

WARDLAW'S

Perspectives in

Nutrition

12e

Carol Byrd-Bredbenner
Jacqueline Berning
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WARDLAW'S PERSPECTIVES IN NUTRITION, TWELFTH EDITION

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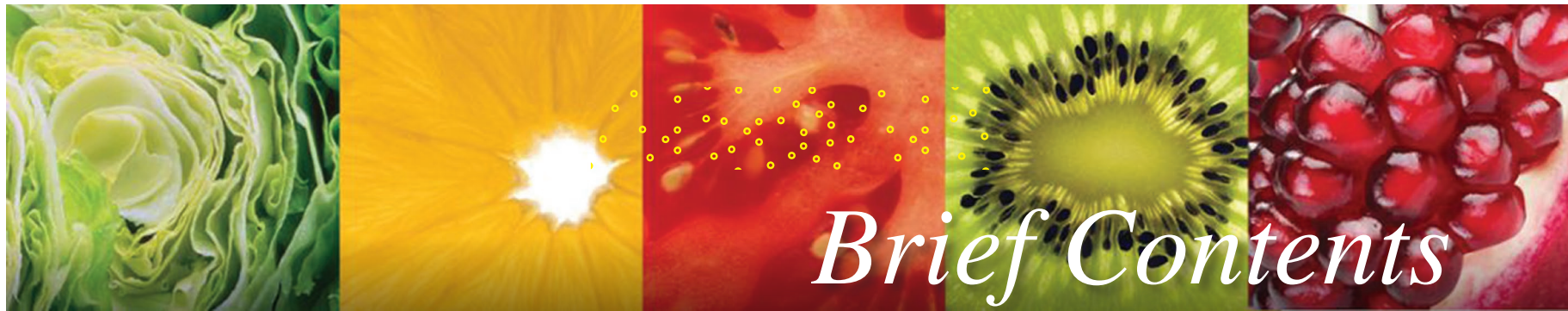
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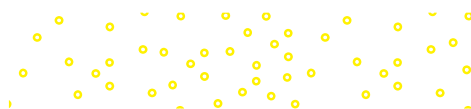
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Meet the Author Team



Carol Byrd-Bredbenner, Ph.D., R.D., FAND, received her doctorate from Pennsylvania State University. Currently, she is Distinguished Professor in the Nutritional Sciences Department at Rutgers, The State University of New Jersey. She teaches a wide range of undergraduate and graduate nutrition courses. Her research interests focus on investigating environmental factors that affect dietary choices and health outcomes. Dr. Byrd-Bredbenner has authored numerous nutrition texts, journal articles, and computer software packages. She has received teaching awards from the American Dietetic Association (now called the Academy of Nutrition and Dietetics), Society for Nutrition Education, and U.S. Department of Agriculture. She was the recipient of the American Dietetic Association's Anita Owen Award for Innovative Nutrition Education Programs, American Society for Nutrition's Excellence in Nutrition Education Award, and Society for Nutrition Education and Behavior's Helen Denning Ullrich Award for Lifetime Excellence in Nutrition Education. She also was a Fellow of the United Nations, World Health Organization at the WHO Collaborating Center for Nutrition Education, University of Athens, Greece. She enjoys exploring food and culinary customs, traveling, diving, and gardening.

Jacqueline R. Berning, Ph.D., R.D., CSSD, earned her doctorate in nutrition from Colorado State University in Fort Collins, Colorado. She is currently Professor and Chair of the Health Science Department at the University of Colorado at Colorado Springs (UCCS), where she has won numerous teaching awards. Dr. Berning is published in the area of sports dietetics and was the sport dietitian for the Denver Broncos for over 25 years, Cleveland Indians for 18 years, and Colorado Rockies for 10 years. Currently, she is the sport dietitian for UCCS athletics and U.S. Lacrosse. She is active in the Academy of Nutrition and Dietetics, where she served as Chair of the Program Planning Committee for FNCE and is currently Chair of the Appeals Committee. In 2014, Dr. Berning was awarded the Mary Abbot Hess Award for Culinary Events for teaching the University of Colorado football team how to grocery shop and cook. Additionally, she served 6 years as an ADA spokesperson and is former Chair of the Sports, Cardiovascular, and Wellness Nutritionists dietetics practice group. She enjoys walking, hiking, and gardening.



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Danita Saxon Kelley, Ph.D., R.D., earned her doctorate in nutritional sciences from the University of Kentucky. She serves as Associate Dean of the College of Health and Human Services and is a Professor in the Family and Consumer Sciences Department at Western Kentucky University. Previously, Dr. Kelley was Director of the Didactic Program in Dietetics at Western Kentucky University. She is a Past President of the Board of Directors for the Kentucky Academy of Nutrition and Dietetics. Her scholarly work has focused on adolescents' eating patterns, the communication skills of dietetic students, histaminergic activity and regulation of food intake, and dietary restriction effects on the antioxidant defense system. She has received awards for teaching from the Kentucky Academy of Nutrition and Dietetics and the Dietetic Educators of Practitioners of the Academy of Nutrition and Dietetics. She enjoys singing, walking her dog, cheering for her family in water-ski competitions, and watching her children participate in athletic and musical endeavors.

Jaclyn Maurer Abbot, Ph.D., R.D., earned her doctorate in nutritional sciences at the University of Arizona. She is a Registered Dietitian Nutritionist and adjunct lecturer in the Nutritional Sciences Department at Rutgers, The State University of New Jersey. She teaches online undergraduate courses in nutrition and health and introductory sports nutrition. Her research focuses on nutrition communication and health promotion on an array of topics, including safe food handling, nutrition for optimizing fitness performance, nutrition knowledge and behavior, and disease prevention. She has delivered her research findings via formal classroom teaching, outreach programming, and peer-reviewed journals. She enjoys running, coaching youth sports, and spending time with her husband and 3 young children.





Preface

Welcome to the Twelfth Edition of Wardlaw's Perspectives in Nutrition

Wardlaw's Perspectives in Nutrition has the richly deserved reputation of providing an accurate, current, in-depth, and thoughtful introduction to the dynamic field of nutrition. We have endeavored to build upon this tradition of excellence by enriching this edition for both students and instructors. Our passion for nutrition, our genuine desire to promote student learning, and our commitment to scientific accuracy, coupled with constructive comments from instructors and students, guided us in this effort. Our primary goal has been to maintain the strengths and philosophy that have been the hallmark of this book yet continue to enhance the accessibility of the science content and the application of materials for today's students.

Nutrition profoundly affects all of our lives every day. For the authors, as well as many other educators, researchers, and clinicians, this is the compelling reason for devoting our careers to this dynamic field. The rapid pace of nutrition research and provocative (and sometimes controversial) findings challenge us all to stay abreast of the latest research and understand its implications for health. We invite you to share with us topics that you believe deserve greater or less attention in the next edition.

