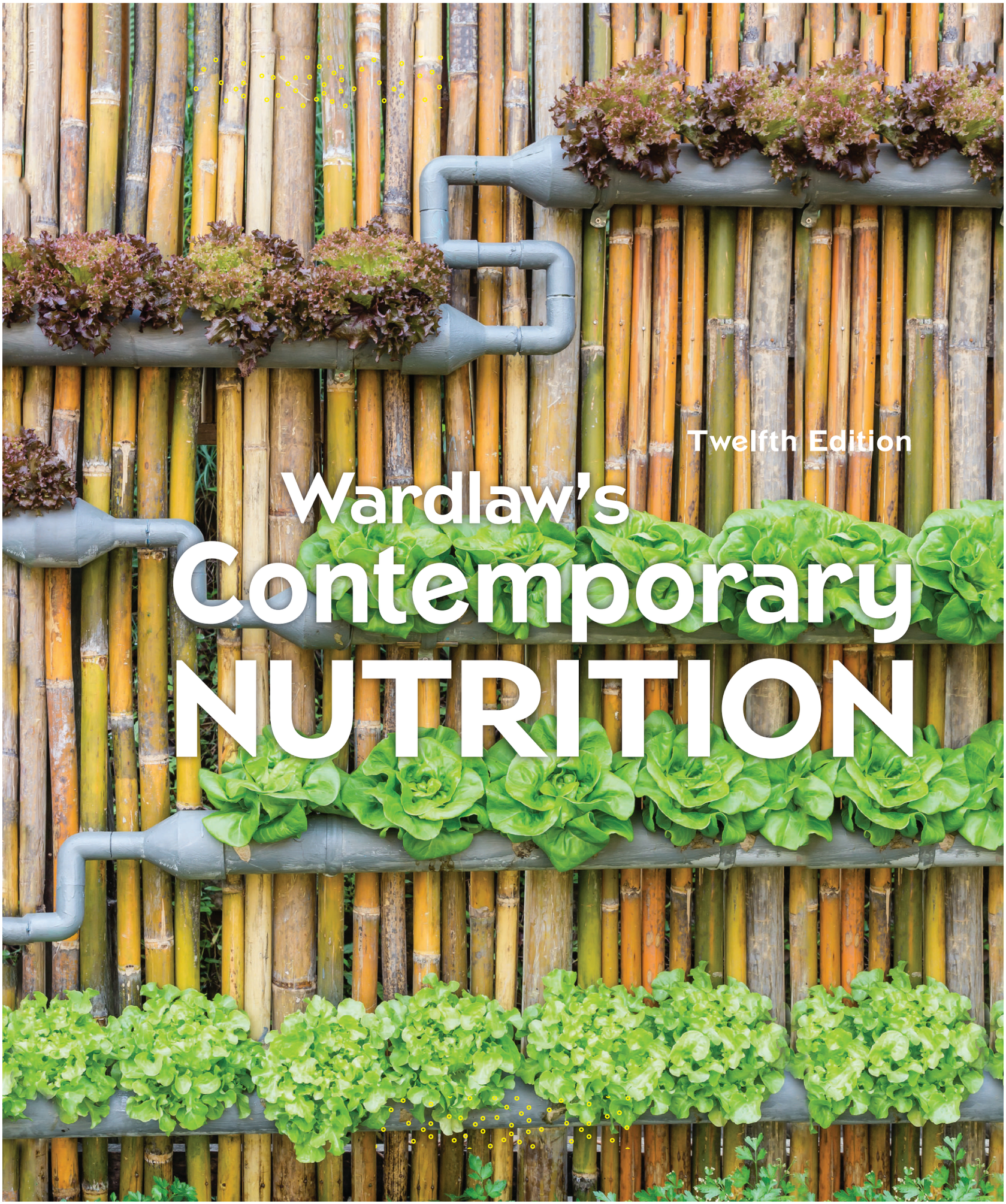

Twelfth Edition

Wardlaw's Contemporary NUTRITION

WARDLAW'S CONTEMPORARY NUTRITION, TWELFTH EDITION

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Brief Contents





Breakfast bowl: Alexis Joseph/McGraw-Hill Education; dietary fiber health food: Marilyn Barbone/Shutterstock; micronutrients/phytochemicals: Alexis Joseph/McGraw-Hill Education; swimmer: Erik Isakson/Blend Images LLC; portrait of a couple expecting a baby sitting on a park bench: Stockbyte/Getty Images

Dear Students,

Welcome to the fascinating world of nutrition! Because we all eat several times a day and the choices we make can have a dramatic influence on health, nutrition is our favorite area of science. At the same time, though, the science of nutrition can seem a bit confusing. One reason for all the confusion is that it seems like "good nutrition" is a moving target; different authorities have different ideas of how we should eat, and nutrition recommendations sometimes change! Second, there are so many choices. Did you know that the average supermarket carries about 40,000 food and beverage products? With so many food manufacturers vying for your attention, how can you identify a healthy product? Third, as a nation, we eat many of our meals and snacks away from home. When we eat foods someone else has prepared for us, we surrender control over what is in our food, where the food came from, and how much of it goes on our plates. Undoubtedly, you are interested in what you should be eating and how the food you eat affects you.

Wardlaw's Contemporary Nutrition *is designed to accurately convey changing and seemingly conflicting messages to all kinds of students. Our students commonly have misconceptions about nutrition, and many have a limited background in biology or chemistry. We teach complex scientific concepts at a level that will enable you to apply the material to your own life.*

This marks the twelfth edition of ***Wardlaw's Contemporary Nutrition.*** *We have added several unique and timely features to this edition, most notable, information from the recently released* ***Dietary Guidelines for Americans, 2020–2025****. To help sort fact from fiction, we start each chapter with a new* ***Fake or Fact*** *feature to call out common misconceptions about foods and health, then we explain what science has to say. The* ***Magnificent Microbiome*** *feature explores the many ways the gut microbiota influences your health. Sustainability topics are highlighted in* ***Sustainable Solutions*** *found in every chapter. We have also redesigned our vitamin and mineral facts into "flash card" infographics that concisely summarize the food sources, main functions, recommendations, and other pertinent features of each vitamin and mineral. Finally, in the* ***COVID Corner****, we have addressed many ways the global outbreak both affects and is affected by food and nutrition.*

We have written this book to help you make informed choices about the food you eat. We will take you through explanations of the nutrients in food and their relationship to health and make you aware of the multitude of other factors that drive food choices. To guide you, we refer to many reputable research studies, books, policies, and websites throughout the book. With this information at your fingertips, you will be well equipped to make your own informed choices about what and how much to eat. There is much to learn, so let's get started!

