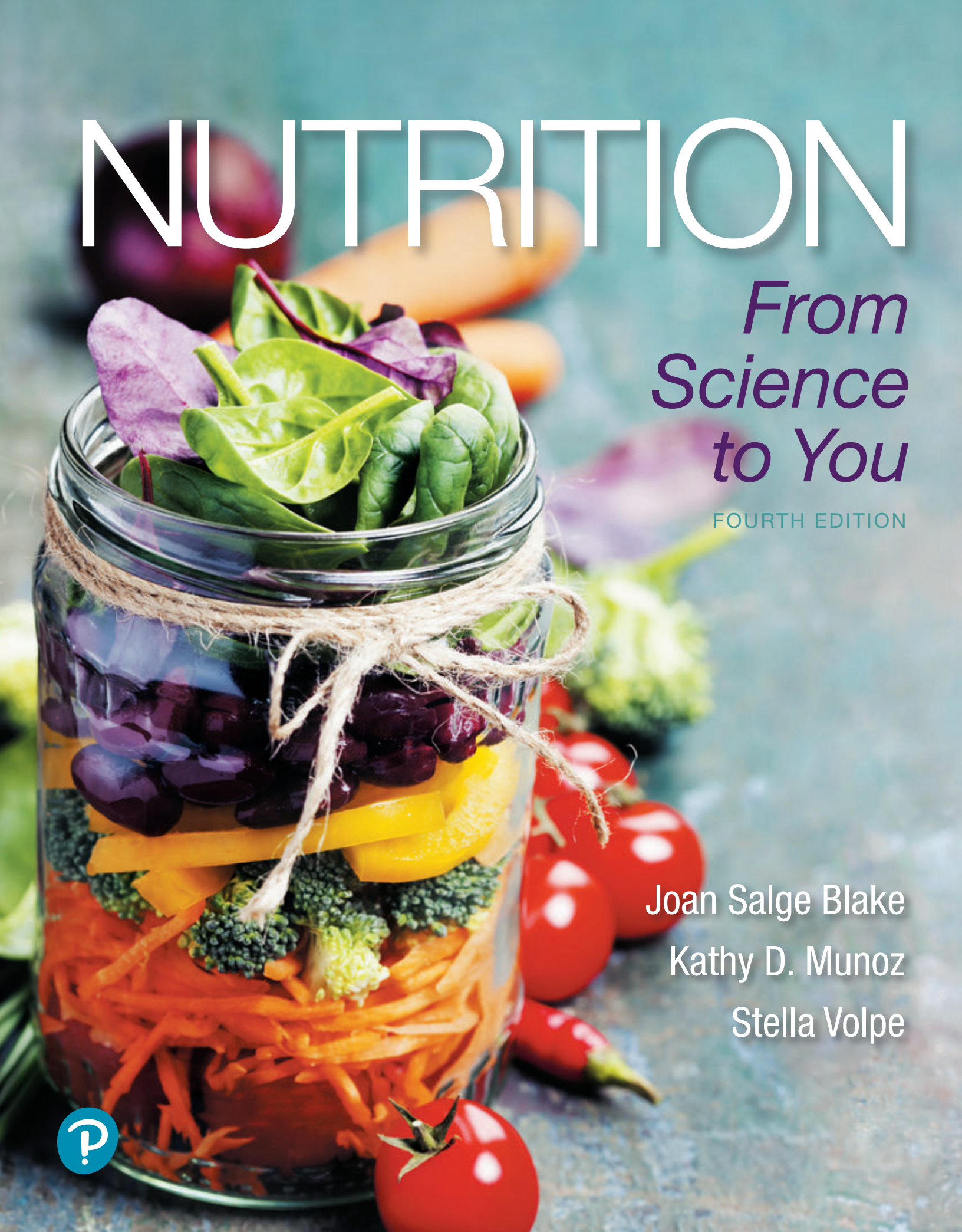
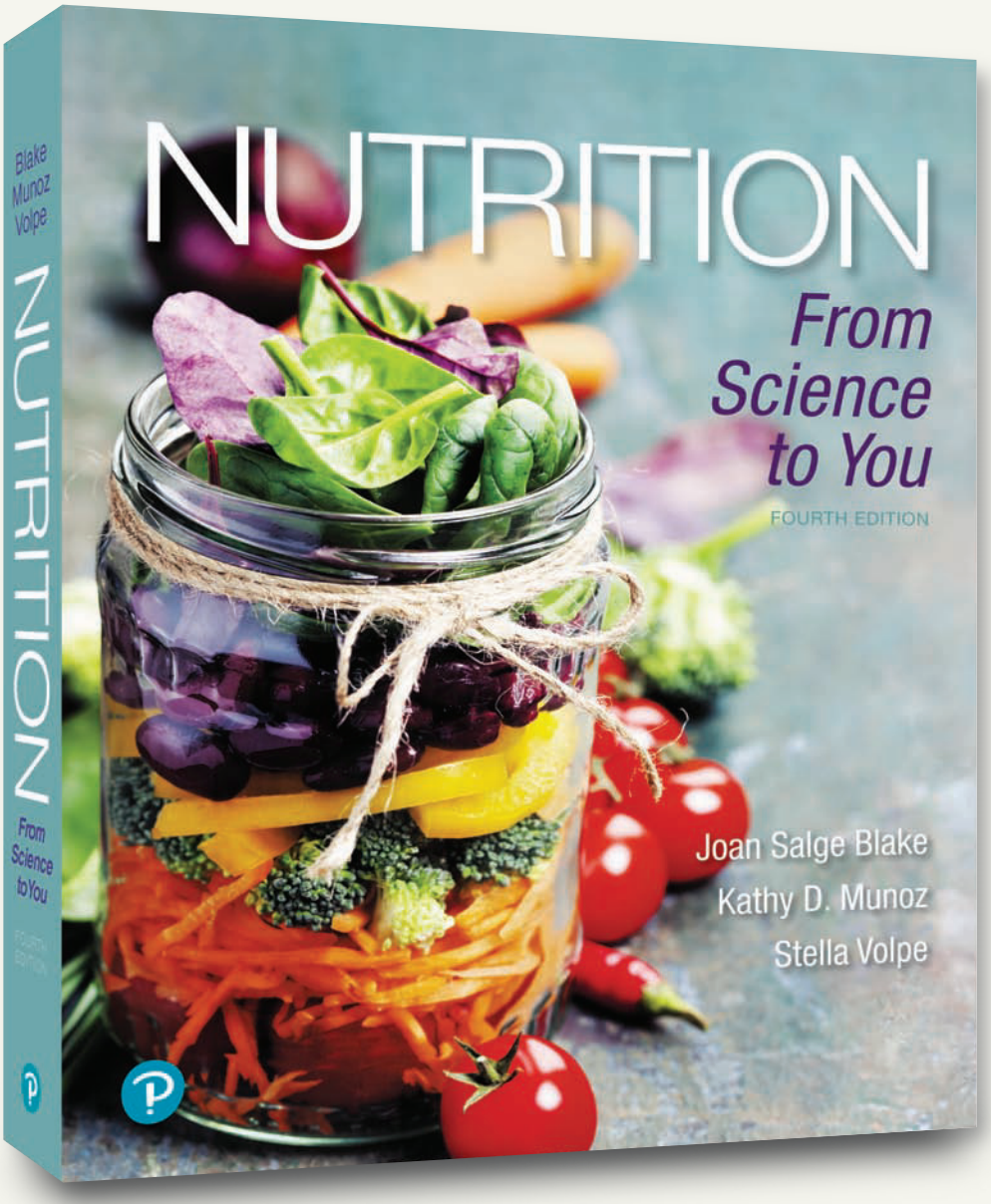

NUTRITION
From Science to You
FOURTH EDITION
Joan Salge Blake
Kathy D. Munoz
Stella Volpe

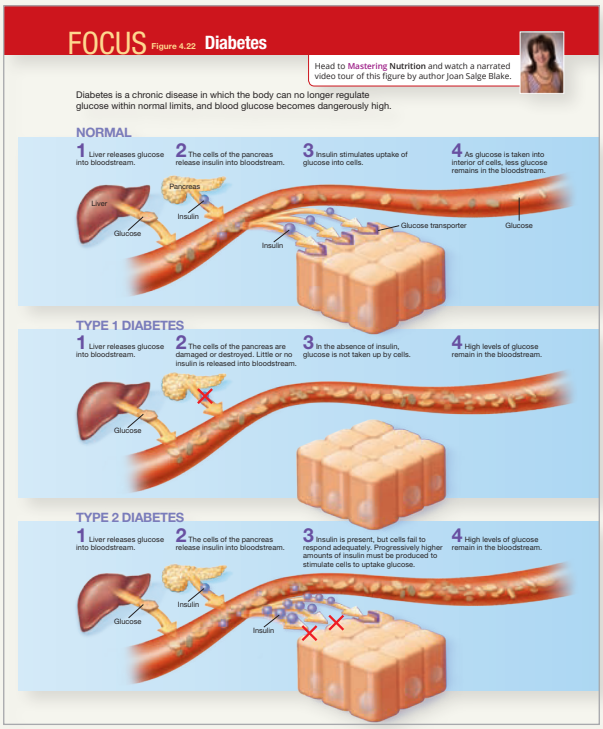
A Modern and Personal Approach to Nutrition

Nutrition: From Science to You helps students understand the science of nutrition and how to successfully apply it to their personal lives fute careers. Thoroughly updated to better meet the needs of tomorrow's nutrition and allied health professionals, the **4th Edition** provides students with more inter-professional applications, increased coverage of emerging and high interest topics such as the microbiome and Leaky Gut syndrome, and new dietary and nutrition guidelines.



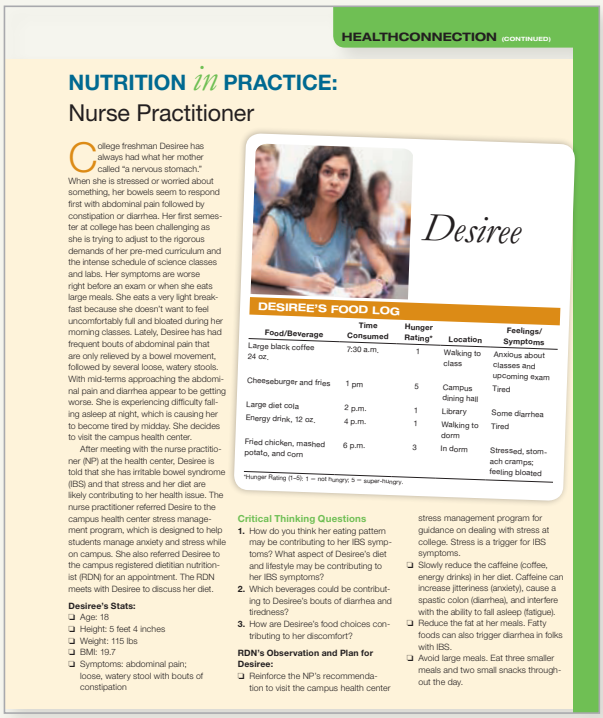
Pearson

Helping Students Make Connections Between



NEW! Focus Figure Narrated Walkthroughs provide a video tour of each full-page Focus Figure. These figures explore targeted and integrated topic areas through visual information displays that are bold, clear, and detailed. In the narrated walkthroughs, author Joan Salge Blake breaks down each part of the Focus Figure and further explains them, just as she would in the classroom.

NEW! Inter-professional Nutrition in Practice case studies encourage critical thinking and emphasize the applicability of the content to students' own lives and future careers. Some case studies draw upon Joan Salge Blake's experience as a dietitian working with actual clients, while others have been created with a new focus for those students interested in pursuing other allied health professions such as nursing, physical therapy, etc.



HEALTHCONNECTION (CONTINUED)

NUTRITION *in* PRACTICE:

Nurse Practitioner

College freshman Desiree has always had what her mother called "a nervous stomach." When she is stressed or worried about something, her bowels seem to respond first with abdominal pain followed by constipation or diarrhea. Her first semester at college has been challenging as she is trying to adjust to the rigorous demands of her pre-med curriculum and the intense schedule of science classes and labs. Her symptoms are worse right before an exam or when she eats large meals. She eats a very light breakfast because she doesn't want to feel uncomfortably full and bloated during her morning classes. Lately, Desiree has had frequent bouts of abdominal pain that are only relieved by a bowel movement, followed by several loose, watery stools. With mid-terms approaching the abdominal pain and diarrhea appear to be getting worse. She is experiencing difficulty falling asleep at night, which is causing her to become tired by midday. She decides to visit the campus health center.