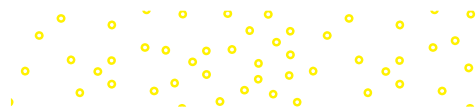
To your health!

Carol Byrd-Bredbenner

Jacqueline Berning

Danita Kelley

Jaclyn Maurer Abbot





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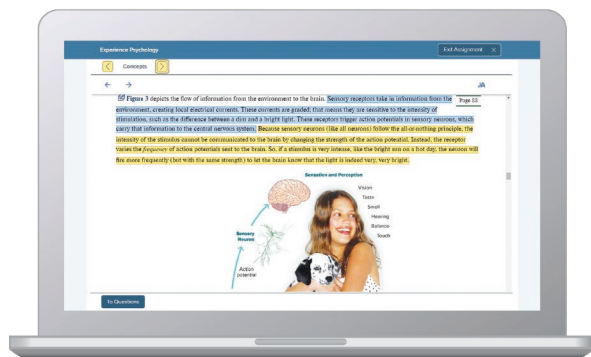
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— Jordan Cunningham,
Eastern Washington University



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Saves students and instructors time while improving performance



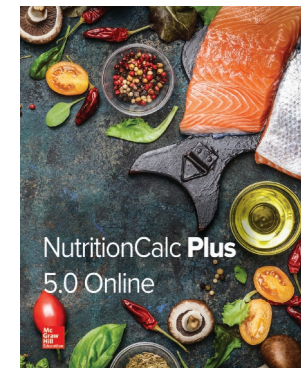
McGraw Hill Campus integrates all of your digital products from McGraw Hill with your school's Learning Management System for quick and easy access to best-in-class content and learning tools.

Dietary Analysis Tools

NutritionCalc Plus is a powerful dietary analysis tool featuring more than 30,000 foods from the ESHA Research nutrient database, which is comprised of data from the latest USDA Standard Reference database, manufacturers' data, restaurant data, and data from literature sources. NutritionCalc Plus allows users to track food and activities, then analyze their choices with a robust selection of intuitive reports. The interface was updated to accommodate ADA requirements and modern mobile experience native to today's students. This tool is provided complimentary in Connect with *Perspectives in Nutrition*.

Dietary Analysis Case Studies One of the challenges instructors face with teaching nutrition classes is having time to grade individual dietary analysis projects. To help overcome this challenge, assign auto-graded dietary analysis case studies. These tools require students to use NutritionCalc Plus to analyze dietary data, generate reports, and answer questions to apply their nutrition knowledge to real-world situations. These assignments were developed and reviewed by faculty who use such assignments in their own teaching. They are designed to be relevant, current, and interesting!

Assess My Diet Students are using NutritionCalc Plus to analyze their own dietary patterns. But how can instructors integrate that information into a meaningful learning experience? With Assess My Diet, instructors can now assign auto-graded, personalized dietary analysis questions within Connect. These questions refresh their memory on the functions and food sources of each nutrient and prompt the students to evaluate their own eating behaviors. Students can evaluate their own nutrient intakes compared to current Dietary Reference Intakes and demonstrate their ability to perform calculations on their own data, such as percent of calories from saturated fat. They can compare the nutrient density of their own food selections to see which of their food choices provides the most fiber or iron. A benefit of the Assess My Diet question bank is that it offers assignable content that is personalized to the students' data, yet it is still auto-graded. It saves time and keeps all assignments in one place.



Presentation tools allow you to customize your lectures

Enhanced Lecture Presentations Contain lecture outlines, art, photos, and tables. Fully customizable, adapted for ADA compliance, complete, and ready to use—these presentations will streamline your work and let you spend less time preparing for lecture!

Editable Art Fully editable (labels and leaders) line art from the text

Animations Over 50 animations bring key concepts to life, available for instructors *and* students.

Digital Lecture Capture

Tegrity® is a fully automated lecture capture solution used in traditional, hybrid, “flipped classes” and online courses to record lessons, lectures, and skills.

Virtual Labs and Lab Simulations Virtual Labs

While the sciences are hands-on disciplines, instructors are now often being asked to deliver some of their lab components online, as full online replacements, supplements to prepare for in-person labs, or make-up labs.

These simulations help each student learn the practical and conceptual skills needed, then check for understanding and provide feedback. With adaptive pre-lab and post-lab assessment available, instructors can customize each assignment.

From the instructor's perspective, these simulations may be used in the lecture environment to help students visualize processes, such as digestion of starch and emulsification of lipids.

Connecting Students to Today's Nutrition

Our Intended Audience

This textbook was developed for students pursuing nutrition and health science careers as well as those wanting a better understanding of how nutrition affects their lives. Because this course often attracts students from a broad range of majors, we have been careful to include examples and explanations that are relevant to them and to include sufficient scientific background to make the science accessible to them. The appendices help students who wish to learn more or need assistance with the science involved in human physiology, chemistry, and metabolism.

To better bridge the span of differing science backgrounds and to enhance student interest and achievement of course objectives, we organized the presentation of the material within chapters to flow seamlessly from concrete to abstract learning. In chapters focusing on nutrients, for example, concrete concepts, such as food sources of the nutrients and recommended intakes, are introduced early in the chapter to create a framework for more abstract concepts, such as functions, digestion, and absorption.



Accurate, Current Science That Engages Students

The twelfth edition continues the tradition of presenting scientific content that is reliable, accurate, and up-to-date. This edition incorporates coverage of recent nutrition research, as well as the recent updates to consumer guidelines and tools—Dietary Guidelines for Americans, MyPlate, *Healthy People*, and the new Nutrition Facts panel. It also retains the in-depth coverage students need to fully understand and appreciate the role of nutrition in overall health and to build the scientific knowledge base needed to pursue health-related careers or simply live healthier lives. To enhance these strengths and promote greater comprehension, new research findings and peer-reviewed references are incorporated and artwork is enhanced to further complement the discussions. The presentation of complex concepts was scrutinized to increase clarity through the use of clear, streamlined, precise, and student-friendly language. Timely and intriguing examples, illustrative analogies, clinical insights, culinary perspectives, historical notes, future perspectives, and thought-provoking photos make the text enjoyable and interesting to students and instructors alike.