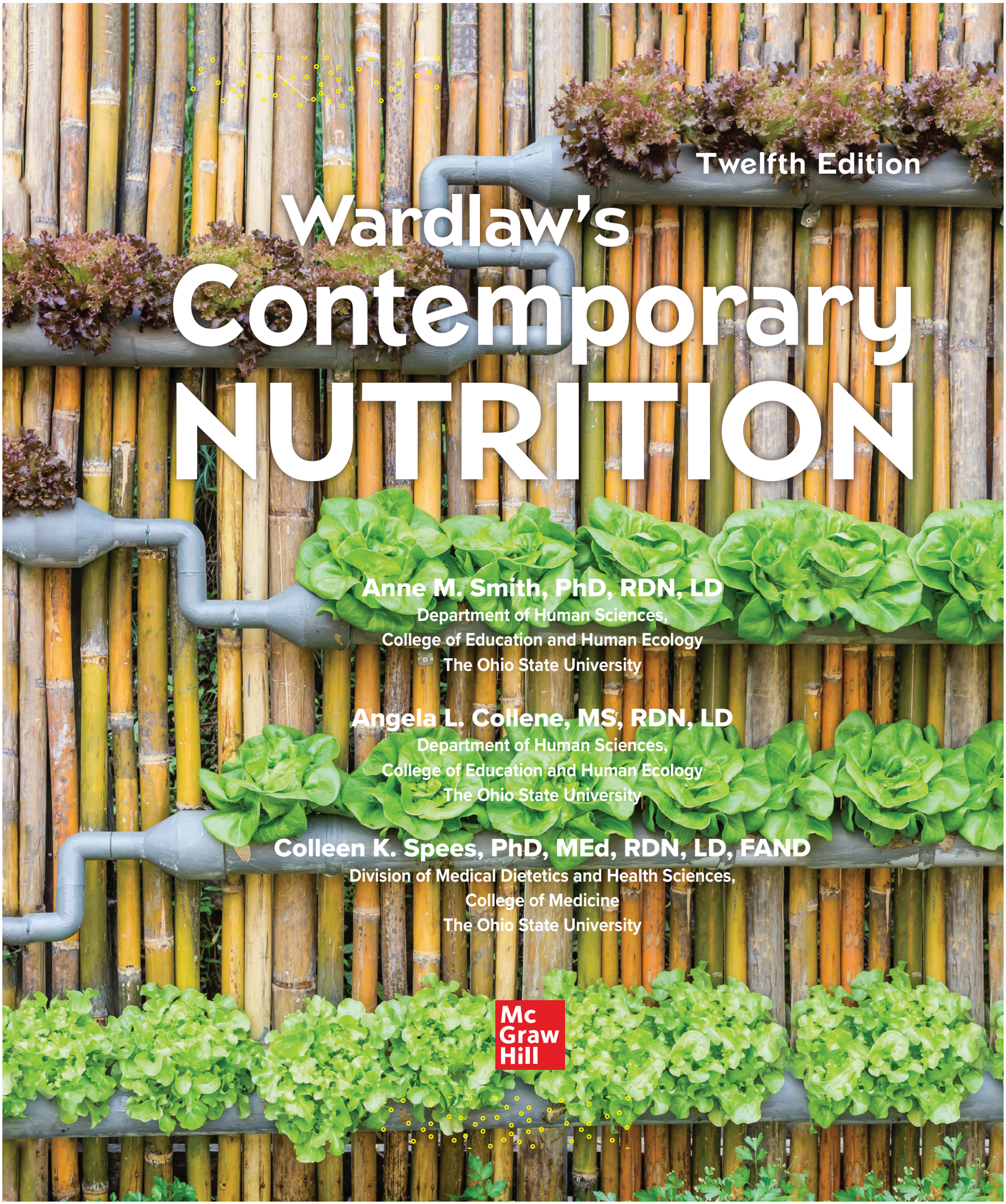
Anne Smith
Angela Collene
Colleen Spees

About the Cover

To expand upon our wildly successful *Farm to Fork* feature, we are excited to introduce the sustainable practice of hydroponics in this edition! As our cover image displays, this alternative agricultural practice involves growing plants in soilless and nutrient-rich root mediums in a variety of controlled environments, including gutters, pipes (as pictured growing vertically on the cover), and other space-saving and inexpensive containers. Learners will also enjoy our new *Sustainable Solutions* feature, created to promote environmentally friendly and applicable tips that students can use to improve their corner of the world.

Briana Zabala

The authors, Anne Smith, Colleen Spees, and Angela Collene, at the Hope Garden, a living research, teaching, and service-learning laboratory at The Ohio State University, academic home of the author team.



Twelfth Edition

Wardlaw's Contemporary NUTRITION

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Mc Graw Hill

About the Authors

Monty Soungpradith/Open Image Studio LLC

ANNE M. SMITH, PhD, RDN, LD, is an associate professor emeritus at The Ohio State University. She was the recipient of the Outstanding Teacher Award from the College of Human Ecology, the Outstanding Dietetic Educator Award from the Ohio Dietetic Association, the Outstanding Faculty Member Award from the Department of Human Nutrition, and the Distinguished Service Award from the College of Education and Human Ecology for her commitment to undergraduate education in nutrition. Dr. Smith's research in the area of vitamin and mineral metabolism has appeared in prominent nutrition journals, and she was awarded the Research Award from the Ohio Agricultural Research and Development Center. She is a member of the American Society for Nutrition and the Academy of Nutrition and Dietetics.

Tim Klontz, Klontz Photography

ANGELA L. COLLENE, MS, RDN, LD, began her career at her alma mater, The Ohio State University, as a research dietitian for studies related to diabetes and aging. Other professional experiences include community nutrition lecturing and counseling, owner of a personal chef business, and many diverse and rewarding science writing and editing projects. She is currently interested in the intersection between nutrition and mental health and—quite predictably for the mother of three little girls—maternal and child nutrition. Mrs. Collene currently teaches introductory nutrition and life cycle nutrition at The Ohio State University. She is a member of the Academy of Nutrition and Dietetics.

Ralphoto Studio

COLLEEN K. SPEES, PhD, MEd, RDN, LD, FAND, is an academic instructor and researcher at The Ohio State University College of Medicine. In addition to teaching Evidence-Based Practice and Nutritional Genomics, Dr. Spees's primary research focus involves conducting garden-based biobehavioral clinical interventions aimed at providing optimal nutrition for high-risk populations (see http://go.osu.edu/hope). In addition, Dr. Spees is the recipient of several national awards from the Academy of Nutrition and Dietetics, including the Distinguished Practice Award; Award for Excellence in Oncology Nutrition Research; Outstanding Dietetic Educator Award; Nutrition Informatics Video Challenge Teaching Award; and the Top Innovator in Education Teaching Award. In addition, she is the most recent recipient of the Early Professional Achievement Award from the Society for Nutriiton Education and Behavior and serves on the Scientific Panel for the American Cancer Society's Dietary and Physical Activity Guideline. Dr. Spees is also a recognized Fellow of the Academy of Nutrition and Dietetics.

Acknowledgments

It is because of the tireless efforts of a cohesive team of talented professionals that we can bring you the twelfth edition of *Wardlaw's Contemporary Nutrition*. We consider ourselves massively blessed to work with the top-notch staff at McGraw Hill. We thank Lauren Vondra, Portfolio Manager, for her effective leadership of our team. We value the efforts of our Executive Marketing Manager, Tami Hodge, who consistently connects instructors with our work and brings us constructive feedback from the field. We are immensely grateful to our Product Developer, Darlene Schueller, who strategically led the day-to-day efforts of the entire editorial team. We especially appreciate her longevity over many editions of the *Contemporary Nutrition* products and value her keen eye for detail, strong work ethic, and organizational expertise. We are grateful to our Content Project Manager, Ann Courtney, and her staff for their patience and careful coordination of the numerous production efforts needed to create the very appealing and accurate twelfth edition. We thank Tammy Juran, our Assessment Content Project Manager, for her efforts and assistance. We appreciate the meticulous work of our copyeditor, Heath Lynn Silberfeld; proofreaders Kevin Campbell and David Heath; and our Content Licensing Specialist, Brianna Kirschbaum. We thank our Designer, David Hash, who ensured that every aspect of our work is visually appealing—not just on the printed page but also in a variety of digital formats. Finally, we are indebted to our colleagues, friends, and families for their constant encouragement, honest feedback, and shared passion for the science of nutrition.

Reviewers

In the preparation of each edition, we have been guided by the collective wisdom of reviewers who are excellent teachers. They represent experience in community colleges, liberal arts colleges, institutions, and universities. We have followed their recommendations, while remaining true to our overriding goal of writing a readable, student-centered text.