After meeting with the nurse practitioner (NP) at the health center, Desiree is told that she has irritable bowel syndrome (IBS) and that stress and her diet are likely contributing to her health issue. The nurse practitioner referred Desire to the campus health center stress management program, which is designed to help students manage anxiety and stress while on campus. She also referred Desiree to the campus registered dietitian nutritionist (RDN) for an appointment. The RDN meets with Desiree to discuss her diet.

Desiree's Stats:

- ❑ Age: 18
- ❑ Height: 5 feet 4 inches
- ❑ Weight: 115 lbs
- ❑ BMI: 19.7
- ❑ Symptoms: abdominal pain; loose, watery stool with bouts of constipation

Desiree

DESIREE'S FOOD LOG

Food/Beverage	Time Consumed	Hunger Rating*	Location	Feelings/ Symptoms
Large black coffee 24 oz.	7:30 a.m.	1	Walking to class	Anxious about classes and upcoming exam
Cheeseburger and fries	1 pm	5	Campus dining hall	Tired
Large diet cola	2 p.m.	1	Library	Some diarrhea
Energy drink, 12 oz.	4 p.m.	1	Walking to dorm	Tired
Fried chicken, mashed potato, and corn	6 p.m.	3	In dorm	Stressed, stomach cramps; feeling bloated

*Hunger Rating (1–5): 1 = not hungry; 5 = super-hungry.

Critical Thinking Questions

1. How do you think her eating pattern may be contributing to her IBS symptoms? What aspect of Desiree's diet and lifestyle may be contributing to her IBS symptoms?
2. Which beverages could be contributing to Desiree's bouts of diarrhea and tiredness?
3. How are Desiree's food choices contributing to her discomfort?

RDN's Observation and Plan for Desiree:

- ❑ Reinforce the NP's recommendation to visit the campus health center stress management program for guidance on dealing with stress at college. Stress is a trigger for IBS symptoms.
- ❑ Slowly reduce the caffeine (coffee, energy drinks) in her diet. Caffeine can increase jitteriness (anxiety), cause a spastic colon (diarrhea), and interfere with the ability to fall asleep (fatigue).
- ❑ Reduce the fat at her meals. Fatty foods can also trigger diarrhea in folks with IBS.
- ❑ Avoid large meals. Eat three smaller meals and two small snacks throughout the day.

Nutrition, Themselves, and Their Future Careers

Health Connections appear in each chapter directly before the Visual Chapter Summary. Tied to learning outcomes, these figures highlight diseases and disorders in which nutrition plays a major role, as well as nutritional practices that offer unique health benefits.

NEW! and EXPANDED! Coverage of important topics, including:

- Prediabetes
- Non-celiac gluten sensitivity
- FODMAP diet
- FITT and HIIT
- Prebiotics and synbiotics
- And more!

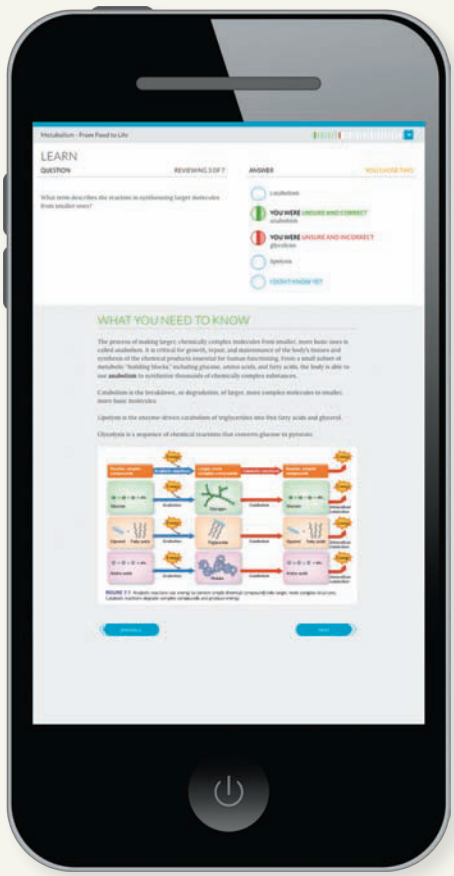
Continuous Learning Before,

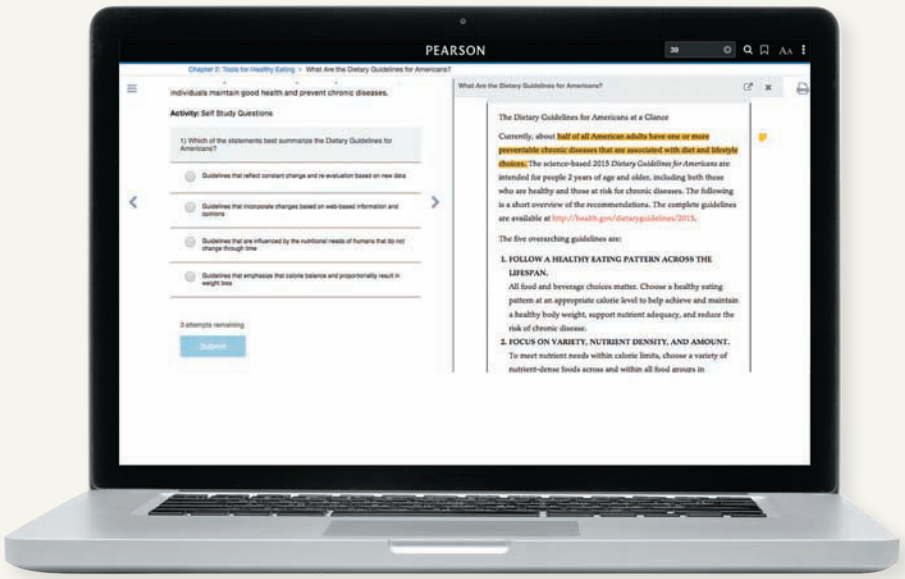
BEFORE CLASS

Mobile Media and Reading Assignments Ensure Students Come to Class Prepared

UPDATED! Dynamic Study Modules help students study effectively on their own by continuously assessing their activity and performance in real time. These are available as graded assignments prior to class, and accessible on smartphones, tablets, and computers.

NEW! Instructors can now remove questions from Dynamic Study Modules to better fit their course.





UPDATED! Pearson eText now optimized for mobile:

- Pearson eText mobile app offers offline access
- 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 & After Class with MasteringNutrition™

DURING CLASS

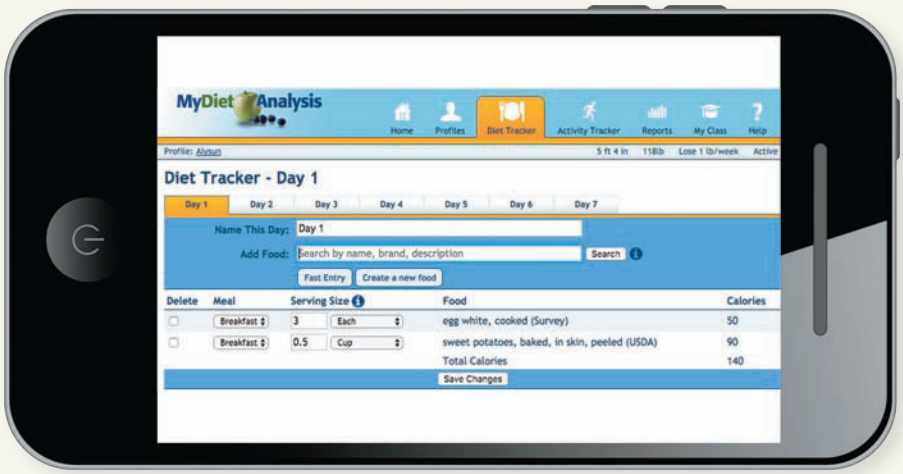
Engage students with Learning Catalytics

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

Mastering Nutrition Delivers Diet Analysis Tools and Activities to students

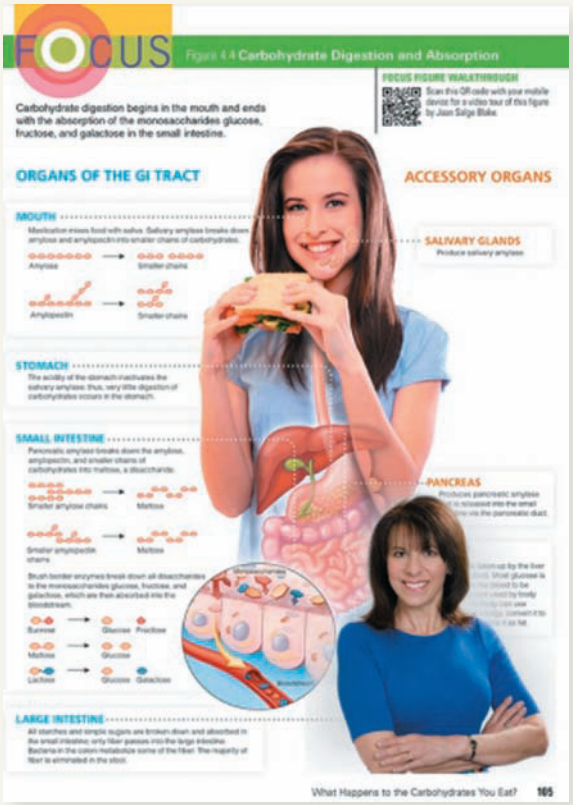
Mastering Nutrition includes Access to MyDietAnalysis
MyDietAnalysis is available as a single sign on to Mastering Nutrition. For smartphone users, a mobile website version of MyDietAnalysis is available. Students can track their diet and activity intake accurately, anytime and anywhere, from their mobile device.



Continuous Learning Before,

AFTER CLASS

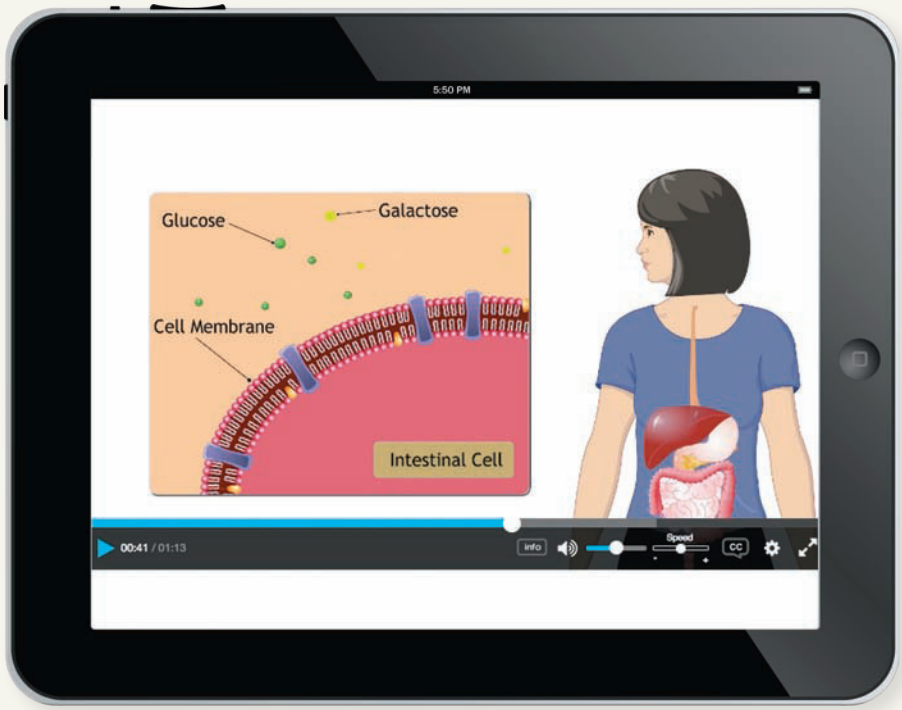
Easy to Assign, Customize, Media-Rich, and Automatically Graded Assignments.