CLINICAL PERSPECTIVE

Food Protein Allergies



People with hypersensitivity to certain foods can be tested to determine which food allergens cause their symptoms.
Science Photo Library/Getty Images

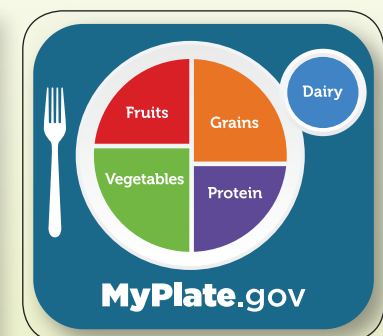
Allergies, including food allergies, involve responses of the immune system designed to eliminate foreign proteins (antigens). Food allergy responses occur when the body mistakenly reacts to a food as though it were a harmful invader. In some people, certain food components, typically proteins (called **allergens**), cause hypersensitivity reactions and trigger this response. These allergens stimulate white blood cells to produce antibodies (mostly, the **immunoglobulin IgE**) that bind to antigens and cause the symptoms associated with an allergic reaction.²¹

Fortunately, most allergic reactions are mild, such as a runny nose, sneezing, itching skin, hives, or digestive upset (indigestion, nausea, vomiting, diarrhea). For those who are severely allergic, exposure to the allergenic food may cause a generalized, life-threatening reaction involving all body systems (known as **anaphylaxis** or anaphylactic shock). Anaphylaxis causes decreased blood pressure

without immediate medical help. In the U.S., allergic reactions result in 200,000 emergency room visits and 150 to 200 deaths per year.

The protein in any food can trigger an allergic reaction. However, 8 foods account for 90% of all food allergies: peanuts, tree nuts (e.g., walnuts and cashews), milk, eggs, fish, shellfish, soy, and wheat (Fig. 7-16). Other foods frequently identified as causing allergic reactions are sesame seeds, meat and meat products, fruits, and cheese.

The only way to prevent allergic reactions is to avoid foods known to trigger reactions. Carefully reading food labels and asking questions when eating out are essential, perhaps life-saving, steps for those with food allergies.²¹ In addition, individuals preparing foods at home or in restaurants need to know their menu ingredients and take steps to ensure that foods that cause an allergic reaction in a person do not come in contact with the food to be served to that individual. Even trace amounts of an allergen can cause a reaction. To prevent




Connecting with a Personal Focus

Applying Nutrition on a Personal Level

A key objective in nearly all introductory courses is for students to apply their new knowledge of nutrition to their own lives. Practical applications clearly linked to nutritional science concepts are woven throughout each chapter to help students apply their knowledge to improving and maintaining their own health and that of others for whom they are responsible, such as future patients or offspring.

- **Take Action** features in each chapter allow students to examine their own diets and health issues.
- Updated **case studies** showcase realistic scenarios and thought-provoking questions.
- New discussion of the Nutrition Facts panel outlines the innovative changes to this important consumer tool.




Take Action

Estimate Your Fiber Intake

To roughly estimate your daily fiber consumption, determine the number of servings you ate yesterday from each food category listed here. Multiply the serving amount by the value listed and then add up the total amount of fiber. How does your total fiber intake for yesterday compare with the general recommendation of 28 g of fiber per day? If you are not meeting your needs, how could you do so?

Food Category	Size of 1 Serving	Number of Servings You Ate Yesterday	Average Grams Fiber per Serving	Grams Fiber
Vegetable				

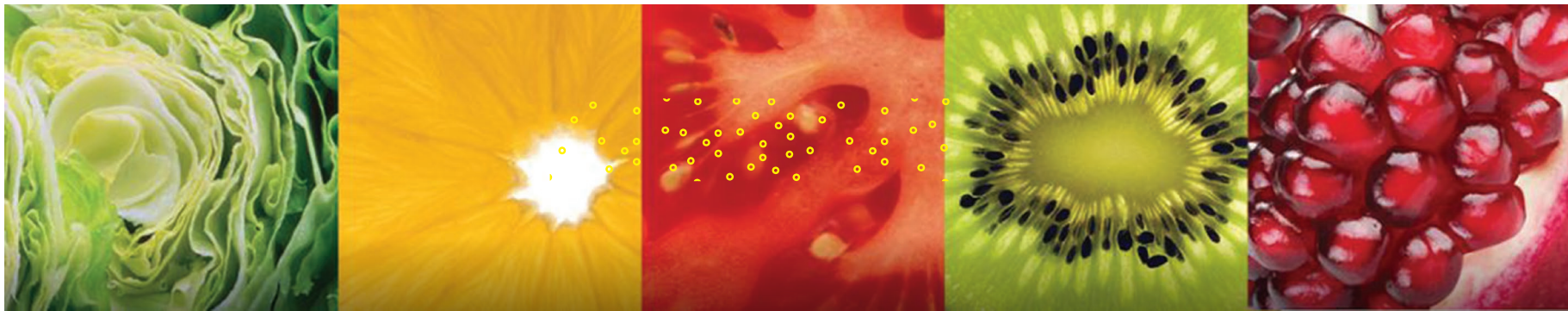
CASE STUDY FOLLOW-UP



Although the dish was cooked thoroughly, it was held at an unsafe temperature from the time it was removed from the oven at 1:00 P.M. until it was served at 6:00 P.M. This 5-hour time span greatly exceeded the maximum time of 2 hours at room temperature for a cooked food. This allowed the growth of a foodborne illness-causing pathogen. Ideally, this product should have been transported on ice in a cooler to the party, refrigerated at the party, and then reheated to 165°F (74°C) before serving at 6:00 P.M. Overall, it is risky to leave perishable items, such as meat, fish, poultry, eggs, and dairy products, at room temperature for more than 2 hours.

Applying Nutrition to Career and More

- **Expert Perspective from the Field** features examine cutting-edge topics and demonstrate how emerging, and sometimes controversial, research results affect nutrition knowledge and practice.
- **Clinical Perspectives** highlight the role of nutrition in the prevention and treatment of disease. These topics will be especially interesting to students planning careers in dietetics or health-related fields.
- **Global Perspectives** discuss concepts related to critical health and nutrition issues around the world. These timely features also aim to engage students with thought-provoking challenges.
- **Historical Perspectives** heighten awareness of critical discoveries and events that have affected our understanding of nutritional science.
- **Perspective on the Future** features address emerging trends affecting nutrition science and practice.
- **Culinary Perspectives** focus on interesting food trends and their impact on health.
- Each major heading in the chapters is numbered and cross-referenced to the end-of-chapter summary and study questions to make it easy to locate and prioritize important concepts.



HISTORICAL PERSPECTIVE



Photographing Atoms

Discovering the molecular layout of biologically important molecules is critical to understanding their function and treating disease. The biochemist and crystallographer Dorothy Crowfoot Hodgkin developed X-ray techniques that permitted her to determine the structure of over 10 molecules, including insulin, vitamin B-12, vitamin D, and penicillin. Her work with insulin improved the treatment of diabetes. Knowing the structure of vitamin B-12 advanced our knowledge of its role in blood health. Learn more about this Nobel Prize winner at www.nobelprize.org/prizes/chemistry/1964/hodgkin/biographical.