Amy Bolinger
Greenville Technical College

Diane E. Carson
California State University, Long Beach

Susan Krug
Butte College

Sharon Lawless
Allen Community College

Jennifer L. Newton
Greenville Technical College

Susan Wakeman
Greenville Technical College

Ask the RDN Contributors

We are grateful to our reputable and talented RDN colleagues who authored several new *Ask the RDN* features in this edition. It was exciting to share the spotlight and include their evidence-based expertise and applicable, down-to-earth recommendations. Many thanks to the following:

Leslie Bonci, MPH, RDN, CSSD, LDN
Zachari Breeding, MS, RDN, LDN, FAND
Karen K. Collins, MS, RDN, CDN, FAND
Alexis Joseph, MS, RDN, LD
Sally Kuzemchak, MS, RDN
Leah McGrath, RDN, LDN
Chris Vogliano, MS, RDN

Student-Informed Reviews

We are very pleased to have been able to incorporate real student data points and input, derived from thousands of our SmartBook® users, to help guide our revision. SmartBook heat maps provided a quick visual snapshot of usage of portions of the text and the relative difficulty students experienced in mastering the content. With these data, we were able to hone not only our text content but also the SmartBook probes.

With the twelfth edition of *Wardlaw's Contemporary Nutrition,* we remember its founding author, Gordon M. Wardlaw. Dr. Wardlaw had a passion for the science of nutrition and the research that supports it and demonstrated an exceptional ability to translate scientific principles into practical knowledge. This skill is what made his book truly "contemporary." He was tireless when it came to staying current and relevant to a changing world. It has been a privilege for all of us to join Dr. Wardlaw as coauthors of this textbook. For Anne Smith, he was an extraordinary colleague, mentor, and friend. Angela Collene was blessed to have been one of his graduate students at The Ohio State University, where she first began to assist with revisions to his books. Colleen Spees was a student in Dr. Wardlaw's first nutrition class at The Ohio State University and now holds his previous tenured faculty position. Like so many other students, colleagues, and friends, we remember Dr. Wardlaw as a source of vast knowledge, good humor, and inspiration. The best way we know to honor our dear friend and mentor is to carry on his legacy of outstanding textbooks in introductory nutrition. *Wardlaw's Contemporary Nutrition* will continue to evolve and reflect current trends and breakthroughs in nutrition science, but Dr. Wardlaw's fingerprints will remain on every page.

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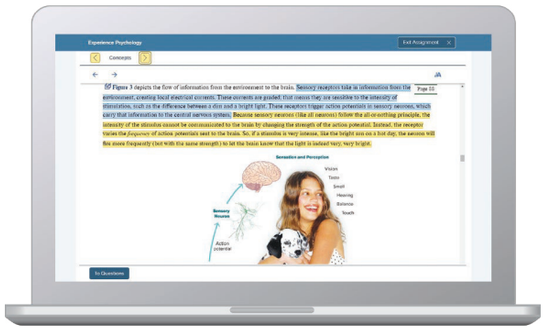

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>
> - Jordan Cunningham, Eastern Washington University

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Connecting Teaching and Learning

vicushka/123RF

NutritionCalc Plus

NutritionCalc Plus is a **powerful dietary analysis tool** featuring more than 30,000 foods from the reliable and accurate ESHA Research nutrient database, which is comprised of data from the latest USDA Standard Reference database, manufacturer's data, restaurant data, and data from literature sources. NutritionCalc Plus allows users to track food and activities, and 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.

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.

Dietary Analysis Case Studies in Connect®

Pkchai/Shutterstock

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!

create®

McGraw Hill Create® is a self-service website that allows you to create customized course materials using McGraw Hill's comprehensive, cross-disciplinary content and digital products.

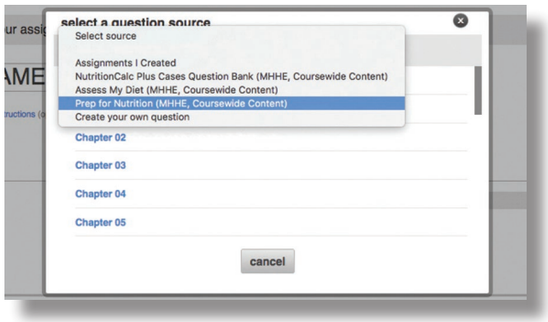
tegrity®

Tegrity in Connect is a tool that makes class time available 24/7 by automatically capturing every lecture. With a simple one-click start-and-stop process, you capture all computer screens and corresponding audio in a format that is easy to search, frame by frame. Students can replay any part of any class with easy-to-use, browser-based viewing on a PC, Mac, or other mobile device.

Educators know that the more students can see, hear, and experience class resources, the better they learn. Tegrity's unique search feature helps students efficiently find what they need, when they need it, across an entire semester of class recordings. Help turn your students' study time into learning moments immediately supported by your lecture.

Assess My Diet

Auto-graded personalized dietary analysis. 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 compare their own nutrient intakes to current Dietary Reference Intakes and demonstrate their ability to perform calculations on their own data, such as percentage 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.



Prep for Nutrition

To help you **level-set your classroom**, we've created Prep for Nutrition. This question bank highlights a series of questions, including Basic Chemistry, Biology, Dietary Analysis, Mathematics, and Student Success, to give students a refresher on the skills needed to enter and be successful in their course! By having these foundational skills, you will feel more confident your students can begin class, ready to understand more complex concepts and topics. Prep for Nutrition is **course-wide for ALL nutrition titles** and can be found in the Question Bank dropdown within Connect.

Campus

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.

connect MASTER

Writing Assignment

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connect + proctorio

Remote Proctoring & Browser-Locking Capabilities

New remote proctoring and browser-locking capabilities, hosted by Proctorio within Connect, provide control of the assessment environment by enabling security options and verifying the identity of the student.

Seamlessly integrated within Connect, these services allow instructors to control students' assessment experience by restricting browser activity, recording students' activity, and verifying students are doing their own work.

Instant and detailed reporting gives instructors an at-a-glance view of potential academic integrity concerns, thereby avoiding personal bias and supporting evidence-based claims.

Connecting Students to Today's Nutrition

Understanding Our Audience

We have written *Wardlaw's Contemporary Nutrition* while assuming that our students have a limited background in college-level biology, chemistry, or physiology. We have been careful to include the essential science foundation needed to adequately comprehend certain topics in nutrition, such as protein synthesis in Chapter 6. The science in this text has been presented in a simple, straightforward manner so that undergraduate students can master the material and apply it to their own lives. The Concept Maps and detailed, annotated figures bring complex topics into view for students from any major.

Check Out the Functional Approach

An alternative presentation of the contents of this book is available as *Wardlaw's Contemporary Nutrition: A Functional Approach.* The difference, as shown in the side-by-side tables of contents below, is in Part Three. Instead of describing these nutrients in their traditional categories (e.g., water-soluble vitamins), we discuss them in groups based on their roles in fluid and electrolyte balance, body defenses, bone health, energy metabolism, blood health, and brain health. This format enables students to understand in more detail how these nutrients interact in food and in our bodies to support key functions that sustain our health.

Wardlaw's Contemporary Nutrition, Twelfth Edition

Wardlaw's Contemporary Nutrition: A Functional Approach, Sixth Edition

Featuring the Latest Guidelines and Research

Nutrition is a dynamic field. Ongoing research continually reshapes our knowledge of nutritional science. The twelfth edition has been carefully updated to reflect current scientific understanding, as well as the latest health and nutrition guidelines. For everyday dietary and activity planning, students will learn about the *Dietary Guidelines for Americans, MyPlate,* and *Physical Activity Guidelines for Americans*. In discussions about specific nutrition concerns, the most recent data and recommendations from the Academy of Nutrition and Dietetics, American Heart Association, American Diabetes Association, American Cancer Society, National Academy of Medicine, and American Psychological Association are included in this edition.