NEW! Focus Figure Coaching activities are interactive, mini-lessons narrated by author Joan Salge Blake. These video walkthroughs, and associated coaching activities, help students understand key concepts.'

NEW! MDA Personalized Dietary Analysis activities guide students in a thorough investigation of their dietary intake and are focused on the most commonly assigned topics in diet analysis projects. Follow-up feedback and a reflection question help students understand how to improve their diets. **Activities can also be automatically graded,** saving instructors valuable time from grading their students' lengthy diet analysis projects

During & After Class with MasteringNutrition

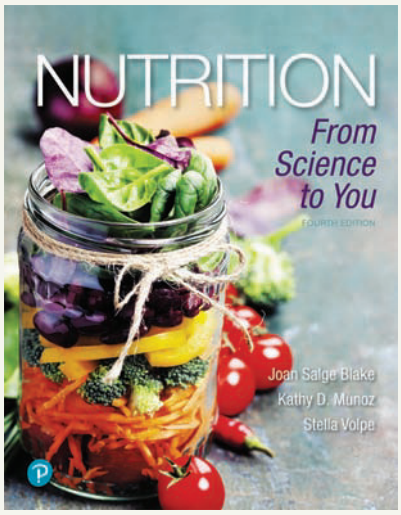


Nutrition Animations help students master tough topics with associated auto-graded coaching activities that contain hints and wrong-answer feedback.

NutriTools Coaching Activities allow students to combine and experiment with different food options and learn firsthand how to build healthier meals.

Additional videos in Mastering Nutrition include Math Videos, ABC News Videos, and Joan Salge Blake's Practical Nutrition Tips!

Resources for YOU, the Instructor



Mastering Nutrition

Mastering Nutrition provides you with everything you need to prep for your course and deliver a dynamic lecture, in one convenient place. Resources include:

MEDIA ASSETS FOR EACH CHAPTER

- ***ABC News*** Lecture Launcher videos
- Nutrition Animations
- Practical Nutrition Tip videos
- PowerPoint Lecture Outlines
- PowerPoint clicker questions and Jeopardy-style quiz show questions
- Files for all illustrations and tables and selected photos from the text

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 a quizzes.

TEACHING RESOURCES

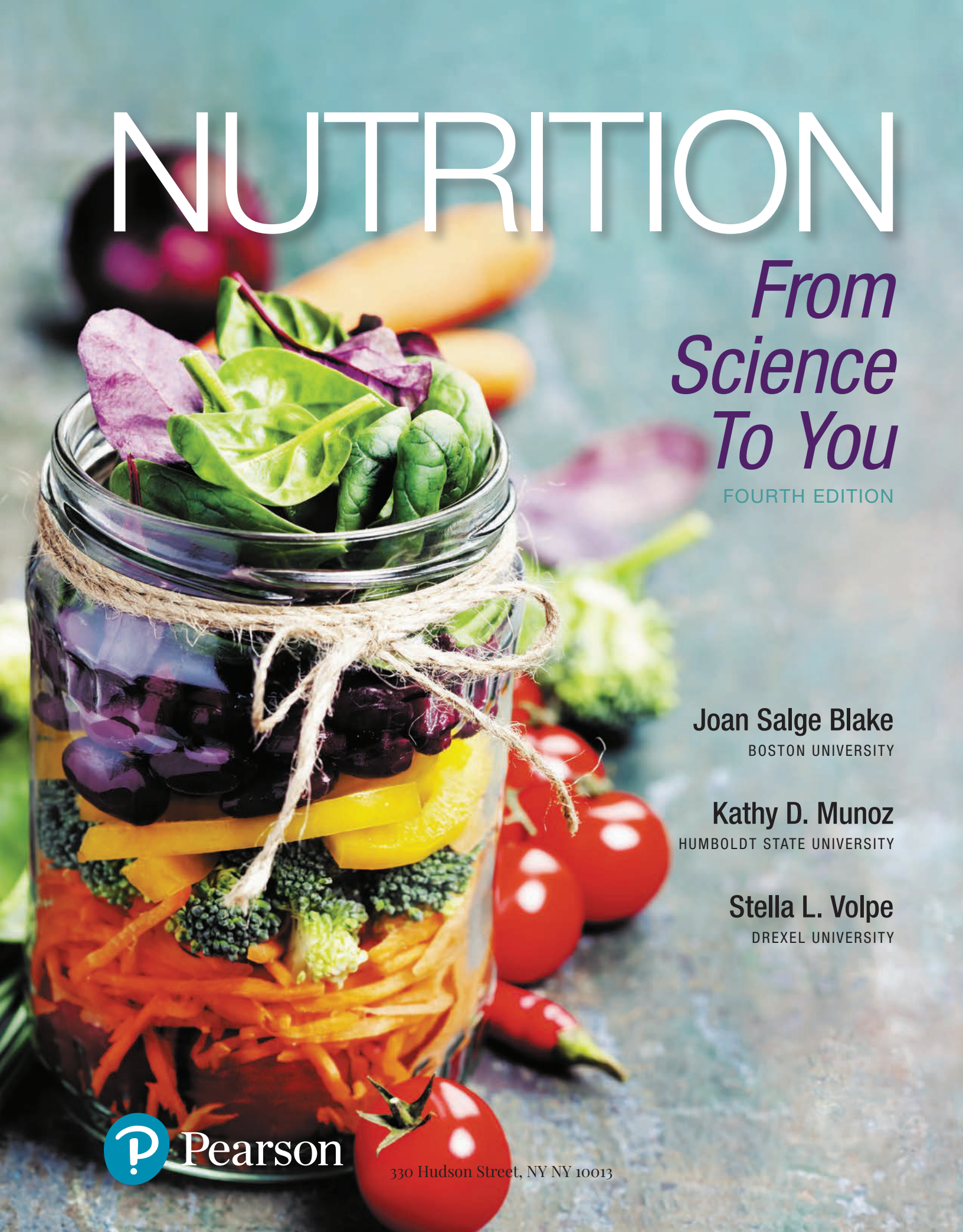
- Instructor Resource and Support Manual in Microsoft Word and PDF formats
- Learning Catalytics: Getting Started
- Getting Started with Mastering Nutrition

STUDENT SUPPLEMENTS

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

Measuring Student Learning Outcomes?

All of the Mastering Nutrition assignable content is tagged to book content and to Bloom's Taxonomy. You also have the ability to add your own learning outcomes, helping you track student performance against your learning outcomes. You can view class performance against the specified learning outcomes and share those results quickly and easily by exporting to a spreadsheet.



NUTRITION

From Science To You

FOURTH EDITION

Joan Salge Blake
BOSTON UNIVERSITY

Kathy D. Munoz
HUMBOLDT STATE UNIVERSITY

Stella L. Volpe
DREXEL UNIVERSITY

Pearson

330 Hudson Street, NY NY 10013

Courseware Portfolio Manager: Michelle Yglecias
Content Producer: Lizette Faraji
Managing Producer: Nancy Tabor
Courseware Director, Content Development: Barbara Yien
Development Editor: Laura Bonazzoli
Courseware Editorial Assistant: Nicole Constantine, Crystal Trigueros
Rich Media Content Producer: Lucinda Bingham
Full-Service Vendor: SPi Global
Copyeditor: Laura Patchkovsky
Compositor: SPi Global
Art Coordinator: Morgan Ewald, Lachina Publishing Services
Design Manager: Mark Ong
Interior Designer: Gary Hespenheide
Cover Designer: Gary Hespenheide
Rights & Permissions Project Manager: Linda DeMasi, Cenveo Publishing Services
Rights & Permissions Management: Ben Ferrini
Photo Researcher: Clare Maxwell
Manufacturing Buyer: Stacey Weinberger, LSC Communications
Executive Product Marketing Manager: Neena Bali, Alysun Burns
Field Marketing Manager: Mary Salzman
Printer/Binder: LSC Communications, Inc.
Cover Printer: Phoenix Color/Hagerstown
Cover Photo Credit: Natalia Klenova/Shutterstock

Cataloging-in-Publishing data is on file with the Library of Congress
Names: Blake, Joan Salge, author. | Munoz, Kathy D., 1951- author. | Volpe, Stella, 1963- author.
Title: Nutrition : from science to you / Joan Salge Blake (Boston University), Kathy D. Munoz (Humboldt State University), Stella L. Volpe (Drexel University).
Description: Fourth edition. | New York : Pearson, [2019]
Identifiers: LCCN 2017056138
Subjects: LCSH: Nutrition–Textbooks.
Classification: LCC RA784 .B553 2019 | DDC 613.2–dc23
LC record available at https://lccn.loc.gov/2017056138

ISBN 10: **0-13-466826-X;** ISBN 13: **978-0-134-66826-0** (Student edition)
ISBN 10: **0-134-79645-4;** ISBN 13: **978-0-134-79645-1** (Instructor's Review Copy)

1 17

Pearson www.pearson.com

Brief Contents

Contents

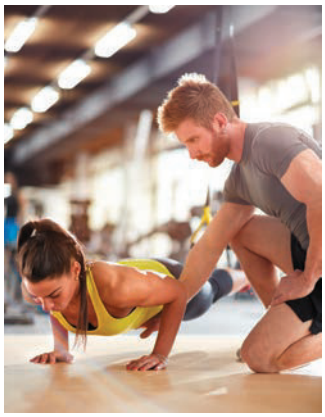
6 Proteins 205

7 Alcohol 247

8 Energy Metabolism 281

9 Fat-Soluble Vitamins 317

16 Nutrition and Fitness 577



17 Life Cycle Nutrition: Pregnancy through Infancy 619

19 Life Cycle Nutrition: Older Adults 697

20 Food Safety, Technology, and Sustainability 731

Special Features

Scan this QR code to access all Focus Figure Narrated Walkthroughs videos, Calculation Corner videos, and MP3 Tutor Sessions for this edition.

FOCUS FIGURE

HEALTHCONNECTION

Calculation Corner

Chemistry Boost

EXAMINING THE EVIDENCE

NUTRITION *in* PRACTICE

Self-Assessment

SPOTLIGHT

TABLE TIPS

FITNESS TIPS

About the Authors

Joan Salge Blake, MS, RD, LDN

Boston University

Dr. Joan Salge Blake is a Clinical Associate Professor and Dietetics Internship Director at Boston University's Sargent College of Health and Rehabilitation Sciences. She teaches both graduate and undergraduate nutrition courses. She received her MS and EdD from Boston University.

Joan is a member of the Academy of Nutrition and Dietetics (formerly the American Dietetic Association) and the Massachusetts Dietetic Association (MAND). She has been a presenter and Presiding Officer at both the AND Annual Meeting and the MAND Annual Convention and is a guest lecturer at both the Boston University Goldman School of Dental Medicine and the Boston University School of Medicine. She was previously named MDA's "Young Dietitian of the Year" and is the past Director of Education and Nominating Committee Chairperson for the MDA. She currently serves on the MDA board. Joan has received the Whitney Powers Excellence in Teaching award from Boston University and the Annie Galbraith Outstanding Dietitian award from the Massachusetts Dietetic Association.

In addition to teaching and writing, Joan has a private practice specializing in weight management and lifestyle changes. Joan is often asked to translate complex nutritional issues in popular terms in the media. She has conducted over 1,000 media interviews and is a contributor of nutrition articles in a variety of news outlets. Joan was an AND National Media Spokesperson for nine years.

Kathy D. Munoz, EdD, RDN

Humboldt State University

Kathy D. Munoz is a professor emerita and professor of nutrition in the Department of Kinesiology and Recreation Administration at Humboldt State University. She teaches undergraduate introductory nutrition, exercise nutrition, and weight management courses, and teaching preparation in higher education courses in the Extended Education, College of eLearning. She received her EdD from the University of Southern California in curriculum design and an MS in Foods and Nutrition with a minor in exercise physiology from Oregon State University.

Kathy is a member of the Academy of Nutrition and Dietetics and the California Dietetic Association. Her professional memberships include Dietitians in Integrative and Functional Medicine (DIFM), Sports, Cardiovascular, and Wellness Nutrition (SCAN), and Weight Management (WM).