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Perspective on the Future

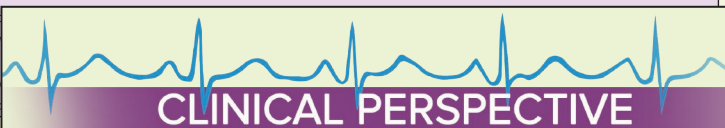
The common wisdom that eating 3500 kcal less than you need will result in the loss of 1 pound has come under great scrutiny. Weight loss research models based on thermodynamics, mathematics, physics, and chemistry indicate that many more than 3500 calories may be stored in a pound of body fat. Researchers have developed a body weight planner that allows users to make personalized calorie and physical activity plans to reach a goal weight.²⁴ Learn more at www.pbrc.edu/research-and-faculty/calculators/weight-loss-predictor.



Expert Perspective from the Field

Tailoring a Healthy Eating Plan to Fit Your Lifestyle

According to Dr. Judith Rodriguez,²⁵ finding your lifestyle is the key to controlling weight. Dr. Rodriguez groups diets based on lifestyle. Consumers match their lifestyles with products. You match what you like to eat or the c



CLINICAL PERSPECTIVE

Foodborne Illness Can Be De

Foodborne illness often means a few hours or even a few days of discomfort and then the illness resolves on its own. In some cases, though, foodborne illness causes more serious medical problems, which can have lifelong

GLOBAL PERSPECTIVE

How Big Is Your Footprint?

Growing evidence indicates that what we eat may affect not only our personal health but also that of the environment. The world population is projected to increase to over 9 billion by 2050. The Food and Agricultural Organization (FAO) projects that food and feed production will need to increase by 70% to adequately feed the world's population. Many scientists believe that meat rich diets and the agricultural practices that support the production of food for these diets negatively affect the environment. For instance, producing food for nonvegetarian diets (especially beef-based diets) uses more water, fossil fuel energy, and acres of farmland than producing food for vegetarian diets.²⁶ Meat rich diets also cause greater emissions of greenhouse gases, such as carbon dioxide, methane, and nitrous oxide, which are associated with global warming.²⁶ Scientists are concerned that continued population growth may, in turn, decrease agricultural productivity, reduce farmers' incomes, and increase global food insecurity.²⁷

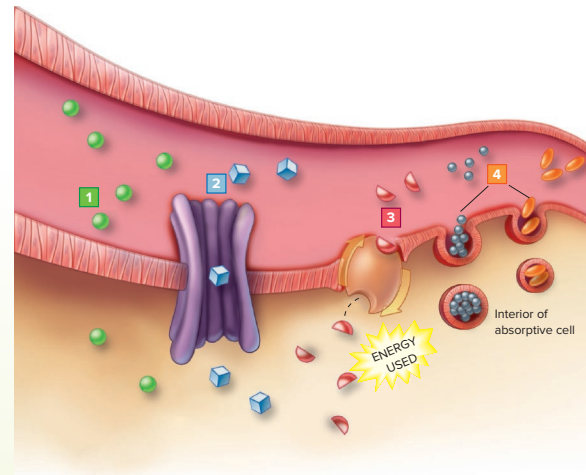
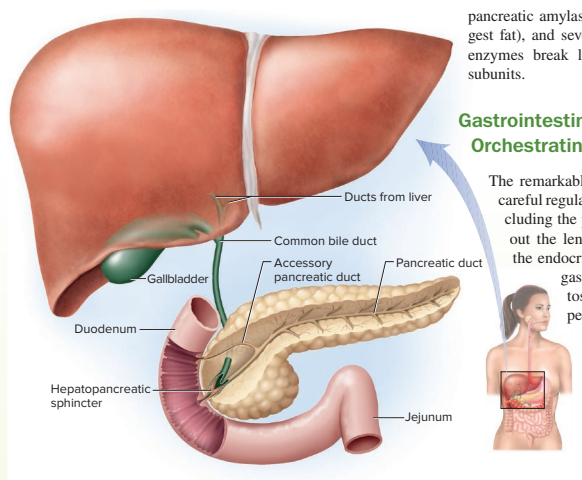
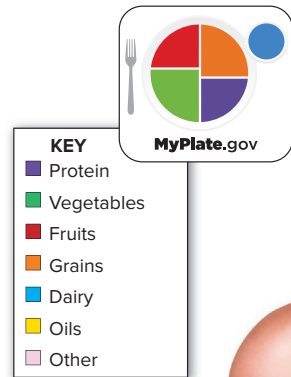
Not all scientists agree with these findings and concerns, however. Some believe that consuming a low-fat vegetarian diet with some dairy products and/or meat may actually increase land use efficiency, thereby protecting environmental resources and promoting food security.²⁸ They point out that high quality farmland is required to grow fruits, vegetables, and grains, whereas meat and dairy products can be produced on the more widely available, lower quality land. Even though diets containing meat use more land, they can feed more people because of the greater availability of lower quality farmland. It appears that diets have different "agricultural land footprints," depending on the amount of plant-based and animal-based food they contain. Supporters of mixed animal/vegetable-based diets point out that vegetarian diets often include tofu and other meat substitutes produced from soy, chickpeas, and lentils. Many meat substitutes are highly processed and require energy-intensive production methods. Thus, including small amounts of meat may offer both environmental and nutritional benefits.

Making Visual Connections

Dynamic, Accurate Artwork

More than 1000 drawings, photographs, and tables in the text were critically analyzed to identify how each could be enhanced and refined to help students more easily master complex scientific concepts.

- Many images were updated or replaced to inspire student inquiry and comprehension and to promote interest and retention of information.
- Many illustrations were redesigned to use brighter colors and a more attractive, contemporary style. Others were fine-tuned to make them clearer and easier to follow. Navigational aids show where a function occurs and put it in perspective of the whole body.
- Coordinated color schemes and drawing styles keep presentations consistent and strengthen the educational value of the artwork. Color-coding and directional arrows in figures make it easier to follow events and reinforce interrelationships.