Newsworthy Nutrition, a feature in each chapter, highlights the use of the scientific method in recently published research studies that relate to the chapter topics. In addition, assignable questions in Connect take learning a step further by asking students to read primary literature and apply what they have learned.

Newsworthy Nutrition

Calcium supplements and cardiovascular disease risk

INTRODUCTION: Although several studies have shown a beneficial effect of calcium intake on cardiovascular effects, others have shown that calcium intake, especially from calcium supplements, is associated with increased mortality or the risk of heart attack and stroke. **OBJECTIVE:** The goal of this study was to explore the associations between calcium from dietary and supplemental intakes and cardiovascular disease (CVD) risks. **METHODS:** The study design was a systematic review and meta-analysis of 16 randomized controlled trials and 26 prospective cohort studies of dietary or supplemental intake of calcium, with or without vitamin D, and cardiovascular outcomes. Data was from PubMed, Cochrane Central, Scopus, and Web of Science, published up to March 2019. **RESULTS:** Results of cohort studies indicated that there were no associations between dietary calcium intakes and the risk of CVD, coronary heart disease (CHD), and stroke, for intakes ranging from 200 to 1500 mg/day. Results showed that calcium supplements, ranging from 1000 to 1400 mg/day, did not increase the risk of CVD and stroke; however, the risk of CHD increased by 20% and the risk of heart attack increased by 21% with the use of oral calcium supplements. **CONCLUSIONS:** Keeping in mind that very high calcium intakes are difficult if not impossible to achieve by dietary sources alone, the authors conclude that calcium intake from dietary sources does not increase the risk of CVD, and they suggest that adequate dietary calcium intakes are beneficial to cardiovascular protection. They conclude that calcium supplements might raise CHD risk, especially heart attack, and therefore the concerns regarding potential adverse cardiovascular risks are related to the use of calcium supplements.

Source: Yang C and others: The evidence and controversy between dietary calcium intake and calcium supplementation and the risk of cardiovascular disease: A systematic review and meta-analysis of cohort studies and randomized controlled trials. *Journal of the American College of Nutrition* 18:1, 2019. DOI:10.1080/07315724.2019.1649219.

In light of the COVID-19 pandemic, we have added the *COVID Corner* feature to highlight the many ways the global outbreak both affects and is affected by food and nutrition.

COVID CORNER

In 2020, online shopping and curbside pick-up of groceries increased dramatically as a result of the COVID-19 pandemic. The pandemic also had devastating effects on the economy which severely impacted the food budget of many families.

Ask the RDN appears in every chapter to answer frequently asked questions we hear from our students and colleagues. For many topics, including plant-based eating, sustainability, and child nutrition, we have reached out to additional experts in their fields to answer questions. This feature will highlight the function and ability of the RDN to translate the latest scientific findings into easy-to-understand, practical, and applicable nutrition information.

ASK THE RDN **Plant-Based Eating**

Dear RDN: *I am hearing more and more about the health benefits of a plant-based eating pattern. Can you give me some tips on replacing meat and dairy with high-quality plant proteins?*

Regularly consuming foods high in plant proteins, such as legumes (including tofu and other soybean products), whole grains, nuts, and seeds can help prevent and reverse a slew of chronic conditions, including cancers, diabetes, and heart disease. Plant foods are packed with fiber and phytochemicals that support immunity, combat inflammation, and promote healthy bacteria in our gut. As an added bonus, plant proteins are far more affordable, sustainable, and lower in terms of environmental impact than animal proteins.

The good news is that you don't have to swear off meat forever to reap these benefits. Research suggests that following a flexitarian diet (increasing plant-based foods and reducing, but not eliminating, animal foods) yields similar health benefits, like reduced risk of heart disease and diabetes. Eating less meat doesn't mean you're going to suffer from protein deficiency any time soon, either. It is important to note that protein is found in *almost all* foods; and It is nearly impossible not to get enough protein if you're eating enough calories.

In order to transition to a more plant-centric dietary pattern, start small. Overturning your entire eating pattern in a day can be a bit overwhelming initially. Instead of jumping to extremes, pick two small changes to implement each week. First, it may be swapping cow's milk with unsweetened almond or coconut milk. The great thing about nondairy beverages is that they're lower in calories, and some pack more calcium and vitamin D than dairy milk. Make your morning oatmeal with almond milk and stir in a tablespoon of peanut butter and chia seeds for a protein boost. Chia seeds are a hydrating powerhouse, made up of 20% protein and 25% fiber while absorbing up to 30 times their weight in water.

Did you know ¼ cup of pumpkin seeds has 7 grams of protein? Or that hemp seeds are the highest-protein seed, with 3 grams of protein per tablespoon? Peanuts boast the most protein in the nut category, with 7 grams per serving. For a tasty chocolate-banana shake, blend together 1 large frozen overripe banana, 1 tablespoon peanut butter, 1 tablespoon hemp seeds, 1 tablespoon cocoa powder, a handful of spinach, and 1 cup unsweetened vanilla almond milk. Breakfast is served!

For lunches, try power bowls made with a base of wild rice or quinoa, which yield 6 and 8 grams of protein per 1 cup serving, respectively. Top with ½ cup beans, chickpeas, or baked tempeh, a handful of arugula, avocado slices, a drizzle of tahini and lemon juice, and a sprinkle of hemp seeds for a calcium boost. If you're craving a sandwich, stuff a sprouted wheat wrap with ½ cup of black beans, a sprinkle of corn, salsa, avocado, crunchy romaine, and hot sauce.

Consider pasta night. Instead of refined white pasta, try one of the many bean or lentil-based noodles on the market. You can find spaghetti, fusilli, and penne made from black beans, lentils, or chickpeas that all boast 13 grams of protein or more per one cup serving. Stick with 100% whole grain pasta, and you've still got 8 grams of protein and 25% of the Daily Value of fiber per one cup serving. On top of pasta, instead of parmesan, sprinkle nutritional yeast, a cheesy-tasting inactive yeast that's packed with protein and vitamin B-12. Drizzle a tablespoon of tahini and a tablespoon of hemp seeds on your green salad for another 6 grams of protein.

For stir-fry night, swap the chicken for high-protein edamame, which you can usually find in the freezer section of your grocery store. Soy is not only a complete plant protein, but it also has a high concentration of branched-chain amino acids, which are beneficial to athletic performance. Many stores sell marinated tofu (or try tempeh) that's delicious in stir-fry as well. For a tasty peanut sauce, whisk together ¼ cup natural peanut butter, ¼ cup almond milk, 4 teaspoons honey, and 4 teaspoons reduced sodium soy sauce.

When you're craving chili, swap the meat for a couple cans of kidney beans. Adding sautéed mushrooms to the mix will up the umami factor and add meatiness. Boost spices like oregano and chili powder for extra flavor. High-plant-protein dinner is served!

When it comes to baking, experiment with nut- and seed-based flours. Peruse your favorite food blogs for chocolate chip cookies or banana bread made with almond flour or coconut flour for a protein boost. These versions are lower in carbohydrates and super moist thanks to the healthy fat content.

There's no doubt about it—plant proteins are trending *for good.* Do your health and wallet a favor and hop on the bandwagon!

©Raul Velasco

Enjoy your plant proteins,

Alexis Joseph, MS, RD, LD

Dietitian, Nutrition Consultant, Founder of Hummusapien; Co-Owner of Alchemy Brands

The *Medicine Cabinet* feature presents information on common medications used to treat diseases that have a nutrition connection. These features highlight the ways medications can affect nutritional status, as well as ways food and nutrients can affect how medications work.