Kathy has published articles in *Research Quarterly for Exercise and Sport, Children's Health Care,* the *Journal of Nutrition Education,* and the *International Journal of Sport Nutrition and Exercise,* and has co-authored a series of nutrition and physical activity curriculum guides for elementary teachers. Kathy has also been recognized for her research in, and development of curriculum for, asynchronous learning.

Stella L. Volpe, PhD, RD, LDN, FACSM

Drexel University

Dr. Stella Lucia Volpe is Professor and Chair of the Department of Nutrition Sciences at Drexel University. Stella is a nutritionist and exercise physiologist who has built a program of research focusing on three interrelated areas that traverse the lifespan: (1) obesity and diabetes prevention via mineral supplementation, (2) weight management through diet, exercise, and educational programs, and (3) environmental change leading to weight management. She is conducting a cross-sectional, long-term study assessing body composition, resting metabolic rate, maximal oxygen consumption and diet in athletes. In addition, she has recently completed a three-year, school-based obesity prevention trial.

Stella received her BS in Exercise Science from the University of Pittsburgh, her MS in Exercise Physiology from Virginia Tech, and her PhD in Nutrition, also from Virginia Tech.

Prior to beginning her faculty appointment at Drexel University, Stella was on the faculty of the University of Pennsylvania, and previous to that, she was on the faculty at the University of Massachusetts, Amherst. Stella is both a Certified Clinical Exercise Physiologist (American College of Sports Medicine [ACSM]), and a Registered Dietitian Nutritionist. She is a Fellow of the ACSM. Stella is a competitive athlete in field hockey, rowing, ice hockey. She enjoys being active with her husband and their German Shepherd dogs, Sasha and Bear.

Preface

Why We Wrote *Nutrition: From Science to You*

We wrote *Nutrition: From Science to You* to provide you with a solid foundation about nutrition and how it affects *you* and your nutritional needs, concerns, and questions.

Between the three of us, we have more than 60 years of experience teaching college-level nutrition. We've conducted and published research, studied the literature, and listened to and watched our students learn the science. We've taken copious notes regarding students' questions, interests, concerns, and misunderstandings, both in and outside the classroom. These years of experience have culminated in a textbook that we believe translates the latest nutrition science into a readable format to provide you with information that you can easily incorporate into your life and the lives of others.

As a college student, you are exposed to a steady stream of nutrition and health information from the media, your family and friends, and the Internet. Although you may think Google has the answer to your nutrition questions, we have seen students frequently fall victim to misinformation found on the Web. We designed *Nutrition: From Science to You* to be as user friendly as possible, and packed exclusively with sound nutrition information. The text goes beyond basic nutrition science and provides realistic advice and strategies to help you apply what you learn in your own life. The text is written to meet *your* nutritional concerns and answer *your* questions.

Remember, nutrition matters to *you!* What you eat today and tomorrow will affect you and your body for years to come. Just as important, what you learn about nutrition today will enable you to make a positive effect on the lives of others from now on.

New to This Edition

- **The 2015 Dietary Guidelines of America and Nutrition Facts Panel** are fully integrated into the fourth edition.
- **Focus Figure Video Walkthroughs** narrated by author Joan Salge Blake provide a video tour of the full-page Focus Figure, where each part is broken down and further explained by Joan Salge Blake, just as she would do in the classroom. Students can access these videos in—and instructors can assign them from—Mastering Nutrition.
- **Inter-professional Nutrition in Practice case studies** encourage critical thinking and emphasize the applicability of the content to your own life and future career. Some case studies draw upon Joan Salge Blake's experience as a dietitian working with actual clients, while others have been created with a new focus for those students interested in pursuing other allied health professions such as nursing, physical therapy, etc.
- **New and expanded topics such as:** prediabetes, non-celiac gluten sensitivity, FODMAP diet, FITT and high intensity interval training, prebiotics and synbiotics, and more. In addition, Chapter 8, including metabolism and energy metabolism pathways, has been significantly restructured for clarity.

Other Key Features

- **Learning Outcomes** are used to structure the chapter: each main heading is accompanied by its own learning outcome; **The Take-Home Message** at the end of each main section repeats the learning outcome number before a brief summation of the key points; and the **Visual Chapter Summary** is organized by learning outcome number and contains key images and concepts. This strong pedagogical structure throughout the chapter promotes comprehension and facilitates study and review.
- **Health Connections** appear in each chapter directly before the Visual Chapter Summary. These sections, which are tied to learning outcomes, highlight diseases and disorders in which nutrition plays a major role, as well as nutritional practices that offer unique health benefits.
- **Content has been updated throughout** to be consistent with new guidelines, data, research, and trends.
- **Mastering™ Nutrition,** the 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 your personal progress. The Mastering system is the most effective and widely used online homework, tutorial, and assessment system for the sciences. It 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 lectures. Mastering Nutrition for the fourth edition includes new Focus Figure Coaching Activities, updated NutriTools Coaching Activities, and much more. Learn more at www.masteringhealthandnutrition.com.
- **MyDietAnalysis mobile website** is available, so you can track your diet and activity intake accurately, anytime, and anywhere from your mobile device. Learn more at www.mydietanalysis.com. Access to MyDietAnalysis is included in Mastering Nutrition at no additional cost.
- **Examining the Evidence** features look at the latest research on hot topics in nutrition today. These features guide you to making better, informed choices in your personal nutrition, while also demonstrating the ways nutrition professionals are constantly expanding and refining our understanding of nutritional science.
- **Exploring Micronutrients** within Chapters 9, 10, 12, and 13 are self-contained sections that incorporate photos, illustrations, and text to present each vitamin and mineral. Each micronutrient is discussed using the same categories (forms, absorption and transport, functions, daily needs, food sources, and toxicity and deficiency symptoms) for a consistent and easy-to-study format.
- **Chemistry Boosts** review chemistry concepts within the context in which you need to know them.
- **Calculation Corners** walk through mathematical equations used in the chapter and give you practice working the equations themselves. These features also have corresponding math video activities in Mastering Nutrition.
- **True or False?** pretests open each chapter with 10 true/false statements that help you realize that the things you think you know about nutrition aren't always accurate. Answers are given at the end of the chapter.
- **Table Tips** give practical ideas for incorporating adequate amounts of each nutrient into your diet using widely available foods.
- **Self-Assessments** throughout the book ask you to think about your own diet and behaviors and how well you are meeting your various nutrient needs.

Chapter-by-Chapter Updates

Nutrition research and applications continue to expand our understanding of this advancing and dynamic science. To keep pace, we've reorganized the content, and visually

improved the figures and tables to enrich student learning in each chapter in the 4th edition of *Nutrition: From Science to You*.

Chapter 1: What Is Nutrition?

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Updated statistics on such key topics as the obesity epidemic, consumption trends, the quality of the American diet, leading causes of death in the United States.
- Moved content on meeting nutrition needs into its own section with Learning Outcome and The Take-Home Message.
- Created a new Health Connection on *Finding Credible Nutrition Information*.

Chapter 2: Tools for Healthy Eating

- Learning outcomes are highlighted to match the major headings, the Take-Home Message, and visual chapter summaries.
- Added a new Focus Figure 2.3, *Dietary Reference Intakes*.
- Created a new Focus Figure 2.10, *The Nutrition Facts Panel,* to describe the newest proposed food label changes.
- Developed a new Health Connection, with accompanying Learning Outcome and The Take-Home Message, on *Portion Distortion* to provide guidance on how to recognize healthy portion sizes to reduce the risk of weight gain.

Chapter 3: Digestion, Absorption, and Transport

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summary sections.
- Added a new Figure 3.12 summarizing the actions of digestive hormones.
- Added a new Figure 3.13 on how the cardiovascular and lymphatic systems transport nutrients.
- Added a new Figure 3.16 on the effects celiac disease has on the wall of the small intestine.
- Consolidated coverage of celiac disease and other digestive disorders into a new Health Connection with accompanying Learning Outcome and The Take-Home Message.

Chapter 4: Carbohydrates

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Created a new Figure 4.9 on absorption and storage of monosaccharides.
- Added a discussion of hypoglycemia to the section on regulating blood glucose.
- Added a new Focus Figure 4.23, *Diabetes*, showing the mechanisms involved in both type 1 and type 2 diabetes.
- Revised all carbohydrate food source diagrams to feature new foods.
- Added a discussion of glycemic index and glycemic load to the section on best food sources of carbohydrates.
- Created a new Examining the Evidence feature, *Do Sugar-Sweetened Beverages Cause Obesity?*
- Updated coverage of sugar substitutes.
- Relocated Health Connection on diabetes and included Learning Outcome and The Take-Home Message.

Chapter 5: Lipids

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Revised headings to clarify when the discussion covers lipids in general or triglycerides specifically.
- Revised the Focus Figure 5.16, *Lipid Digestion and Absorption*.
- Created a new Figure 5.15, *Lipoproteins,* to illustrate the both the size and compositions differences between the lipoproteins.
- Created a new Figure 5.18 on the metabolism of linoleic acid and alpha-linolenic acid.
- Moved both Figure 5.19 on the production of bile from cholesterol and Figure 5.20 on the phospholipid bilayer to the section discussing the roles of phospholipids and cholesterol in the body.
- Revised all lipid food source diagrams to feature new foods.
- Updated the research on the Mediterranean Diet in a new Spotlight box and added a new figure of the latest Healthy Mediterranean Diet Pyramid.
- Added a new Examining the Evidence feature, *Is Coconut Oil the Next Superfood?*
- Updated the Health Connection on heart disease and added a Learning Outcome and The Take-Home Message.
- Created a new Focus Figure 5.25, *Atherosclerosis*.

Chapter 6: Proteins

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Revised Figure 6.1 on the structural differences between carbohydrates, proteins, and fats.
- Revised Figure 6.2 on the organization and shape of proteins.
- Modified Focus Figure 6.6 on the digestion and absorption of protein.
- Revised Focus Figure 6.7 on protein synthesis.
- Modified Figure 6.9 on deamination and transamination.
- Moved coverage of amino acid score, PDCAAS, biological value, protein quality to the section discussing food sources of protein.
- Updated the statistics and references in the Examining the Evidence feature, *Does Soy Reduce the Risk of Disease?*
- Revised all protein food source diagrams to feature new foods.
- Expanded the Health Connection on vegetarian diets, with accompanying Learning Outcome and The Take-Home Message, to include benefits and potential risks of vegetarian diets.
- Added Figure 6.20, *MyVeganPlate*.

Chapter 7: Alcohol

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Reorganized the order of the topics presented and updated latest statistics and research.
- Moved content on reasons for drinking into its own section with Learning Outcome and The Take-Home Message.
- Moved content on short-term effects of alcohol into its own section with Learning Outcome and The Take-Home Message.
- Expanded the coverage of the negative impact of alcohol consumption, including the statistics on depression.

- Moved *Figure 1, How Red Wine May Affect the Risk of Cardiovascular Disease* to the Examining the Evidence, *Does Moderate Alcohol Consumption Provide Health Benefits?*
- Expanded the information on the moderate consumption of alcohol to emphasize the age-related benefits not seen in younger adults.
- Expanded the content on alcohol abuse and alcoholism in the Health Connection, with accompanying Learning Outcome and The Take-Home Message, and updated statistics on the prevalence of different types of alcohol abuse.

Chapter 8: Energy Metabolism

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Modified references to high-energy electrons and hydrogen ions throughout the chapter.
- Created a new figure for the Chemistry Boost box that illustrates oxidation-reduction reactions.
- Revised Figure 8.5, *The Metabolic Fate of Food.*
- Created a new Table 8.2, *Glucogenic and Ketogenic Amino Acids*
- Revised Figure 8.11, *Fatty Acids Are Oxidized for Energy.*
- Revised Figure 8.13, *The Electron Transport Chain.*
- Revised explanation of electron transport chain and oxidative phosphorylation.
- Revised Figure 8.18, *The Metabolism of Alcohol.*
- Created a new Figure 8.19 to illustrate galactosemia.
- Expanded the Health Connection, with accompanying Learning Outcome and The Take-Home Message, on inborn errors of metabolism.