The Guidelines

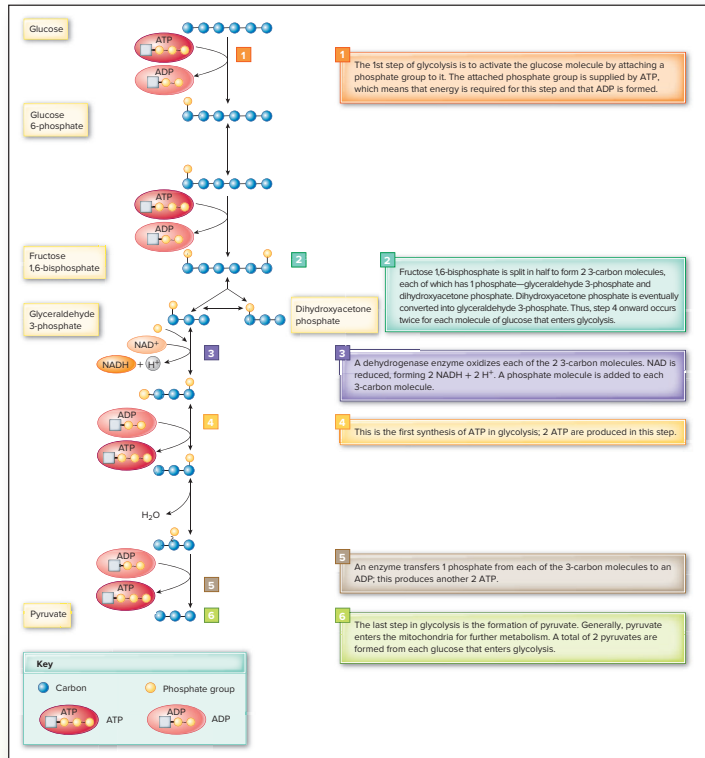
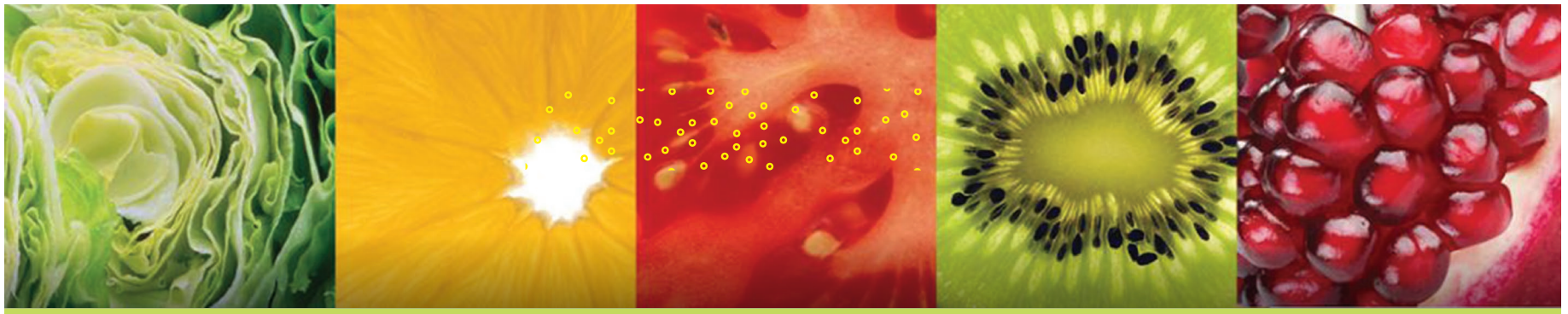
Make every bite count with the *Dietary Guidelines for Americans*. Here's how:

1. Follow a healthy dietary pattern at every life stage.
2. Customize and enjoy nutrient-dense food and beverage choices to reflect personal preferences, cultural traditions, and budgetary considerations.
3. Focus on meeting food group needs with nutrient-dense foods and beverages, and stay within calorie limits.
4. Limit foods and beverages higher in added sugars, saturated fat, and sodium, and limit alcoholic beverages.

Key Recommendations

1. **Follow a healthy dietary pattern at every life stage.** At every life stage—infancy, toddlerhood, childhood, adolescence, adulthood, pregnancy, lactation, and older adulthood—it is never too early or too late to eat healthfully.
 - **For about the first 6 months of life,** exclusively feed infants human milk. Continue to feed infants human milk through at least the first year of life, and longer if desired. Feed infants iron-fortified infant formula during the first year of life when human milk is unavailable. Provide infants with supplemental vitamin D beginning soon after birth.
 - **At about 6 months,** introduce infants to nutrient-dense complementary foods. Introduce infants to potentially allergenic foods along with other complementary foods. Encourage infants and toddlers to consume a variety of foods from all food groups. Include foods rich in iron and zinc, particularly for infants fed human milk.
 - **From 12 months through older adulthood,** follow a healthy dietary pattern across the lifespan to meet nutrient needs, help achieve a healthy body weight, and reduce the risk of chronic disease.
2. **Customize and enjoy nutrient-dense food and beverage choices to reflect personal preferences, cultural traditions, and budgetary considerations.** A healthy dietary pattern can benefit all individuals regardless of age, race, or ethnicity, or current health status. The *Dietary Guidelines* provides a framework intended to be customized to individual needs and preferences, as well as the foodways of the diverse cultures in the U.S.

3. **Focus on meeting food group needs with nutrient-dense foods and beverages, and stay within calorie limits.** An underlying premise of the *Dietary Guidelines* is that nutritional needs should be met primarily from foods and beverages—specifically, nutrient-dense foods and beverages. Nutrient-dense foods provide vitamins, minerals, and other health-promoting components and have no or little added sugars, saturated fat, and sodium. A healthy dietary pattern consists of nutrient-dense forms of foods and beverages across all food groups, in recommended amounts, and within calorie limits. The core elements that make up a healthy dietary pattern include:
 - Fruits, especially whole fruit
 - Grains, at least half of which are whole grain
 - Dairy, including fat-free or low-fat milk, yogurt, and cheese, and/or lactose-free versions and fortified soy beverages and yogurt as alternatives
 - Protein foods, including lean meats, poultry, and eggs; seafood; beans, peas, and lentils; and nuts, seeds, and soy products
 - Oils, including vegetable oils and oils in food, such as seafood and nuts
4. **Limit foods and beverages higher in added sugars, saturated fat, and sodium, and limit alcoholic beverages.** At every life stage, meeting food group recommendations—even with nutrient-dense choices—requires most of a person's daily calorie needs and sodium limits. A healthy dietary pattern doesn't have much room for extra added sugars, saturated fat, or sodium—or for alcoholic beverages. A small amount of added sugars, saturated fat, or sodium can be added to nutrient-dense foods and beverages to help meet food group recommendations, but foods and beverages high in these components should be limited. **Limits are:**
 - **Added sugars**—Less than 10 percent of calories per day starting at age 2. Avoid foods and beverages with added sugars for those younger than age 2.
 - **Saturated fat**—Less than 10 percent of calories per day starting at age 2.
 - **Sodium**—Less than 2,300 milligrams per day—and even less for children younger than age 14.
 - **Alcoholic beverages**—Adults of legal drinking age can choose not to drink or to drink in moderation by limiting intake to 2 drinks or less in a day for men and 1 drink or less in a day for women, when alcohol is consumed. Drinking less is better for health than drinking more. There are some adults who should not drink alcohol, such as women who are pregnant.



- In many figures, process descriptions appear in the body of the figure. This pairing of the action and an explanation walks students step-by-step through the process and increases the teaching effectiveness of these figures.
- Intriguing chapter opening photos pique students' curiosity by featuring seemingly unrelated topics that draw connections between the photo and nutrition.
- Finally, a careful comparison of artwork with its corresponding text was done to ensure that they are completely coordinated and consistent. The final result is a striking visual program that holds readers' attention and supports the goals of clarity, ease of comprehension, and critical thinking. The attractive layout and design of this edition are clean, bright, and inviting. This creative presentation of the material is geared toward engaging today's visually oriented students.