Medicine Cabinet

Proton pump inhibitors (PPIs) are medications that inhibit the ability of gastric cells to secrete hydrogen ions and thus reduce acid production. Low doses of this class of medications may be available without a prescription. Because stomach acid is important for the absorption of vitamin B-12, prolonged use of PPIs could impair vitamin B-12 status.

Examples:

- Omeprazole (Prilosec®)
- Lansoprazole (Prevacid®)
- Rabeprazole (Aciphex®)
- Esomeprazole (Nexium®)

H_2 blockers impede the stimulating effect of histamine on acid-producing cells in the stomach.

Examples:

- Cimetidine (Tagamet®)
- Nizatidine (Axid®)
- Famotidine (Pepcid®)

Connecting with a Personal Focus

Valuing Our Food Supply

In this edition, we continue our *Farm to Fork* feature. Each chapter spotlights one or two fruits or vegetables and traces their path to our plates. Where does it grow? How do you select the most flavorful and nutritious foods? What are the best ways to store and prepare foods to maximize nutritional value?

FARM to FORK **Carrots and Beets**

Alexis Joseph/McGraw-Hill Education

Carrots and beets are root crops with a wide range of nutrients, flavors, and health-promoting benefits. Red beet juice has also been touted to enhance athletic performance.

Grow

- The wild ancestor of carrots was purple, but most carrots grown in the United States are orange, a good indicator of the nutrients and other phytochemicals they contain, especially beta-carotene. Farmers are again producing purple carrot varieties, which are sweeter and higher in beta-carotene and the purple pigments, anthocyanins.
- Red beets are high in betalins, phytochemicals that may reduce the risk of cancer and other diseases.

Applying Nutrition on a Personal Level

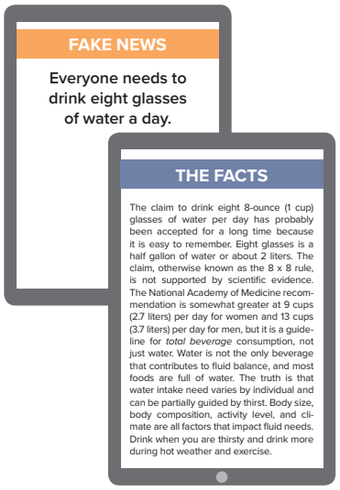
Throughout the twelfth edition, we reinforce the fact that each person responds differently to nutrients. To further convey the importance of applying nutrition to their personal lives, we include many examples of people and situations that resonate with college students. We also stress the importance of learning to intelligently sort through the seemingly endless range of nutrition messages to recognize reliable information and to sensibly apply it to their own lives. Our goal is to provide students the tools they need to eat healthfully and make informed nutrition decisions after they complete the class. Many of these features can be assigned and graded through Connect to help students learn and apply the information and engage with the text.

Challenging Students to Think Critically

The pages of *Wardlaw's Contemporary Nutrition* contain numerous opportunities for students to learn more about themselves and their diet and to use their new knowledge of nutrition to improve their health. These pedagogical elements include *Ask the RDN, Case Studies, Nutrition and Your Health,* and *Newsworthy Nutrition.* Many of the thought-provoking topics highlighted in these features are expanded upon in the online resources found in Connect.

Fake or Fact

To counter the nutrition misinformation we see from all directions, we open each chapter with *Fake or Fact.* This new feature highlights a relevant fake news topic followed by an explanation of the evidence that either supports or refutes the claim.



Sustainable Solutions

In response to the drive toward sustainability—including environmental, health, social, and economic issues—we have introduced a new feature, *Sustainable Solutions*, in which we highlight sustainability topics related to each chapter's content.

More than half (54%) of the respondents to the *2019 Food and Health Survey* said that environmental sustainability is important when they purchase and consume foods. Being labeled as locally grown, sustainably sourced, non-GMO/not bioengineered, and organic are the primary characteristics used to identify sustainable foods, along with foods with recyclable or minimal packaging.

Sustainable Solutions

Magnificent Microbiome

In light of the rapidly expanding body of research related to the gut microbiome and its impact on human health, we have added a new feature, *Magnificent Microbiome*, that explores relevant interactions between chapter topics and the gut microbiota.

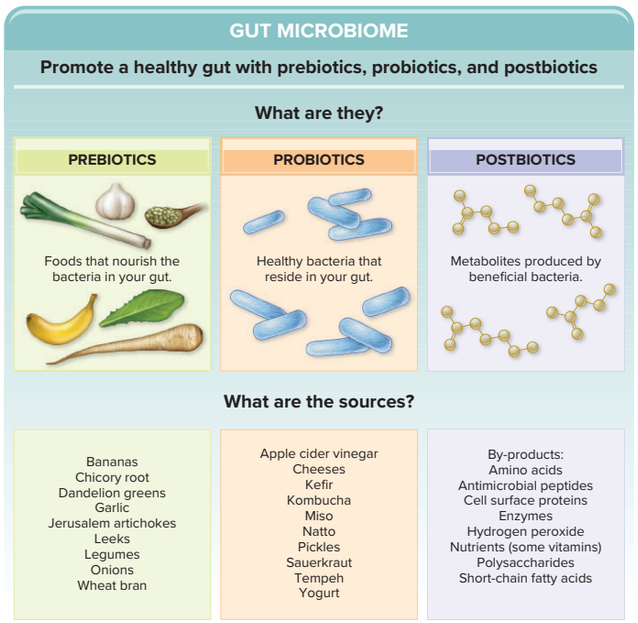
Connecting to Engaging Visuals

Attractive, Accurate Artwork

Illustrations, photographs, infographics, and tables in the text were created to help students master complex scientific concepts.

- Many illustrations were redesigned or replaced to inspire student inquiry and comprehension and to promote interest and retention of information. Several new infographics have been created to present materials in a more attractive, contemporary style.
- In many figures, color-coding and directional arrows make it easier to follow events and reinforce interrelationships. Process descriptions appear in the body of the figures. This pairing of the action and an explanation walks students step-by-step through the process and increases teaching effectiveness.
- Throughout the chapters, every photo and caption has been chosen with the intention to spark critical thinking.

The final result is a striking visual program that holds readers' attention and supports 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.