Chapter 9: Fat-Soluble Vitamins

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- For each fat-soluble vitamin, included the Learning Outcome at the beginning of the section, and added a new The Take-Home Message at the end.
- Revised all fat-soluble vitamin food source diagrams to feature new foods.
- Created a new Focus Figure 9.8, *Retinal and Its Role in Vision.*
- Revised Table 9.4 on the function, daily needs, food sources, toxicity, and deficiency of each fat-soluble vitamin.
- Moved the Nutrition in Practice on vitamin D deficiency to fall within the vitamin D section.
- Created a new Health Connection, with accompanying Learning Outcome and The Take-Home Message, on the role of vitamin supplements in good health.
- Added a new Figure 9.27 on dietary supplement labels.

Chapter 10: Water-Soluble Vitamins

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Revised Figure 10.1, *Digesting and Absorbing Water-Soluble Vitamins.*
- Moved Figure 10.3 on the functions of B vitamins in energy metabolism to the section discussing the primary functions of water-soluble vitamins.
- Revised Table 10.1 on the function, daily needs, food sources, toxicity, deficiency, and active form of each water-soluble vitamin.
- For each water-soluble vitamin, included the Learning Outcome at the beginning of the section, and added a new The Take-Home Message at the end.

- Revised all water-soluble vitamin food source diagrams to feature new foods.
- Revised Figure 10.16, *Pantothenic Acid and Energy Metabolism.*
- Revised Figure 10.20, *Vitamin B_6 Assists in Transamination.*
- Revised Figure 10.23, *The Digestion of Folate*
- Added new Figure 10.28 on the absorption of vitamin B_{12}, including the reactions of vitamin B_{12} with the R protein and intrinsic factor in the gastrointestinal tract.
- Revised discussion of how folate deficiency may mask vitamin B_{12} deficiency.
- Updated the information in the Examining the Evidence feature on vitamin C and the common cold.
- Added a new Health Connection, with accompanying Learning Outcome and The Take-Home Message, on the role of a healthy diet and lifestyle in cancer risk.

Chapter 11: Water

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Revised Figure 11.1, *The Composition of the Body.*
- Revised Figure 11.5, *Sources of Body Water and Routes of Excretion.*
- Updated the Examining the Evidence feature on bottled water to include the most recent research.
- Updated coverage of the health effects of too much or too little water with the latest research and moved into a new Health Connection, with accompanying Learning Outcome and The Take-Home Message,
- Added a new Focus Figure 11.12, *Fluid Balance during Exercise.*

Chapter 12: Major Minerals

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Revised Table 12.2 on the function, daily needs, food sources, toxicity, and deficiency, of each major mineral.
- For each major mineral, included the Learning Outcome at the beginning of the section, and added a new The Take-Home Message at the end.
- Revised all major mineral food source diagrams to feature new foods.
- Revised Figure 12.4, *Sodium Helps Transport Some Nutrients.*
- Revised Figure 12.8 to illustrate the size of a kidney stone.
- Created a new Focus Figure 12.11 on the hormonal regulation of blood calcium levels.
- Revised and updated the content on bone mass and osteoporosis in the Health Connection, with accompanying Learning Outcome and The Take-Home Message.

Chapter 13: Trace Minerals

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Revised Table 13.1 on the function, daily needs, food sources, toxicity, deficiency, and interaction of each trace mineral.
- For each trace mineral, included the Learning Outcome at the beginning of the section, and added a new The Take-Home Message at the end.
- Revised all trace mineral food source diagrams to feature new foods.
- Expanded the Health Connection, with accompanying Learning Outcome and The Take-Home Message, to include the causes, symptoms, testing, and treatment for both microcytic and macrocytic anemia.

- Revised Figure 13.18 compares healthy red blood cells to microcytic and macrocytic red blood cells affected by anemia.

Chapter 14: Energy Balance and Body Composition

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Added a new Focus Figure 14.1 describing energy balance, negative energy balance, and positive energy balance.
- Expanded discussion of the health risks associated with underweight and overweight.
- Added Table 14.6 defining the terms underweight, overweight, and obesity classified by BMI.
- Added Table 14.7 listing different methods of classifying obesity in adults.
- Created a new Health Connection, with accompanying Learning Outcome and The Take-Home Message, on disordered eating using updated content previously located in Chapter 15.
- Added Table 14.8 presenting the diagnostic criteria for classifying eating disorders.
- Added Table 14.9 explaining the warning signs associated with eating disorders.
- Added a Self-Assessment feature, *Are You At Risk for an Eating Disorder?*

Chapter 15: Weight Management

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Updated all statistics about the prevalence of overweight and obesity.
- Added new information on weight bias and discrimination and the classification of obesity as a disease by the AMA.
- Created a new Figure 15.1 describing the cost of treating obesity in America.
- Created a new Focus Figure 15.2 on hormonal regulation of hunger and satiety.
- Created a new Figure 14.4 illustrating lipoprotein lipase activity in lean, overweight, and obese adults.
- Included a new section on the role of nutrigenomics and epigenetics in obesity and weight management.
- Created a new Figure 15.5 on the structure of an epigenome.
- Added a discussion of decreased physical activity due to the prevalence of the automobile.
- Added a new Examining the Evidence feature on carbohydrates and their role in obesity.
- Expanded the discussion on low-energy-density foods as they relate to weight management.
- Added a new Examining the Evidence feature on microbiomes and their possible link to obesity.
- Added a new Examining the Evidence feature on whether anaerobic or aerobic exercise is the most effective for weight loss.
- Revised and updated the content on obesity medications and bariatric surgery in the Health Connection feature, with accompanying Learning Outcome and The Take-Home Message.

Chapter 16: Nutrition and Fitness

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Added a new Focus Figure 16.5 on energy sources that fuel different levels of activity.

- Added a new Table 16.3 on the timing of foods and amount of macronutrients needed to improve exercise performance.
- Added a new Nutrition in Practice on an athlete, which introduces the student to the process of nutrition counseling and dietetics in a real-world setting.
- Revised the Spotlight feature on the female athlete triad with the latest diagnostic terminology.
- Created a new Health Connection, with accompanying Learning Outcome and The Take-Home Message, on the role of various dietary supplements in exercise performance and fitness.
- Added discussion of the potential risks and benefits of bicarbonate loading and amino acid supplementation.

Chapter 17: Life Cycle Nutrition: Pregnancy through Infancy

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Revised coverage of fetal health risks associated with pregnancy in overweight or underweight women with latest research.
- Revised coverage of fetal health risks associated with drug use during pregnancy.
- Revised discussion of goals for weight gain during pregnancy.
- Revised discussions of iron and vitamin D needs during pregnancy to emphasize the value of supplementation for most women.
- Revised Figure 17.8, *The Letdown Response.*
- Revised coverage of the relationship between breast-feeding and risk of developing food allergies with latest research.
- Updated discussion of feeding infants juice with the latest recommendations from the AAP.
- Updated the Health Connection on food allergies and added a Learning Outcome and The Take-Home Message.

Chapter 18: Life Cycle Nutrition: Toddlers through Adolescence

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Updated discussion of young children's iron needs.
- Revised Figure 18.3 on the USDA's SuperTracker website.
- Revised coverage of the National School Lunch Program.
- Added discussion of the School Breakfast Program.
- Added a section on determining childhood overweight and obesity.
- Updated Figure 18.4, *Increase in Overweight among U.S. Children and Adolescents.*
- Updated and expanded section on the factors contributing to overweight and obesity in children to include discussions of sugary beverages, genetics, family environment, targeting marketing, and peer influence.
- Updated the Examining the Evidence feature, *Does Sugar Cause Behavior Problems in Children?*
- Updated coverage of eating disorders in adolescents with latest research.
- Updated and expanded Health Connection, with accompanying Learning Outcome and The Take-Home Message, on health effects of childhood obesity to include risks of CVD and psychological problems, as well as approaches to obesity reduction and management.

Chapter 19: Life Cycle Nutrition: Older Adults

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Updated discussion of lifestyle factors that contribute to the leading causes of death in older Americans.
- Revised discussion of changes in body composition during aging.
- Created a new Table 19.1 on the recommended dietary changes for older adults.
- Updated the Examining the Evidence feature, *Does Kilocalorie Restriction Extend Life?*.
- Updated discussion of older adults' potential benefit from supplements with latest research.
- Revised coverage of Alzheimer's disease.
- Added a new Health Connection, with accompanying Learning Outcome and The Take-Home Message, on hypertension.

Chapter 20: Food Safety, Technology, and Availability

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Revised chapter opening section.
- Updated statistics throughout chapter.
- Revised Figure 20.1, *Bioaccumulation of Toxins*.
- Revised Figure 20.3 on cross-contamination.
- Updated Table 20.2, *Safe Food Temperatures*.
- Revised Table 20.3, *Agencies that Oversee the Food Supply*.
- Revised Figure 20.7, *The Farm-to-Table Continuum*.
- Moved coverage of label terms for animal foods to the section on the use of hormones and antibiotics.
- Updated and relocated discussion of organic food production.
- New Figure 20.13 of a sustainable systems framework.
- Updated coverage of genetically engineered food in a new Health Connection, with accompanying Learning Outcome and The Take-Home Message.

Chapter 21: Global Nutrition and Malnutrition

- Learning Outcomes tie into major headings, The Take-Home Messages, and Visual Chapter Summaries.
- Revised focus of chapter to address hunger as well as other forms of malnutrition, including overnutrition.
- Added a new section defining hunger, malnutrition, undernutrition, and overnutrition.
- Updated statistics about the prevalence of hunger and food insecurity in the United States and worldwide.
- Updated Figure 21.1, *Hunger in the United States*.
- Created new Figure 21.2 on world population growth.
- Added a new section on food deserts in the United States.
- Created a new Figure 21.3 showing food insecurity worldwide.
- Added new sections on food waste and nutrition transition to the discussion of malnutrition worldwide.
- Added new section on malnutrition in overweight and obese individuals.
- Created new Table 21.2, *Food Assistance Programs in the United States*.

- Added a new section on global programs addressing issues related to food and water supply.
- Revised discussion of health effects of chronic hunger in a new Health Connection, with accompanying Learning Outcome and The Take-Home Message.

Supplements

Mastering Nutrition with MyDietAnalysis with Pearson eText

www.masteringnutrition.pearson.com

The Mastering Nutrition with MyDietAnalysis online homework, tutorial, and assessment system delivers self-paced tutorials that provide individualized coaching, focus on your course objectives, and are responsive to each student's progress. Set up your course in 15 minutes with proven, assignable, and automatically graded nutrition activities that reinforce your course's learning outcomes.

- **Visual Chapter Summary Coaching Activities** review the main ideas of the chapter while incorporating engaging assessments.
- **NEW Focus Figure Narrated Walkthrough Coaching Activities** guide students through key nutrition concepts with interactive mini-lessons.
- **NEW MyDietAnalysis Personalized Diet Analysis Activities** provide students with hands-on diet analysis practice that can also be automatically graded.
- **Reading Quizzes** (20 questions per chapter) ensure that students have completed the assigned reading before class.
- **Dynamic Study Modules** help students study effectively by continuously assessing student performance and providing practice in areas where students struggle the most.
- **25 *ABC News* Videos** with quizzing bring nutrition to life and spark discussion on current hot topics in the nutrition field. They include multiple-choice questions that provide wrong-answer feedback to redirect students to the correct answer.
- **40 Nutrition Animations Activities** explain big-picture concepts that help students learn the hardest topics in nutrition. These animations have questions that provide wrong-answer feedback that address students' common misconceptions.
- **Math Video Coaching Activities,** accessible through Mastering, provide hands-on practice of important nutrition-related calculations.
- **Mobile-ready NutriTools Coaching Activities** allow students to combine and experiment with different food options and learn firsthand how to build healthier meals.
- **MP3 Chapter Summary** relate to chapter content and come with multiple-choice questions that provide wrong-answer feedback.
- **Access to *Get Ready for Nutrition*** gives students extra math and chemistry study assistance.
- **The Study Area** is broken down into learning areas and includes videos, animations, MP3s, and much more.

MyDietAnalysis Premium 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. MyDietAnalysis is available as a single sign-on to Mastering Nutrition.

- View a classwide nutritional average. MyDietAnalysis will allow you to see a nutritional profile of your entire class, enabling you to base your lecture on your students' needs.
- Video help with associated quizzes covers the topics students struggle with most.
- A mobile website version of MyDietAnalysis is also available for mobile devices.