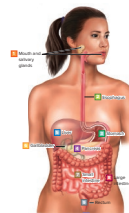
Illustrative Chapter Summary

The visual chapter summary continues to reinforce key concepts and promote student engagement and comprehension.

Chapter Summary

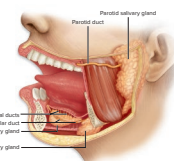
4.1 The cell is the basic structural unit of the human body.

Cells join together to make up tissues. The 4 primary types of tissues are epithelial, connective, muscle, and nervous. Tissues unite to form organs, and organs work together as an organ system.



4.3 Chewing food breaks it into small pieces and increases its surface area.

which enhances enzyme activity. Amylase produced by salivary glands digests a small amount of starch. Chewed food mixed with saliva is called a bolus. When swallowing is initiated, the epiglottis covers the trachea to prevent food from entering it. Peristalsis moves food down the esophagus. There are 5 basic taste sensations perceived by taste cells on taste buds in the mouth, especially the tongue. Genetic variability affects the ability to taste bitter compounds. The sense of smell contributes greatly to flavor perceptions.



4.2 The GI tract includes the mouth, esophagus, stomach, small intestine, and large intestine

(colon, rectum, and anus). Sphincters along the GI tract control the flow of its contents. The accessory organs (liver, gallbladder, and pancreas) are an important part of the digestive system. Movement through the GI tract is mainly through muscular contractions known as peristalsis. GI contents are mixed with segmental contractions. Enzymes are specialized protein molecules that speed up digestion by catalyzing chemical reactions. Most digestive enzymes are synthesized in the small intestine and pancreas. A lack of digestive enzymes can result in poor digestion, poor absorption, malnutrition, and weight loss.

4.4 The lower esophageal sphincter protects the esophagus from the

backflow of acidic stomach contents. When this sphincter does not work normally, heartburn and GERD may occur. Stomach cells produce gastric juice (HCl, pepsinogen, mucus, and intrinsic factor). The hormone ghrelin triggers hunger and eating. Pepsin (from pepsinogen) starts the digestion of protein. Mixing of food and gastric juice results in the production of chyme, the liquid substance released in small amounts into the small intestine.

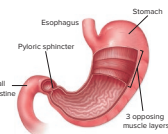


Table 4-2 Overview of GI Tract Digestion and Absorption Functions

Organs	Digestive Functions
Mouth and salivary glands	Prepare food for swallowing; chewing, moistening with saliva Detect taste molecules Start digestion of starch with amylase enzyme



Connecting with the Latest Updates

Global Updates and Changes

- The entire twelfth edition updated, refined, and streamlined to enhance student learning
- Complete Dietary Guidelines update to include 2020–2025 recommendations
- Nutrition Facts panels updated to latest FDA regulations
- Latest Daily Values incorporated in nutrient content charts
- New *Culinary Perspective* features throughout
- Fresh, new art for visual engagement
- People-first language used throughout the text to put the person before diagnosis, such as “a person with alcoholism” rather than “an alcoholic”

Chapter 1, *The Science of Nutrition*

- Updated statistics on leading causes of death
- *Culinary Perspective* featuring fermented foods
- Latest regulatory changes on *trans* fats introduced
- Streamlined and enhanced discussion of functional foods
- Expanded discussion of environmental factors affecting food choices
- Extensive revision of *Healthy People* goals and objectives
- Introduction of the concept of nutrition-focused physical exams
- New discussion on systematic reviews and meta-analyses
- New *Historical Perspective* on Joseph Goldberger
- New figure explaining human genome components

Chapter 2, *Tools of a Healthy Diet*

- Expansion of summary of nutrient claims on food labels table to include omega-3 fatty acid claims
- Enhanced menu labeling *Expert Perspective from the Field*
- *Take Action* updated to include the latest dietary intake recommendations
- Streamlined discussion of MyPlate and international dietary guidance graphic symbols

Chapter 3, *The Food Supply*

- Updated domestic and international food insecurity statistics highlighting the worldwide burden of malnutrition and hunger
- Updated food insecurity map
- Expanded discussion of food sustainability and agrobiodiversity
- New image depicting food sustainability from farm to table
- New *Culinary Perspective* on reducing food waste at the grocery store and home
- Extensive revision of discussion on amending agricultural plant and animal traits via selective breeding, mutagenesis, genetic (transgenetic) modification, genome editing, and safety and other concerns

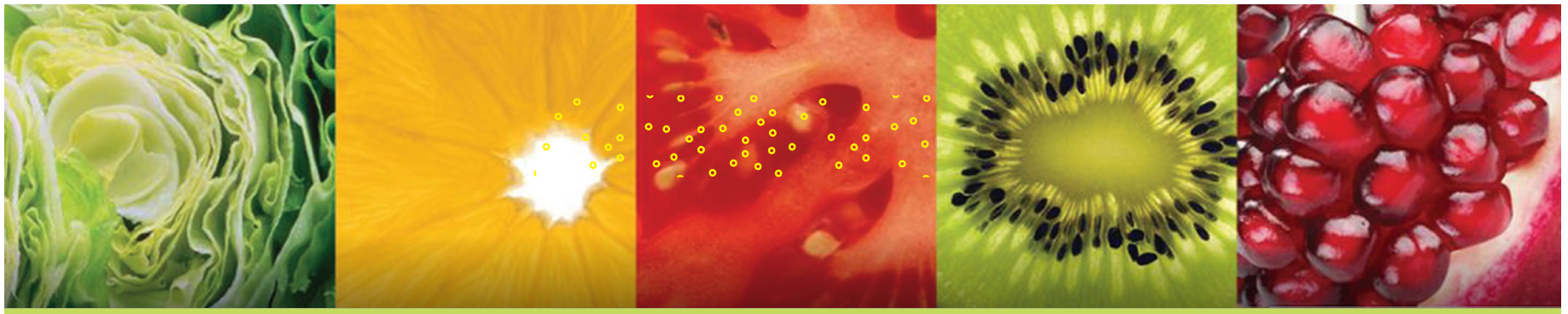
- Expanded discussion of gene editing and illustration to increase comprehension
- Expanded discussion of food nanotechnology
- Latest BPA regulations added
- New non-nutritive sweetener, advantame, introduced
- Latest CDC foodborne illness statistics included
- Enhanced discussion of seafood toxins
- Fully updated discussion of water contamination in Flint, Michigan
- Enhanced *Expert Perspective from the Field* on sustainability in university food service