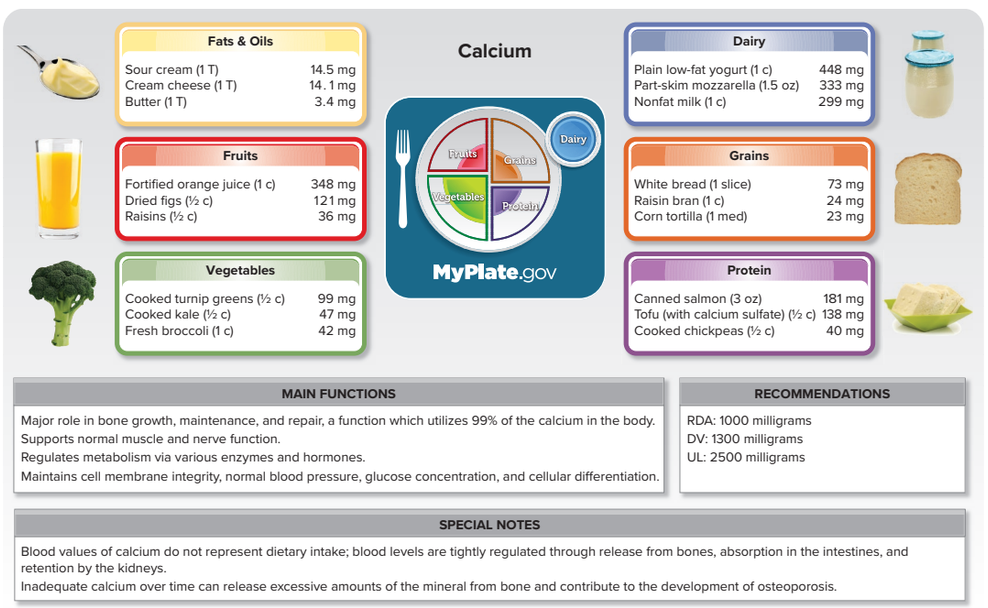


FIGURE 9-23 ▶ Food sources, functions, and recommendations for calcium. The fill of the background color (none, 1/3, 2/3, or completely covered) within each food group on MyPlate indicates the average nutrient density for calcium in that group. The figure shows the calcium content of several foods in each food group. Overall, the richest sources of calcium are dairy foods (and dairy alternatives), legumes, green leafy vegetables, and fortified foods.
mayonnaise: Iconotec/Alamy Stock Photo; orange juice: Sergei Vinogradov/seralexvi/123RF; broccoli: lynx/iconotec.com/Glow Images; two jars of yogurt, Foodcollection; slice of bread: Ingram Publishing/Age Fotostock; tofu: chengyuzheng/iStock/Getty Images; MyPlate: U.S. Department of Agriculture
Sources: Office of Dietary Supplements, Dietary Supplements Fact Sheets, available from https://ods.od.nih.gov/factsheets/list-all; USDA FoodData Central, available from https://fdc.nal.usda.gov.

Connecting with the Latest Updates

Global Changes

- Chapters have been updated with information from the recently released *Dietary Guidelines for Americans, 2020–2025*.
- A new feature, *Sustainable Solutions*, highlights sustainability topics related to each chapter's content.
- Current research reveals many new ways in which the gut microbiome influences human health. *Magnificent Microbiome*, another new feature, explores relevant interactions between chapter topics and the gut microbiota.
- The *Newsworthy Nutrition* feature has been updated to include headings (Objectives, Methods, Results, Conclusions) within the research summary, and the type of study (e.g., systematic review, meta-analysis, cross-sectional studies, animal studies, and case reports) has been added in italics.
- In a new *COVID Corner* feature, we have addressed food and nutrition issues related to the novel coronavirus pandemic that dramatically impacted our lives beginning in 2020.
- Are you looking for *What Would You Choose, What the Dietitian Chose,* and *Rate Your Plate?* Although these features have been removed from the chapters, they still exist as assignable content within Connect.
- The *Ask the RDN* feature has been enhanced with new contributions from experts in the field as well as photos and short bios of the authors.
- Two new *Farm to Fork* features (about mushrooms and about pineapples) have been added.
- Several tables and figures have been transformed into eye-catching infographics that help students to map complex concepts.
- The terms "plant-focused" and "plant-forward" are now used along with "plant-based" to describe dietary patterns that emphasize plants.
- The content about alcohol has been moved from Chapter 16 to Chapter 1.
- The order of Chapters 12 and 13 have been switched so that topics in the *Protecting Our Food Supply* chapter (where our food comes from, how it is grown, and the safety of our food supply) are discussed before related issues in the *Global Nutrition* chapter.

Chapter-by-Chapter Revisions

Chapter 1: *Nutrition, Food Choices, and Health*

- A new *Fake or Fact* feature dispels myths about the effect of nutritional supplements on viral infections.
- Figures 1-2 and 1-3 have been updated with recent Loss-Adjusted Food Availability Data.
- The impact of the COVID-19 pandemic on food access and utilization and the ability to maintain a healthy diet is discussed in the new *COVID Corner* feature.
- The section *What Influences Your Food Choices* has been updated with results from the 2019 Food and Health Survey.
- The importance of environmental sustainability during the purchase and consumption of foods is discussed in the new *Sustainable Solutions* feature.
- Figure 1-4 has been updated with the most recent data on the 10 leading causes of death.
- Figure 1-5 is a new infographic illustrating the major functions of the various classes of nutrients.
- Figure 1-6 is a new infographic showing plant foods and their phytochemicals organized by their color families.
- Section 1.5 has been enhanced with information on the strength of scientific evidence and includes a new infographic (Figure 1-9: Hierarchy of Evidence) and discussion of additional types of studies (systematic review, meta-analysis, cross-sectional studies, and case reports).
- Figure 1-11 has been updated with the most recent statistics on the rates of obesity among adults.
- A new *Newsworthy Nutrition* feature, "Obesity-Related Cancers on the Rise in Young Adults," summarizes a 2019 publication from *The Lancet*.
- The *Nutrition and Your Health* topic has been changed to "Nutritional Implications of Alcohol Consumption" to facilitate the discussion of alcohol earlier in the course.
- Figure 1-12 has been expanded to include the approximate alcohol, carbohydrate, and calorie contents of alcoholic beverages along with the standard drink sizes that provide about 14 grams of alcohol.
- The effects of moderate versus heavy drinking are now illustrated in an infographic (Figure 1-13).
- *Further Readings* include 11 new references.

Chapter 2: *Designing a Healthy Eating Pattern*

- Chapter 2 content has been streamlined and reduced to be more conversational and focused.
- A new Learning Objective (LO 2.9) has been added to reflect the addition of identifying foods and nutrition issues relevant to college students.
- The new *Fake or Fact* feature dispels the myth that healthy food is bland and boring.
- Figure 2-1 has been updated to clarify the comparisons of sugar-sweetened beverages with low-fat milk. Percentage contributions for protein, vitamin A, vitamin C, and riboflavin have been updated to reflect the current USDA nutrient values.

- Two new equation boxes were added to explain the concepts of nutrient and energy density.
- A new figure (2-2) has been added to show simple nutrient-dense swaps to common foods and beverages.
- The Healthy Eating Index (HEI) term has been defined in section 2-1 and added to the glossary.
- Energy density categories and examples of items in each group are now illustrated in a new infographic (Figure 2-3).
- A new infographic (Figure 2-4) highlights the foundational guidelines and recommendations of the *Dietary Guidelines*.
- Figure 2-5 has been added to show the percent of the U.S population (above age 1) who are at or below each dietary goal the *Dietary Guidelines*.
- A new *Newsworthy Nutrition*, "Impact of diet quality on health outcomes," presents a systemic literature review and meta-analysis published in the *Journal of the Academy of Nutrition and Dietetics*.
- A *Fake or Fact* feature is presented in Section 2.2 and highlights plant proteins.
- The *Farm to Fork* feature highlights citrus fruit, including oranges, tangelos, grapefruit, lemons, and limes.
- A new infographic (Figure 2-7) emphasizes Smart and Simple Food Swaps to improve overall dietary patterns.
- The new *Magnificent Microbiome* feature in Section 2.2 briefly describes the impact of dietary and physical activity patterns on gut microbes.
- Table 2-1 has been updated to reflect the most recent U.S. Department of Health and Human Services *Physical Activity Guidelines,* and the sections on Key Guidelines for Children and Adolescents and Older Adults have been moved to later chapters focusing on specific cohorts. The glossary terms "aerobic" and "anaerobic" now appear with other glossary terms in the margin.
- The image and calorie values for Figure 2-10 have been updated to illustrate that all dairy is not the same.
- A new infographic (Figure 2-11: "MyPlate Build-a-Meal Wizard") is designed to help students design meals aligning with the MyPlate food sources.
- A new critical thinking feature about solid fats has been added to the margin in Section 2.3.
- Figure 2-12 has been created to display simple swaps for breakfast, lunch, dinner, and snacking to promote nutrient-dense options that align with the *Dietary Guidelines*.
- A new glossary term, *hidden hunger,* has been added to Section 2.4 in the Undernutrition section.
- The *y*-axis for Figure 2-14 has been updated so the word *suboptimal* replaced *poor* when describing nutritional status and body functions.
- The title for Section 2.5 has been updated to "Measuring Nutritional Status." The content of Assessing Nutritional Status in this section has been streamlined to provide more detail and clarification. Figure 2-15, the ABCDEs of Nutritional Assessment, is now presented in a colorful infographic.
- Section 2.6 has been shortened and renamed "Nutrient Recommendations" to align with USDA verbiage. The DRI Chronic Disease Risk Reduction Intake (CDRR) category has been added and defined in his section. Figure 2-16 has been updated to detail varying nutrient intake levels and their relationship to the DRIs.
- A new *Ask the RDN*, authored by dietitian Zach Breeding, discusses transgender nutrition-related issues and provides recommendations specific to transgender populations.
- Figure 2-17 has been added to Section 2.7 to help evaluate reliable nutrition information. In addition, the text has been updated to reflect tips for evaluating nutrition and health information.
- New information on nutrition and fitness apps has been added to Section 2.7 and includes a link to the Academy of Nutrition and Dietetics's science-based reviews of the most current and popular nutrition apps for smart phones and tablets.
- Table 2-3 has been shortened to emphasize key nutrient claims on food labels. The label terms *reduced* and *low cholesterol* have been added.
- Section 2.8 includes a new "Top 8 Food Allergens" in the margin box to reinforce common food-related allergens. Approved health claims have also been updated.
- Section 2.9 has been added to Chapter 2 (previously located in Chapter 1) and focuses on eating well as a student. The subheadings on food choices and weight control have been updated to reflect the current scientific evidence. This section also contains a section on alcohol and binge drinking. The *Case Study* presents a college student who is trying to improve his dietary patterns while maintaining a busy college schedule and tight budget.
- The new *Sustainable Solutions* feature reinforces the positive impact of a plant-focused dietary pattern.
- There are 24 new *Further Readings* in Chapter 2.