Learning Catalytics

Learning Catalytics is a "bring your own device" student engagement, assessment, and classroom intelligence system that allows students to use their smartphones, tablets, or laptops to respond to questions in class. With Learning Catalytics, you can assess students in real-time using open ended question formats to uncover student misconceptions and adjust lecture accordingly and automatically create groups for peer instruction based on student response patterns, to improve discussion productivity.

Digital Instructional Resources

These valuable teaching resources include everything you need to create lecture presentations and course materials, including JPEG and PowerPoint® files of all the art, tables, and selected photos from the text, and "stepped-out" art for selected figures from the text, as well as animations, all available for download from within Mastering Nutrition or www.pearson.com.

The Digital Instructional Resources includes:

- PowerPoint lecture outlines with links to Nutrition Animations and *ABC News* Lecture Launcher Videos
- Media Link PowerPoint slides for easy importing of videos and animations
- PowerPoint slides with a Jeopardy-type quiz show
- Questions for Classroom Response Systems (CRS) in PowerPoint format, allowing you to import the questions into your own CRS
- Instructor's Resource and Support Manual
- Test Bank (Microsoft® Word, RTF, and PDF files) and Computerized Test Bank
- Introduction to Mastering Nutrition
- Introductory video for Learning Catalytics
- *East Right! Healthy Eating in College and Beyond*
- *Food Composition Table*

Acknowledgments

It takes a village, and then some, when it comes to writing a dynamic textbook. *Nutrition: From Science to You* is no exception. We personally want to extend our gratitude to all of those who passionately shared their expertise and support to make *Nutrition: From Science to You* better than we could have envisioned.

Beginning with the energetic staff at Pearson, we would like to thank Michelle Yglecias, who helped make our vision for this textbook into a reality. Laura Bonazzoli's comprehensive developmental editing improved the clarity of *Nutrition: From Science to You* and made it more enjoyable to read. A special thank you to Barbara Yien, Director of Development, as well, for helping steer the ship while Michelle Yglecias was on maternity leave.

Crackerjack Rich Media Content Producer Lucinda Bingham and Mastering Nutrition Content Development Lead Lorna Perkins worked diligently to create the best media supplements for *Nutrition: From Science to You*. Thanks also to editorial assistant Nicole Constantine for all of her behind-the-scenes work.

A very special thanks to Lizette Faraji, Content Producer, and Nathaniel Jones, Project Manager at SPi Global, for all of their hard work shepherding this book through to publication. Our humble appreciation also goes to Gary Hespenheide, whose design made the text, art, and photos all come alive; and to design manager Mark Ong.

Marketing takes energy, and that's exactly what Executive Product Marketing Managers Neena Bali, Alysun Burns, and Field Marketing Manager, Mary Salzman, generate nonstop. The many instructors who reviewed the first, second, and third editions, as well as those who reviewed and class-tested early versions of this book, are listed on the following pages. We are grateful to all of them for helping in the development of *Nutrition: From Science to You*.

The village also included loyal contributors who lent their expertise to specific chapters. They are: Whitney Evans, PhD of Brown University Alpert Medical Schoolwho revised the three "life cycle" chapters; Kellene Isom, MS, RD, LDN of Brigham and Women's Hospital, who overhauled and expanded the food safety, technology, and sustainability chapter; and Claire Alexander, who updated the global nutrition and malnutrition chapter.

Lastly, an endless thanks to our colleagues, friends, and especially our families. Joan would like to "thank my family, Adam, Brendan, and Craig for their love and support when I was working more than I should have been." Kathy sends a special thanks to "my husband Rich and our children Heather, Wes, and Ryan for keeping me sane and grounded, and my sister Vicki for her steadfast support." Stella would like to acknowledge "my husband, Gary Snyder, for his constant support; and our wonderful dogs, Sasha and Bear, for always making me smile! And to my Mom and Dad, who both instilled in me a wonderful relationship with food, especially home grown and homemade food."

Reviewers

First Edition

Janet Anderson
Utah State University

Sandra Baker
University of Delaware

Gita Bangera
Bellevue College

Lisa Blackman
Tarrant County College, Northwest

Jeanne Boone
Palm Beach State College

John Capeheart
University of Houston-Downtown

Susan Chou
American River College

Nicole Clark
Indiana University of Pennsylvania

Susan Cooper
Montana State University-Great Falls College of Technology

Jessica Coppola
Sacramento City College

Lynn Monahan Couch
West Chester University of Pennsylvania

Wendy Cunningham
California State University, Sacramento

Jeannette Davidson
Bradley University

Holly Dieken
The University of Tennessee at Chattanooga

Johanna Donnenfield
Scottsdale Community College

Roberta Durschlag
Boston University

Brenda Eissenstat
The Pennsylvania State University

Sheryl L. Fuller-Espie
Cabrini College

Eugene J. Fenster
Metropolitan Community College, Longview

Alyce D. Fly
Indiana University

Sara Folta
Tufts University

Betty Forbes
West Virginia University

Sue Fredstrom
Minnesota State University, Mankato

Teresa Fung
Simmons College

Susan Gaumont
Chandler-Gilbert Community College

Jill Golden
Orange Coast College

Gloria Gonzalez
Pensacola State College

Donna Handley
The University of Rhode Island

William Helferich
University of Illinois at Urbana-Champaign

Catherine Howard
Texarkana College

Karen Israel
Anne Arundel Community College

Seema Jejurikar
Bellevue College

Jayanthi Kandiah
Ball State University

Vicki Kloosterhouse
Oakland Community College

Allen Knehans
The University of Oklahoma

Kathy Knight
The University of Mississippi

Shui-Ming Kuo
University at Buffalo

Robert D. Lee
Central Michigan University

Sharon Lemons
Tarrant County College, Northwest

Darlene Levinson
Oakland Community College

Rose Martin
Iowa State University

Mary Martinez
Central New Mexico Community College

George F. McNeil
Fort Hays State University

Monica Meadows
The University of Texas at Austin

Kathleen Melanson
The University of Rhode Island

Mithia Mukutmoni
Sierra College

Pat Munn
Metropolitan Community College, Longview

Megan Murphy
Southwest Tennessee Community College

Dan Neisner
Walla Walla Community College

Corin Nishimura
Leeward Community College

Anna Page
Johnson County Community College

Jill Patterson
The Pennsylvania State University

Janet Peterson
Linfield College

Gwendolyn Pla
Howard University

Roseanne Poole
Tallahassee Community College

Linda Pope
Southwest Tennessee Community College

Elizabeth Quintana
West Virginia University

Denise Russo
Cabrillo College

Kevin Schalinske
Iowa State University

Diana Spillman
Miami University

Sherry Stewart
Navarro College

Leeann Sticker
Northwestern State University

Susan Swadener
California Polytechnic State University, San Luis Obispo

Janelle Walter
Baylor University

Sandy Walz
West Chester University of Pennsylvania

Daryle Wane
Pasco-Hernando State College

Garrison Wilkes
University of Massachusetts-Boston

Jessie Yearwood
El Centro College

Gloria Young
Virginia State University

Maureen Zimmerman
Mesa Community College

Second Edition

Ellen Brennan
San Antonio College

Wendy Buchan
California State University, Sacramento

Nicole A. Clark
Indiana University of Pennsylvania

Mary Dean Coleman-Kelly
The Pennsylvania State University

Eugene J. Fenster
Metropolitan Community College, Longview

Karen Friedman-Kester
Harrisburg Area Community College

Amy Frith
Ithaca College

Susan Edgar Helm
Pepperdine University

Shanil Juma
Texas Woman's University

Allen Knehans
The University of Oklahoma Health Sciences Center

Julia L. Lapp
Ithaca College

John Radcliffe
Texas Woman's University

Nancy L. Shearer
Cape Cod Community College

Eric Vlahov
The University of Tampa

Heidi Wengreen
Utah State University

Third Edition

Julie Albrecht
University of Nebraska Lincoln

Sandra Brown
University of Delaware

Donna M. Cain
Collin County Community College

Jana Gonsalves
American River College

Cindy Hudson
Hinds Community College

Ruth Anne McGinley
Harrisburg Area Community College

Judith Myhand
Louisiana State University

Rebecca Orr
Collin County Community College

John Radcliffe
Texas Woman's University

Jacqueline Vernarelli
Fairfield University

Stanley Wilfong
Baylor University

Fourth Edition

Valerie Amend
Ball State University

Carol Barnes
Mississippi College

Christina Sullivan
City College of San Francisco

Alison Borkowska
Pennsylvania State University

Wendy Buchan
California State University, Sacramento

Kevin Cooper
Sierra College

Rebecca Creasy
Texas A&M University

Yanyan Li
Husson University

Rosanna Licht
Pasco-Hernando State College

Marcia Magnus
Florida State University

Adam Pennell
California State University, Bakersfield

Shelia Taylor
Ozarks Technical Community College

Yolanda Williams
Harrisburg Area Community College, Harrisburg

Class Testers

Janet Anderson
Utah State University

Jeanne Boone
Palm Beach State College

Jessica Coppola
Sacramento City College

Robert Cullen
Illinois State University

Gloria Gonzales
Pensacola State College

Jill Goode-Englett
University of North Alabama

Debra Head
University of Central Arkansas

Lenka Humenikova-Shriver
Oklahoma State University

Allen Knehans
The University of Oklahoma

Janet Levin
Pensacola State College

Darlene Levinson
Oakland Community College

Anna Miller
De Anza College

Vijaya Narayanan
Florida International University

Anna Page
Johnson County Community College

Nancy Parkinson
Miami University

Renee Romig
Western Iowa Tech Community College

Janet Sass
Northern Virginia Community College, Annandale

Susan Swadener
California Polytechnic State University, San Luis Obispo

Janelle Walter
Baylor University

Suzy Weems
Baylor University

Jennifer Zimmerman
Tallahassee Community College

I am nothing without my ABCs. Thanks.

—Joan Salge Blake

I dedicate this to my family for their love and support that sustained me through the development of this book. And to my students, both present and past, for whom this book was written.

—Kathy D. Munoz

I would like to dedicate this book to my Mom, Felicetta Volpe, and my Dad, Antonio Volpe (in memory). I would also like to dedicate this book to my husband, Gary Snyder, and our dogs, Sasha and Bear.

—Stella Lucia Volpe

NUTRITION

From Science To You


99¢
LB.
FRESH WASHED
RED. DASH
99¢
BUNCH

What Is Nutrition? 1

Learning Outcomes

After reading this chapter, you will be able to:

- **1.1** Discuss the factors that drive our food choices.
- **1.2** Define the term *nutrition* and characterize nutrients.
- **1.3** Explain the primary roles of the six classes of nutrients found in food.
- **1.4** Describe the best approach to meeting your nutritional needs.
- **1.5** Summarize three ways in which diet influences health.
- **1.6** Summarize the ABCD method used to assess the nutrient status of individuals and populations.
- **1.7** Discuss the current nutritional state of the average American diet.
- **1.8** Describe the scientific method that leads to reliable and accurate nutrition information.
- **1.9** Explain how to identify reliable nutrition information and how to recognize misinformation.

True or False?

1. Food choices are driven primarily by flavor. T/F
2. Nutrition is the study of dietary supplements. T/F
3. Carbohydrates provide our main source of energy. T/F
4. Alcohol is a nutrient. T/F
5. Taking a dietary supplement is the only way to meet your nutrient needs. T/F
6. The most effective method of nutritional assessment is to ask clients to write down what they've eaten in the last 24 hours. T/F
7. About 25 percent of all Americans are obese. T/F
8. Eliminating all fat from the diet will reduce your risk of developing heart disease. T/F
9. Cancer is the leading cause of death in the United States. T/F
10. You can get good nutrition advice from anyone who calls him- or herself a nutritionist. T/F

See page 36 for the answers.

During the course of a day, we make over 200 decisions about food, from when to eat, how much to eat, and what to eat, to how the food is prepared, and even what size plate to use.[1] You make these decisions for reasons you may not even be aware of. If your dietary advice comes from media sound bites, you may receive conflicting information. Last week's news flash announced that eating more protein would help you fight a bulging waist. Yesterday's headline boldly announced that limiting sugary drinks was the key. This morning, the TV news lead was a health report on the weight-loss benefits of consuming more dietary fiber.