Chapter 4, *Human Digestion and Absorption*

- Enhanced discussion on structure and function of nasal lining
- Updated procedure for treating choking to new Red Cross recommendations
- Updated *Global Perspective* to include latest global data on child death from diarrhea
- Expanded discussion of probiotics and prebiotics
- Expanded discussion of erosive and non-erosive gastroesophageal reflux disease (GERD) and management
- Fully updated discussion of sugar’s role in nonalcoholic fatty liver disease
- New discussion of effects of opioids on intestinal mobility and constipation
- Irritable bowel disease presentation refined to incorporate probiotics and FODMAP dietary protocol
- New *Take Action* on comparing breads on gluten content
- Celiac disease and non-celiac gluten sensitivity prevalence statistics update

Chapter 5, *Carbohydrates*

- Expanded content on function of pectin
- Typical sources of sweeteners (Table 5-1) expanded to include advantame
- Enhanced discussion of total sugar and added sugar declarations on Nutrition Facts panels
- Updated discussion on 100% fruit juice recommendations
- Addition of health concerns associated with high fructose corn syrup
- Streamlined discussion of non-nutritive (alternative) sweeteners
- Added discussion on advantame
- New *Culinary Perspective* on nutritive sweeteners
- Fully updated *Healthy People* carbohydrate intake goals
- Apps for managing diabetes mellitus introduced



Chapter 6, *Lipids*

- New FDA *trans* fats regulations incorporated
- Enhanced presentation of main sources of fatty acids (Table 6-1)
- Refined *Take Action* on dietary fat content
- New *Culinary Perspective* on phospholipids in food
- Revised discussion of phospholipids to reflect recent research findings on functions
- Table 6-2 enhanced and updated to reflect latest recommendations for fat intake
- New discussion on foods that affect blood cholesterol
- Streamlined *Expert Perspective from the Field* on a healthier approach to eating fats
- Refined fat content of foods chart (Figure 6-10)
- Refined fat absorption illustration to increase comprehension (Figure 6-16)

Chapter 7, *Proteins*

- Enhanced discussion on pulses and legumes
- New *Culinary Perspective* on entomophagy
- Enhanced discussion on high protein diets
- Latest statistics on protein-energy malnutrition incorporated
- New feature on meat sweats
- Revised transaminase enzyme pathway to improve understanding (Figure 7-3)

Chapter 8, *Alcohol*

- Enhanced feature on powdered alcohol
- Streamlined discussion of alcohol metabolism
- Revised *Healthy People* goals regarding alcohol use
- Updated alcohol consumption trends and statistics
- Refined discussion of potential benefits of alcohol intake
- Enhanced discussion of the effects of alcohol abuse on nutritional status
- Extensive revision of alcohol intake around the world
- Dangers of combining alcohol and caffeine added
- Updated cirrhosis section to reflect newest research

Chapter 9, *Energy Metabolism*

- Improved clarity of caption explaining ATP stores and energy (Figure 9-4)
- Extensive revision of aerobic carbohydrate metabolism figure and caption to increase student comprehension (Figure 9-5)
- Increased clarity of ATP production sections for carbohydrates and lipids
- Streamlined discussion of ketosis in diabetes
- Modified disposal of excess amino groups figure and caption to enhance student understanding (Figure 9-17)
- Extensive revision of international incidence of cancer figure (Figure 9-18)

- Revised discussion on ATP concentrations to promote learning
- New *Take Action* on intermittent fasting and metabolism
- Recommendations added from the Advisory Committee on Heritable Disorders in Newborns and Children regarding inborn errors of metabolism
- New discussion of trimethylaminuria in inborn errors of metabolism section

Chapter 10, *Energy Balance, Weight Control, and Eating Disorders*

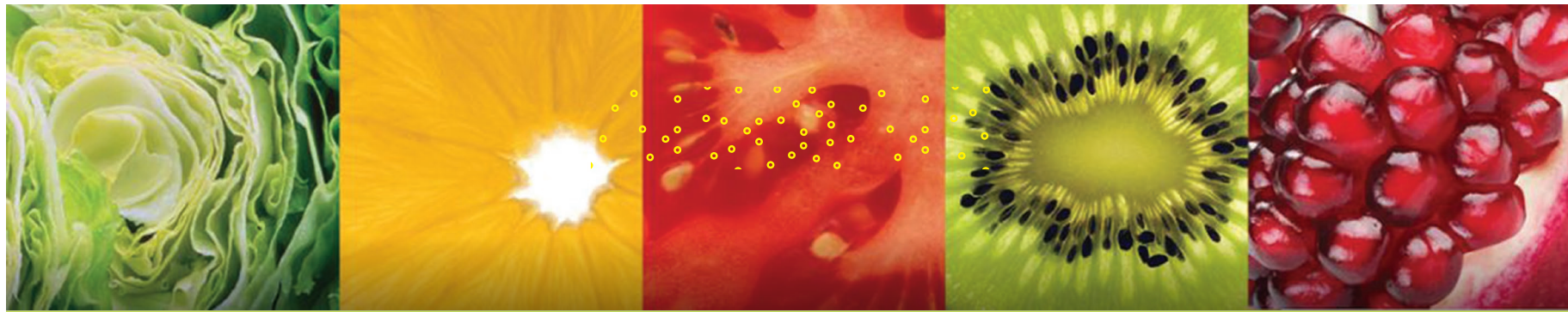
- Most up-to-date map of obesity rates in the U.S.
- Enhanced discussion of estimated energy requirements
- Revised discussion on measuring body fat content
- Weight control objectives from *Healthy People* updated
- Extensive revision to popular diet approaches to weight control (Table 10-7)
- New *Take Action* on how to spot a fad diet
- Eating disorders section streamlined and updated
- Section on binge eating disorder refined

Chapter 11, *Nutrition, Exercise, and Sports*

- Extensive revision of benefits of exercise section
- Refined discussion of section addressing calorie restriction and protein needs of wrestlers
- Enhanced discussion of boosting glycogen stores
- Expanded discussion of fat needs of athletes
- Enhanced section on ketogenic diets and athletic performance
- Streamlined discussion of calcium intake and relative energy deficiency in sports (REDS)
- Refined discussion of fluid intake and replacement strategies
- New *Culinary Perspective* on sports nutrition in the home kitchen
- Extensive revision of gene doping and editing in sports section

Chapter 12, *The Fat-Soluble Vitamins*

- Amsler grid for macular degeneration added
- Role of lutein in brain development and cognitive function added to carotenoid section
- New figure depicting bioconcentration and vitamin A content
- *Historical Perspective* on rickets added
- Fitzpatrick sun-reactive scale added to discussion of skin type and vitamin D deficiency risk
- Enhanced and updated section on current vitamin D concerns and additional functions
- New *Culinary Perspective* on plant-based milk alternatives
- Expansion of vitamin K functions section
- Refined discussion of dietary supplements prevalence