Chapter 3: *The Human Body: A Nutrition Perspective*

- Two new *Fake or Fact* features highlight common misconceptions about peptic ulcers and diverticular disease.
- *Magnificent Microbiome* focuses on the hygiene hypothesis.
- Sections 3.1 and 3.2 have been reorganized to separate the discussion of the structure and function of the cell from the simple introduction to the concept of metabolism.
- Section 3.6 has been reworked to provide a more detailed introduction to the endocrine system, which comes up repeatedly throughout the text.
- Section 3.9 serves as an introduction to the concepts of the microbiota and microbiome, topics that are now woven throughout the text as part of the new *Magnificent Microbiome* features.
- Figure 3-3 has been updated to accentuate the organs of each organ system.

- Figures 3-1, 3-2, 3-4, 3-6, 3-7, 3-9, and 3-14 have been updated to an infographic style to more clearly explain key features of the body systems.
- *Newsworthy Nutrition* has been updated to present recent research on fecal transplant as a treatment for antibiotic-associated diarrhea.
- *Sustainable Solutions* presents the immune system as the human body's natural solution for sustainability!
- *COVID Corner* summarizes the evidence for and against probiotic supplements to boost immune function.
- The discussion of nutrition and genetics has been moved to Chapter 6, where it appears alongside pertinent information on gene expression.
- The discussion of diverticulosis and diverticulitis has been moved from Chapter 4 into the "Nutrition and Your Health Section" of Chapter 3.
- Chapter 3 includes 23 new *Further Readings.*

Chapter 4: *Carbohydrates*

- The chapter opening image has been replaced with a colorful spread of carbohydrate-containing foods.
- The *Fake or Fact* feature dispels the myth that carbohydrates are fattening and should be avoided.
- Figure 4-1 has been updated to include the photosynthesis equation as a component of the figure.
- The Carbohydrate Concept Map is now presented in three separate figures that align with the text (Figure 4-2: Monosaccharides and Disaccharides; Figure 4-5: Polysaccharides; and Figure 4-7: Full Carbohydrate Concept Map). In addition, the chemical structures of each type of carbohydrate are now included in these figures to simplify these complex topics for improved comprehension.
- Section 4.2 contains a new Table 4-1 detailing the classifications of fiber (type, components, physiological effects, and major food sources).
- The *Magnificent Microbiome* feature in Section 4.3 details microbiota-accessible carbohydrates and their importance.
- The Food Sources of Carbohydrate bar graph has been replaced by a colorful flashcard-type infographic (Figure 4-8) that clearly displays the MyPlate food sources, common foods, and images of select foods that contain carbohydrates. All nutrient values have been updated to align with the updated USDA values.
- A new Smart Beverage Choices infographic (Figure 4-9) was added to Section 4.3 to help students recognize healthier beverage choices throughout the day, including while purchasing drinks at smoothie stands and coffee shops.
- Figure 4-10 shows the average intake of grain subgroups compared to the *Dietary Guidelines* for adults.
- Figure 4-11, the Whole Grains Council stamps for use on grain products has been updated from two to three stamps with details for each plus the minimum requirements for whole grains per serving. Table 4-3 has been updated with 13 additional whole and ancient grains, with gluten-free grains clearly identified.
- The new *Sustainable Solutions* feature discusses the systems-level collaborations needed to encourage improved dietary patterns.
- In Section 4.3, energy and sports drinks are added to emphasize these as growing sources of added sugars in the United States.
- Approved by the FDA in 2019, allulose is now included under alternative sweeteners.
- A *Fake or Fact* feature dispels the myth that artificial sweeteners cause cancer.
- Table 4-5 includes updates and additional information about artificial sweeteners, including the newest approved sweetener (allulose), brand names, acceptable daily intakes (ADI), and the amount needed to reach the ADI.
- Figure 4-12 has been updated as a colorful infographic to improve the visual appeal and highlight the main organs involved in carbohydrate digestion and absorption.
- A new infographic (Figure 4-14) is included in Section 4.6 to visually present the carbohydrate-specific recommendations from the *Dietary Guidelines*.
- A new *Newsworthy Nutrition*, "Americans are decreasing consumption of sugar-sweetened beverages," is a cross-sectional study based on research published in the *Journal of Obesity*.
- A new figure (4-16) was created to visually display the top sources and average intakes of added sugars in the population.
- Figure 4-15, has been added to help explain the concept of insulin resistance.
- Figure 4-18 has been updated to present the characteristics of metabolic syndrome as a simple and appealing infographic.
- There are 12 new *Further Readings* in Chapter 4.

Chapter 5: *Lipids*

- A *Fake or Fact* feature weighs the pros and cons of eggs as part of a heart-healthy dietary pattern.
- Section 5.1 has been revised to improve students' understanding of the chemistry of lipids, which is often daunting for non-majors.
- Figure 5-6 and the section on food sources of lipids have been revised to present the food sources of lipids in a more visually appealing manner and give the students practical tips for choosing healthy fats.
- The discussion of *trans* fats has been revised in response to the ban on *trans* fats that went into effect in 2018. *Trans* fats have been removed from Figure 5-7.
- Food sources of omega-3 fatty acids are now presented as Table 5-1.
- *Sustainable Solutions* educates students about aquaculture as a means of providing a safe and sustainable supply of seafood to meet growing global demand.
- Figure 5-10 has been updated with an infographic style to more clearly present the complex topic of digestion and absorption of lipids.
- *COVID Corner* explores the evidence regarding omega-3 fatty acid supplements for COVID-19 prevention or treatment.