It can be frustrating when nutrition news seems to change daily, but the research behind this barrage of news illustrates the progress nutrition scientists are making toward understanding what we eat and how it affects our health. Today's research validates what nutrition professionals have known for decades: Nutrition plays an invaluable role in your health.

In addition to exploring the factors that affect food choice, this chapter introduces you to the study of nutrition. Let's begin with the basic concepts of why and what you eat, why a healthy diet is important to your well-being, and how you can identify credible sources of nutrition information.

What Drives Our Food Choices?

LO 1.1 Discuss the factors that drive our food choices.

Have you ever considered what drives your food choices? Or are you on autopilot as you stand in line at the sub shop and squint at yet another menu board? Do you enjoy some foods and eat them often, while avoiding others with a vengeance? You obviously need food to survive, but beyond your basic instinct to eat are many other factors that affect your food choices. These factors include taste and enjoyment; culture and environment; social life and trends; nutrition knowledge; advertising; time, convenience, and cost; and habits and emotions (**Figure 1.1**).

▲ **Figure 1.1 Many Factors Influence Your Food Choices**

Taste and Enjoyment

Research confirms that when it comes to making food choices, taste is the most important consideration.[2,3] This shouldn't be too much of a surprise, considering there are more than 10,000 taste buds in the mouth. These taste buds tell you that chocolate cheesecake is sweet, fresh lemon juice is sour, and a pretzel is salty. Our preferences for sweet, salty, or creamy foods may be influenced by our genes[4] and may change as we age.[5]

We have a taste for fat, which may also be genetically linked.[6] When fat is combined with sugar, such as in a sugar-laden doughnut, our preference for that food is even stronger.[7]

Texture also affects our likelihood of enjoying foods. We enjoy a flaky piecrust but dislike one that is tough; we prefer crunchy apples to mealy ones, and creamy rather than lumpy soups. Almost 30 percent of adults dislike slippery foods, such as oysters and okra.[8] Researchers have suggested that people's preferences for sweetness, high fat, and specific textures begin early in life and this makes them resistant to change.[9]

Culture and Environment

Roughly one in three Americans is of Hispanic, Native American, Asian, or African descent. Cultural food preferences often influence food choices.

Enjoying food is not just a physiological sensation. Other factors, such as our culture and the environment, also play a role in which foods we eat.[10] If you were a student in Mexico, you may regularly feast on corn tortillas and tamales, as corn is a staple of Mexican cuisines. In India, meals commonly include lentils with rice and vegetables, whereas Native Americans often enjoy stews of mutton (sheep), corn, vegetables, and berries. And, in Asian countries, rice likely would be front and center on your plate.

The environment in which its people live significantly influences a culture's cuisine. This includes the climate and soil conditions as well as the native plants and animals and the distance people live from rivers, lakes, or the ocean. Foods that are available and accessible are more likely to be regularly consumed than foods that are scarce. For example, native Alaskans feast on fish because it is plentiful, but eat less fresh produce, which is difficult to grow locally. For most Americans today, global food distribution networks have made eating only locally available foods less of an issue than in the past; however, the tendency persists for some food items.

Our food environment—the variety of food choices available, the size and shape of plates and glassware, the packaging of foods, and the types and amounts of food that are visible—has a strong influence on what and how much we consume. We eat more food when the serving plates are larger and drink less when beverages are served in taller glasses. Environmental cues also affect eating patterns. You are more likely to linger over a meal when the light is dimmed,[11] or quickly finish your meal when you are standing rather than sitting. Physical cues, such as a friend's empty appetizer plate covered with disposed-of cocktail sticks, may signal you to eat more of your appetizer.

Social Life and Trends

Every year on the fourth Thursday in November, approximately 48 million turkeys are consumed when Americans gather with family and friends to celebrate Thanksgiving.[12] A person is likely to eat more on Thanksgiving than on any other Thursday, and this is partly because of the number of people eating with them. Eating dinner with others has been shown to increase the size of the meal by over 40 percent, and the more people present at the meal, the more you'll eat.[13]

Eating is an important way to bond with others. Sharing a meal with family or friends stimulates conversation, creates traditions, and expands our food experiences. Although eating a quick meal in the campus cafeteria may not provide you the most healthy food options, it will allow you to socialize with classmates.

Eating junk food while watching sports or attending a sporting event sometimes seems like an American way of life.

For many people, activities such as watching a football game with fellow fans or going to a movie with friends often involve particular foods. More pizzas are sold on Super Bowl Sunday than on any other day of the year.[14] Movie theater owners bank on their patrons buying popcorn, candy, and beverages at the concession stand before heading in to watch the film.[15]

Food choices are also affected by popular trends. For instance, home cooks in the 1950s bought bags of "newfangled" frozen vegetables in order to provide healthy meals in less time. A few decades later, vegetables went upscale and consumers bought them as part of ready-to-heat stir-fry mixes. Today, shoppers pay a premium for bags of fresh veggies, like carrots, that have been prewashed and peeled, sliced, or diced, and they pay even more if the food is labeled "organic." In 2013 alone, Americans spent more than $35 billion on organic foods.[16] Millennials (people born between about 1980 and 2000) who are parents are the biggest group of consumers buying organic foods.

The USDA certifies that foods labeled "organic" are grown without the use of toxic and persistent pesticides or fertilizers.

Rates of fruit and vegetable consumption increased among consumers exposed to the FNV advertising campaign.

Food sustainability and food waste are also topics that are on the radar of restaurant patrons and shoppers, who may choose vegetarian meals or smaller portions out of concerns for the environment. Supermarkets provide dozens of choices in flavored and enhanced bottled teas and waters, which are trendy beverages among college students. As food manufacturers pour more money into research and development, who knows what tomorrow's trendy foods will be?

Nutrition Knowledge

Individuals may choose certain foods they associate with good health or avoid other foods they associate with poor health. For example, many Americans consume vegetables, fruits, and whole grains because they perceive them as healthy choices that can help them control their blood pressure or reduce their risk of colon cancer.[17] At the same time, many Americans worry about fried foods causing heart disease.

When it comes to weight management, some consumers believe that specific dietary components are the culprits behind weight gain. While 3 in 10 consumers believe that overeating any type of food will cause weight gain, one in four believe that sugar is more likely to cause you to pack on the pounds.[18]

The more aware you are of the effects of food choices on health, the more likely you are to make an effort to improve those choices. If you believe that choosing low-sodium foods will decrease your blood pressure or that eating yogurt with active cultures will improve your digestion, you are more likely to choose these foods. Many consumers are label-reading in the supermarket, checking the expiration date, Nutrition Facts panel, and ingredients list before buying a food product.[19]

Advertising

The food and beverage industry spends over $136 million annually on advertising.[20] Food companies spend these large sums on advertising for one reason: It works, especially on young people. American children view an estimated 30 hours of food commercials on the television annually, and more than half of these advertisements are for unhealthy foods.[21]

In contrast, commercials for fruits and vegetables are rare, which is unfortunate because healthy foods can be successfully marketed. The Fruit and Vegetable (FNV) campaign, the brainchild of the Partnership for a Healthier America (PHA), a nonprofit organization working with public, private, and nonprofit leaders to develop strategies to end childhood obesity, knows that celebrity marketing to kids is powerful. They recruited influential actors and athletes, all pro bono, to get kids to chow down more produce. Their research showed that 70 percent of individuals who were aware of FNV stated that they purchased and ate more fruits and vegetables after seeing or hearing about the campaign.[22]

Time, Convenience, and Cost

When it comes to making a meal, time is often at a premium. A recent survey reported that close to 60 percent of Millennials spend as little as 15 minutes cooking dinner during the week.[23] Consequently, supermarkets are now offering more prepared and partially prepared foods. If chicken is on the menu tonight, you can buy it uncooked at the meat counter in the supermarket, or you can go to the deli and buy it hot off the rotisserie, cooked and stuffed with bread crumbs or grilled with teriyaki sauce. Rice or pasta side dishes and cooked vegetables are also available to complete the meal.

Convenience has also become more of a factor in food selection. Foods that are easily accessible to you are more likely to be eaten. Decades ago, the most convenient way to get a hot cup of coffee was to brew it at home. Today, Americans are more likely to get their latte or half-caff from one of the 29,000 coffee shops across the United States.[24]

For reasons related to both time and convenience, people eat out more often today than they did a few decades ago. In the 1970s, Americans spent less of their household budget on eating out, compared with today.[25] Because cost is often an issue when considering where to eat out, most meals consumed away from home are fast food, which is often cheaper and quicker than more nutritious meals. Though cheap fast food may be easy on the pocketbook, it is taking its toll on the health of Americans. Epidemiological research suggests that low-cost, high-calorie diets, such as those that incorporate lots of burgers, fries, tacos, and soft drinks, increase the risk of obesity, especially among those at lower socioeconomic levels.[26]

The good news is that cheaper food doesn't have to always mean fast food, and when healthy foods are offered at lower prices, people do buy them. More Americans, especially urban Millennials, are opting for boxes of fresh fruits and vegetables or meal kits delivered directly to their door. They may eat home-cooked meals more often because of these services.[27]

Researchers have found that lowering the cost of fresh fruits and vegetables improves the consumption of these nutritious foods.[28] This suggests that price reductions are an effective strategy to increase the purchase of more-healthful foods.

Although brown rice is a healthy whole-grain addition to any meal, it generally takes almost an hour to cook. For time-strapped consumers, food manufacturers have developed brown rice that cooks in 10 minutes and a precooked, microwavable variety that reheats in less than 2 minutes.

Habits and Emotions

Your daily routine and habits often affect both when you eat and what you eat. For example, if you routinely start your day with a bowl of cereal, you're not alone. Ready-to-eat cereals are the number-one breakfast food choice among Americans.[29] Many individuals habitually snack when watching television or sitting at the computer.[30]

For some individuals, emotions can sometimes drive food choice: feeling happy or sad can trigger eating. In some cases, appetite is suppressed during periods of sadness or depression; in others, food is used as an emotional crutch during times of stress, depression, or joy.

LO 1.1: THE TAKE-HOME MESSAGE Taste and enjoyment are the primary reasons people prefer certain foods. A food's availability makes it more easily become part of a culture, and many foods can be regularly eaten out of habit. Advertising, food trends, limited time, convenience, emotions, and the perception that foods are healthy or unhealthy also influence food choices.

What Is Nutrition?

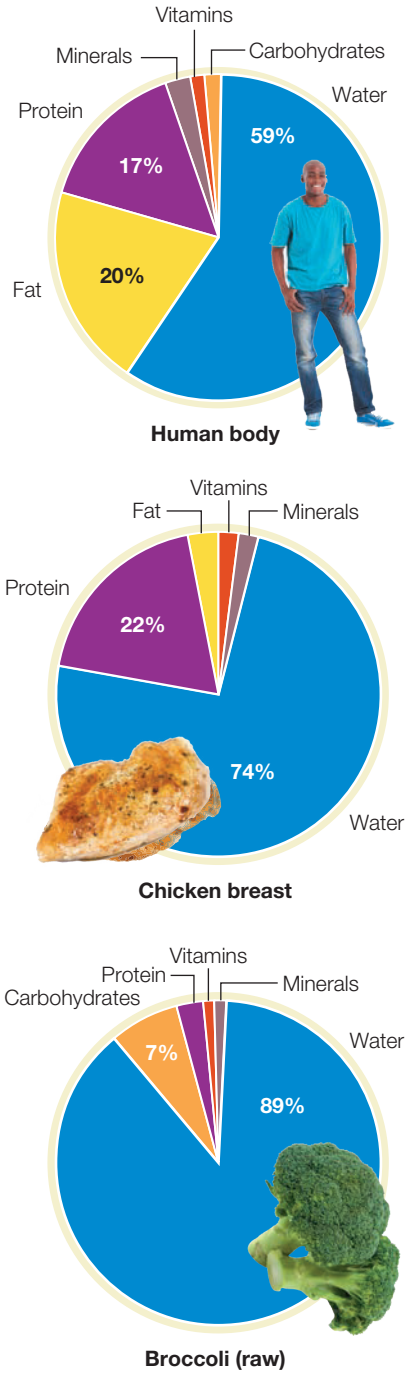
LO 1.2 Define the term *nutrition* and characterize nutrients.