Chapter 13, *The Water-Soluble Vitamins*

- New *Culinary Perspective* on preserving vitamins in fruits and vegetables
- Updated prevalence of thiamin deficiency in older adults
- Expanded section on riboflavin and plant-based milk alternatives
- Streamlined discussion on thiamin absorption and transport
- New *Culinary Perspective* on cooking methods for enhancing niacin bioavailability
- Updated discussion on pharmacologic use of niacin
- Figure added depicting biotinidase deficiency manifested as hypotonia in infants
- Refined discussion of B-6 metabolism and functions
- New image depicting vitamin B-6 deficiency manifested as seborrheic dermatitis
- Update of neural tube defect prevalence and maternal folate status
- New *Take Action* on energy drinks and B-vitamins
- Expanded discussion of vitamin C and cancer

Chapter 14, *Water and Major Minerals*

- Expanded discussion of medical therapies used to slow bone loss
- Latest bottled water statistics
- Enhanced *Take Action* on calcium intake
- Image of uses of phosphorus beyond nutrient functions
- Figure added to depict the structure of chlorophyll and contributions to magnesium intake
- Art added to illustrate biological sources of sulfur

Chapter 15, *Trace Minerals*

- Streamlined discussion of iron
- New feature on disease-causing bacteria and the need for iron
- Enhanced discussion of zinc
- New *Historical Perspective* on unleavened bread and zinc deficiency
- Streamlined discussion on zinc transport
- Menkes disease, a genetic condition impairing copper transport and utilization, pathology image added
- Extensive revision of iodine deficiency disorders
- Refined *Take Action* on local water supply fluoridation
- Extensive revision of the *Global Perspective* on nutrition
- Expanded discussion of dairy and calcium and cancer risk
- Updated iodine status worldwide map
- Enhanced illustration of heme and nonheme absorption

Chapter 16, *Nutritional Aspects of Pregnancy and Breastfeeding*

- Expanded discussion of folate and vitamin B-12 needs during pregnancy
- Refined section on maternal factors increasing the risk of neural tube defects
- Streamlined discussion of maternal prepregnancy weight
- Refined section on recommendations for maternal weight gain during pregnancy
- Added section on postpartum weight loss
- Expanded discussion of maternal age to include older, first-time mothers
- Expanded discussion of breastfeeding links to reduced diabetes risk

Chapter 17, *Nutrition during the Growing Years*

- Streamlined section on tracking child growth
- Extensive refinement of *Global Perspective* on autism
- Expanded discussion on energy needs during growth
- Expanded discussion on water needs during fever, diarrhea, and vomiting
- Expanded discussion of iron deficiency anemia during the growing years
- Updated American Academy of Pediatrics's vitamin D supplementation for exclusively breastfed infants recommendations
- Extensive revision of nutritional qualities of breast milk section
- New *Culinary Perspective* on homemade baby food added
- Contribution of snacks to children's diets added

Chapter 18, *Nutrition during the Adult Years*

- Updated statistics and figure (Figure 18-1) summarizing life expectancy
- Vitamin D links with Alzheimer disease and other types of dementia added
- Strength training recommendations for older adults expanded and updated
- Expanded exercise guidelines for adults
- Added discussion on effects of dysphagia (trouble swallowing) on dietary status
- Revised *Clinical Perspective* to address drug-nutrient interactions
- Expanded discussion on Alzheimer disease
- New illustration depicting body composition changes with sarcopenia



Acknowledgments

We offer a hearty and profound thank you to the many individuals who have supported and guided us along the way.

To our loved ones: Without your patience, understanding, assistance, and encouragement, this work would not have been possible.

To our wonderful students—past, present, and future: The lessons you have taught us over the years have enlightened us and sustained our desire to provide newer, better opportunities to help you successfully launch your careers and promote healthful lifelong living. Thank you, in particular, to the students who have used SmartBook®, as your feedback was instrumental in the revisions for this edition.

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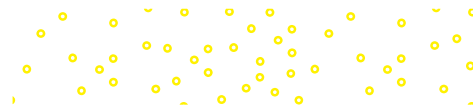
To your health!

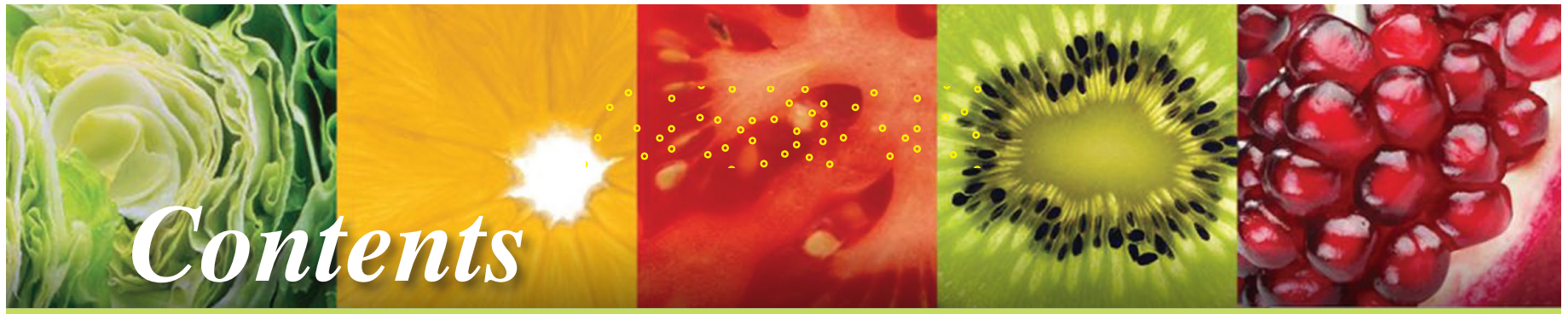
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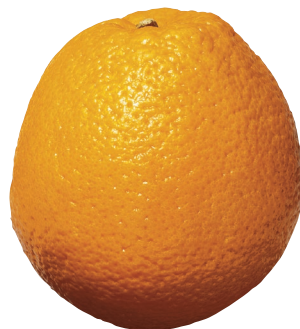
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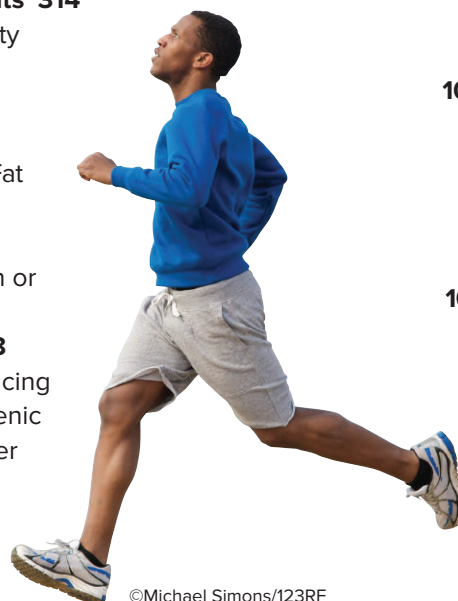
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