more about these nutrients in subsequent chapters; a brief review is provided here.

Macronutrients Provide Energy

Carbohydrates, lipids, and proteins are the only nutrients in foods that provide energy. By this we mean that these nutrients break down and reassemble into a fuel that the body uses to support physical activity and basic physiologic functioning. Although taking a multivitamin and a glass of water might be beneficial in some ways, it will not provide you with the energy you need to do your 20 minutes on the stair-climber! Along with water, the energy nutrients are also referred to as **macronutrients**. *Macro* means "large"; thus, macronutrients are those nutrients needed in relatively large amounts to support normal function and health.

Alcohol is found in certain beverages and foods, and it provides energy—but it is not considered a nutrient. This is because it does not support the regulation of body functions or the building or repairing of tissues. In fact, alcohol is considered to be both a drug and a toxin. (Details about alcohol are provided in In Depth 4.5 on pp. 152–163.)

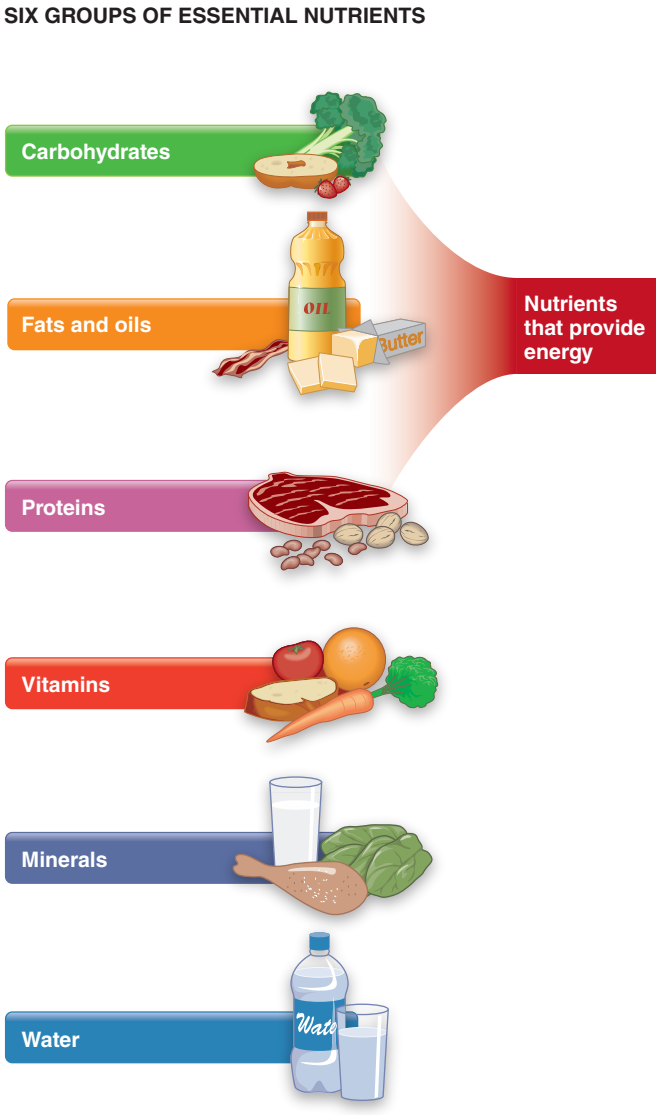


FIGURE 1.5 The six groups of nutrients found in the foods we consume.