The science of **nutrition** is the study of food and the nutrients we need to sustain life and reproduce. It examines the way food nourishes the body and affects health. Since its inception, the science of nutrition has explored how food is digested, absorbed, transported, metabolized, and used or stored in the body. Nutritional scientists study how much we need of each nutrient, the factors that influence our needs, and what happens if we don't consume enough. As with any science, nutrition is not stagnant. The more we discover about the relationship between nutrition and well-being, the greater the impact will be on long-term health.

nutrition Science that studies how nutrients and other components of foods nourish the body and affect body functions and overall health.

nutrients Compounds in foods that sustain body processes. There are six classes of nutrients: carbohydrates, fats (lipids), proteins, vitamins, minerals, and water.

essential nutrients Nutrients that must be consumed from foods because they cannot be made in the body in sufficient quantities to meet its needs and support health.



▲ **Figure 1.2 Nutrients in Foods and in the Body**
Water is the most abundant nutrient found in foods and in the body. Carbohydrates, fats, protein, vitamins, and minerals make up the rest. Note that foods also contain non-nutritive compounds, such as phytochemicals and fiber.

Nutrients Are Essential Compounds in Food

The body is one large organism made up of millions of cells that grow, age, reproduce, and die, all without your noticing. You slough off millions of skin cells when you towel off after a shower, yet your skin isn't noticeably thinner today than it was last week. Your body replaces skin cells at a rate fast enough to keep you covered, and it manufactures new cells using the same nutrients found in a variety of foods. As cells die, **nutrients** from food provide the building blocks to replace them. Nutrients also provide the energy we need to perform all body functions and processes, from maintaining heartbeat to playing tennis.

There are six categories of nutrients found in foods and in the body: carbohydrates, lipids (fats), protein, vitamins, minerals, and water. Foods also often contain beneficial non-nutrient compounds, such as phytochemicals or zoochemicals, and nondigestible fiber, as well as chemicals added by food manufacturers to enhance color, flavor, or texture or extend shelf-life.

Plant foods are made up of about 10 percent carbohydrates, fats, proteins, vitamins, and minerals (**Figure 1.2**). The rest is typically water, and plant foods contain more water (about 90 percent) than do animal foods (about 70 percent). Animal foods are composed of about 30 percent protein, lipids, vitamins, and minerals. One unique quality of animal foods, with the exception of dairy products, is that they do not contain any carbohydrates by the time we consume them.

A healthy human body is about 60 percent water. The other 40 percent is made up of protein and fat, as well as a small amount of stored carbohydrates, minerals in bone, and small amounts of vitamins. Thus, the old saying is true that *we are what we eat*, from the carbohydrates in broccoli to the proteins in meat. The six biochemical ingredients needed to sustain life are all provided by the foods in our diets.

In general, nutrients are **essential**—they must come from foods because either they cannot be made in the body at all, or they cannot be made in sufficient amounts to meet the body's needs. The body can make a few **nonessential nutrients** in sufficient quantities. An example is vitamin D, which is synthesized in the skin upon exposure to sunlight. Under some circumstances, *nonessential* nutrients can become *essential*. We refer to these nutrients as *conditionally essential*. If you are not exposed to enough sunlight, you will not be able to synthesize an adequate amount of vitamin D. You must then obtain vitamin D from foods and/or supplements.

Most Nutrients Are Organic

Carbohydrates, proteins, lipids, and vitamins are the most complex of the six classes of nutrients. These nutrients are **organic** because their chemical structures contain carbon. Organic nutrients also contain the elements hydrogen and oxygen, and in the case of proteins and some vitamins, nitrogen is also part of the molecule (**Figure 1.3**).

Minerals are the least complex of the nutrients. From calcium to zinc, each mineral is an individual element, and its atoms are exactly the same whether found in food or in the body. For instance, the structure of zinc found in lean meats and nuts is the same as that found in a cell membrane or a hair follicle. Minerals are **inorganic** because, as individual elements, they do not contain carbon. Water, a three-atom molecule composed of hydrogen and oxygen, is also inorganic. The Chemistry Boost will help you visualize elements and molecules.

Some Nutrients Provide Energy

All creatures need energy in order to function, and humans are no exception. **Energy** is defined as the capacity to do work. It also provides a source of heat. The body derives chemical energy from certain nutrients in foods, which store energy in their chemical

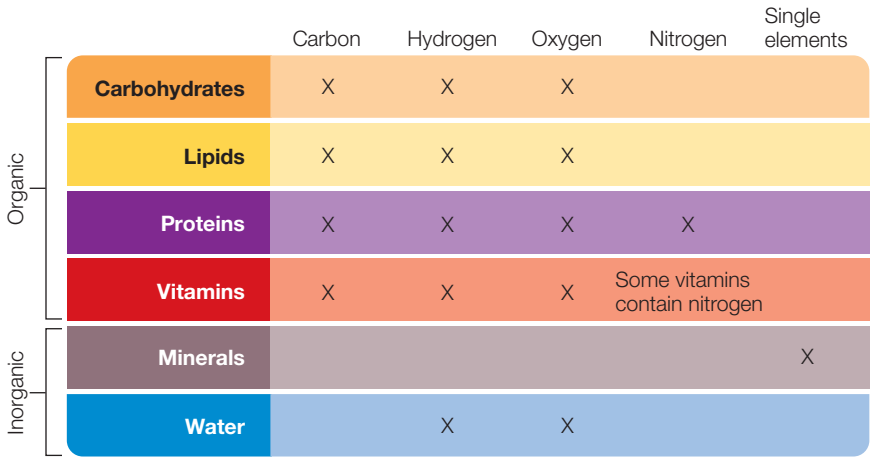


Figure 1.3 The Chemical Composition of the Six Classifications of Nutrients in Food
Each nutrient contains a unique combination of chemical elements.

bonds. During digestion and metabolism, the bonds are broken and the energy is released. This chemical energy released when the foods are digested can be converted into adenosine triphosphate (ATP), a form of energy the body can use. Carbohydrates, lipids (fats), and proteins are defined as the **energy-yielding nutrients** because they contribute energy to the body. Alcohol, although not a nutrient, also provides energy.

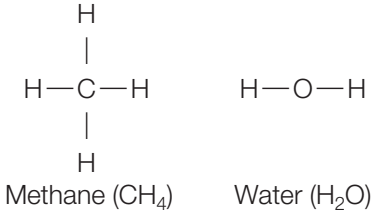
Scientists use the metric system to measure weight, volume, and distance. Grams are the fundamental units of measurement for weight; liters are the fundamental units for volume; and meters are the units used to measure distance. The metric system is a decimal system; that is, larger and smaller units are multiples or divisions of 100. For example, a kilogram is 1,000 grams (*kilo* = 1,000) and a centimeter is a hundredth of a meter (*cent* = 100). This uniform system of measurement allows scientists all over the world to share and compare data. Appendix B provides commonly used metric units.

Scientists measure the energy in foods in kilocalories. A **kilocalorie** is defined as the amount of energy needed to raise the temperature of one kilogram of water 1 degree

Chemistry Boost

Chemical Bonds

Most nutrients consist of carbon, hydrogen, and oxygen. These elements combine to form compounds through chemical reactions. An atom of each element can carry a positive or negative charge and can form a set number of bonds with other elements. For example, carbon can form bonds with four elements, hydrogen can form one bond, and oxygen can form two bonds, as illustrated below. Two or more atoms bonded together are called *molecules*. Molecular oxygen, for example, contains two oxygen atoms (O_2). Compounds are molecules containing two or more different elements. Water (H_2O) is a compound. Molecules tend to be more stable than atoms, and, like atoms, can carry a positive or negative charge. Charged atoms or molecules are called *ions*.



Methane (CH_4) Water (H_2O)

nonessential nutrients Nutrients that can be made in sufficient quantities in the body to meet the body's requirements and support health.

organic Describing compounds that contain carbon or carbon–carbon bonds.

inorganic Describing elements or compounds that do not contain carbon.

energy Capacity to do work.

energy-yielding nutrients Three nutrients that provide energy to the body to fuel physiological functions: carbohydrates, lipids, and protein.

kilocalorie Amount of energy required to raise the temperature of 1 kilogram of water 1 degree centigrade; used to express the measurement of energy in foods; 1 kilocalorie is equal to 1,000 calories.

Celsius. A kilocalorie is not the same as a *calorie* (with a lowercase *c*), which is a much smaller unit of measurement. (In fact, a "calorie" is so small that one slice of bread contains about 63,000 calories.) One kilocalorie is equal to 1,000 calories.

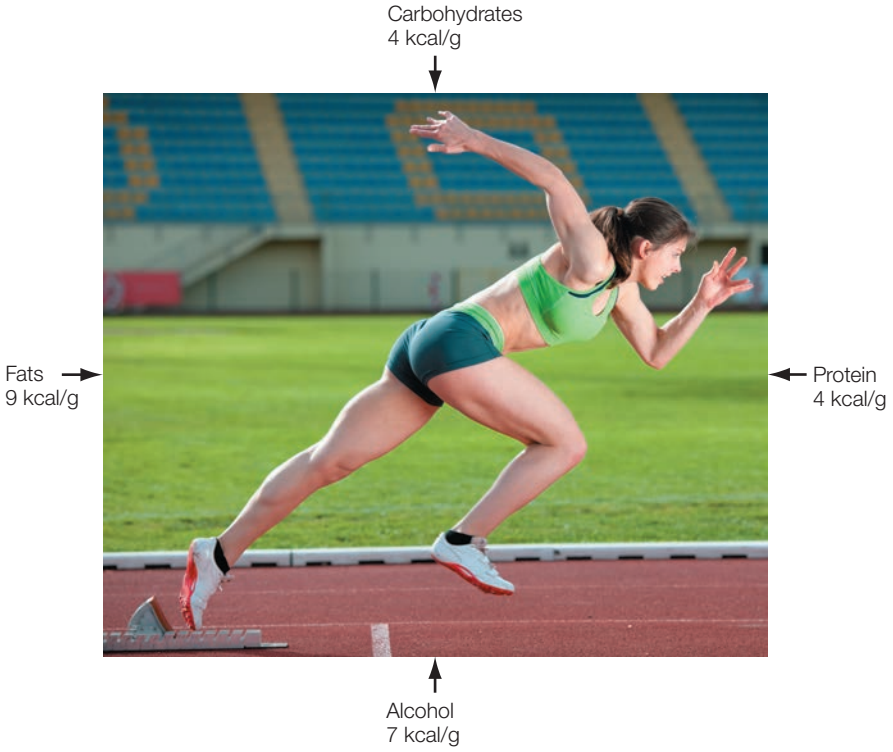
To add to the confusion, the term *Calorie* (with an uppercase *C*) is used on nutrition labels to express the energy content of foods and is often used in science textbooks to mean kilocalories. This text refers to the units of energy found in foods as kilocalories, abbreviated *kcalories* or *kcals*.

Each energy-yielding nutrient provides a set number of kilocalories per gram. Thus the number of kilocalories in one serving of a given food can be determined based on the amount (in grams) of carbohydrates, protein, and fat in the food. Carbohydrates and protein provide 4 kilocalories per gram; so, for example, a food that contains 5 grams of carbohydrate and 3 grams of protein would have 32 kilocalories ($[5 \times 4] + [3 \times 4] = 32$). Fats yield 9 kilocalories per gram, more than twice the number of kilocalories in either carbohydrates or protein. Alcohol contains 7 kilocalories per gram, which must be taken into account when calculating the energy of alcohol-containing foods and beverages (**Figure 1.4**).

Use the Calculation Corner to determine the number of kilocalories in a snack of potato chips and cola.

Energy in foods and in the body is trapped within the bonds that keep the molecules together. When the bonds are broken during the process of metabolism, a significant amount of energy, including some heat, is released. The energy can then be used to digest and absorb the meal, contract muscles, fuel the heartbeat, synthesize new cells, and perform other functions. The Chemistry Boost will help you visualize covalent bonds.

People's energy needs vary according to their age, gender, and activity level. Males generally need more energy because they weigh more and have more muscle mass (which



▸ **Figure 1.4 The Energy-Yielding Nutrients and Alcohol Provide Kilocalories**
Carbohydrates, fats, and protein provide energy, or kilocalories, to fuel the body. Alcohol also contains kilocalories.