- Age-specific guidance on saturated fat intake has been updated to reflect the most recent edition of the *Dietary Guidelines for Americans*.
- *Newsworthy Nutrition* presents a randomized, controlled trial conducted with college students to explore the health benefits of nuts.
- The content of Section 5.7 has been simplified to focus less on medical treatments and more on dietary strategies to lower risk for cardiovascular disease. A new Figure 5-15 contrasts heart attack symptoms for men and women. In addition, a new Figure 5-17 summarizes risk factors for cardiovascular disease.
- *Magnificent Microbiome* explores the impact of postbiotics on heart health.
- Chapter 5 has been updated with 16 new *Further Readings.*

Chapter 6: *Proteins*

- The chapter opens with a *Fake or Fact* feature dispelling the myth that it is impossible to eat too much protein.
- Figure 6-2 now depicts the metabolic reaction that is compromised in the genetic disorder phenylketonuria.
- In Section 6.2 the discussion of protein organization appears before protein synthesis.
- Figure 6-7 has been revised to present the food sources of proteins more visually.
- Figure 6-8 has been enhanced to include photos of possible plant group combinations in which proteins complement each other. Figure 6-9 is a new illustration showing that plant-based proteins are found in a variety of food sources.
- The following topics are discussed in the *COVID Corner* feature: (1) the impact of the pandemic on the livestock and meat industry; (2) the potential beneficial effect of the Mediterranean diet against infections such as COVID-19; and (3) protein recommendations for patients who are ill with infections such as COVID-19.
- A *Sustainable Solution* feature in Section 6.3 discusses the potential of the Mediterranean diet to support sustainable food production.
- In Section 6.4, Figure 6-12 has been redesigned for easier understanding of protein digestion and absorption, and the new *Magnificent Microbiome* feature discusses how different types of protein sources can impact gut microbiota and obesity in both positive and negative ways.
- In Section 6.5, Figure 6-15: Protein Concept Map has been updated to illustrate the regulatory functions of protein.
- Section 6.6 includes a new infographic, Figure 6-17, illustrating the protein-specific recommendations from the new *Dietary Guidelines for Americans, 2020–2025,* as well as a new *Ask the RDN* entitled "Active Eating Advice" written by Leslie Bonci, a sports dietitian for collegiate, professional, Olympic, and recreational athletes as well as performance artists.
- The discussion of nutrition and genetics now appears as Section 6.8, and the difference between nutrigenetics and nutrigenomics is now illustrated in an infographic, Figure 6-19.
- Different types of vegetarians and the protein sources they consume are now illustrated in an infographic, Figure 6-21.
- Table 6-3: Food Plan for Vegetarians is now color-coded based on MyPlate.
- Section 6.9 includes a new *Ask the RDN* on plant-based eating, written by Alexis Joseph, dietitian, nutrition consultant, founder of Hummusapien and co-owner of Alchemy Brands. She provides tips on replacing meat and dairy with high-quality plant proteins.
- Eight new articles are included in the *Further Readings*.

Chapter 7: Energy Balance

- The chapter title has been updated to focus on energy balance versus weight control. This aligns with our updated text presenting a more weight-neutral approach and also including the evidence-based recommendations for those choosing to reduce their body weight.
- The chapter opening image has been updated to display the key components of health—nutrients including water, fruits, and vegetables, as well as hand weights to remind us of physical activity.
- The *Fake or Fact* feature dispels the myth that you should avoid all carbohydrates to lose weight.
- Figure 7-1 has been updated to reflect the most current data related to adult obesity trends in the U.S.
- Figure 7-2 has been updated to be more visually appealing.
- A new infographic (Figure 7-5) presents the components of energy output, including the contributions of basal metabolic rate, voluntary activity, and the thermic effect of food on energy output. In addition, the concepts of nonexercise-activity thermogenesis (NEAT) and exercise-induced thermogenesis (EAT) are introduced.
- The new *Sustainable Solutions* feature in Section 7.1 includes the definition of a sustainable dietary pattern from the Food and Agriculture Organization of the United Nations (FAO).
- Figure 7-6 has been revised to simplify the concepts. The indirect calorimetry image has also been updated in Section 7.2.
- Section 7.3 has been updated with more current images of the BodPod, skinfold and waist circumference measurements, and DXA. This section also now includes information about personal body fat scales with body composition measures that sync with mobile devices for easier tracking. There is also new information on utilizing NutritionCalc Plus in Connect to estimate energy needs.
- Table 7-1 has been updated with all WHO categories and subcategories of body mass indices. Table 7-2 has been replaced by a new infographic (Figure 7-11) visually displaying the health issues related to excess body fatness.
- New text has been added related to obesity posing a threat to national security, and *Further Readings* contains a reference for those with additional interest in this topic.
- The weight-loss triad, Figure 7-20, has been updated to emphasize the interrelated components of successful weight loss and regular physical activity.

- The *Magnificent Microbiome* feature in Section 7.6 describes the connection between gut microbes and appetite.
- A *Fake or Fact* feature dispels the myth that calories alone make you feel full.
- A new infographic, Figure 7-21, visually presents the concept of energy density with various food choices.
- Table 7-3 has been updated with the most recent USDA nutrient analysis food values. The images for Figure 7-22 have also been updated to promote reading of Nutrition Facts labels as part of a sustainable weight management plan.
- The new *Magnificent Microbiome* feature, in Section 7.7, details the impact of regular physical activity and protein intake on the gut microbiome.
- Table 7-4 has been condensed to include popular physical activities and estimated calorie costs associated with each activity, and a new Concept Check question has been added.
- The concept of intuitive eating is now included in this chapter and reinforces respect for one's body and eating without judgment. In addition, a new infographic (Figure 7-25) presents weight bias, its impact, and examples of people-first language.
- Table 7-6 presents the medications approved for obesity treatment, including information about the FDA approval of Plenity and discontinuation of Belviq XR (lorcaserin) given its potential link with cancer.
- Cryolipolysis, patented under the name CoolSculpting™, is described in Section 7.8.
- The *Ask the RDN* features the current evidence on intermittent fasting.
- Table 7-8 and related text have been updated to include new details of the strengths, limitations, and possible side effects of bariatric surgeries performed on youth.
- Section 7.10 includes new information related to specific tips for gaining healthy body weight that should be of interest to students struggling with underweight or those attempting to gain weight.
- Presentation of the five best overall diet plans has been updated in the text and presented in Table 7-8.
- *Further Readings* have been updated with 21 new references.

Chapter 8: *Vitamins and Phytochemicals*

- This chapter title now includes both vitamins and phytochemicals, and the opening image is now a beautiful photograph of fresh produce rich in vitamins and phytochemicals. The learning objectives have been updated to streamline the vitamin content throughout the chapter.
- The new *Fake or Fact* feature dispels the myth that vitamin-fortified foods are a healthier option to include in your dietary pattern.
- Table 8-2: Food Sources of Some Phytochemicals Under Study has been moved from Chapter 1 to Chapter 8.
- Figure 8-2 has been revised to add more visual appeal and enhance learning.
- An updated section on phytochemicals has been included to reflect current research and updates on these health-promoting plant-based chemicals. A new image and text have been added on reusable produce bags that are environmentally friendly.
- Examples of zoochemicals and phytochemicals were added to provide further clarification of these compounds. Carotenoid information has been updated and expanded in Section 8.1.
- The previous food source figures have been replaced throughout the chapter by vitamin-specific flashcard infographics that enhance readability and concisely summarize key information on the food sources of each vitamin, their main functions, relevant recommendations, and other pertinent notes.
- The *Sustainable Solutions* feature discusses biofortification to increase food crop nutrient density.
- New information from the *Dietary Guidelines for Americans, 2020–25*, about vitamin D has been included.
- Factors that impair vitamin D status have been condensed and moved to a margin box. An additional *Farm to Fork* feature focuses on mushrooms, an excellent source of vitamins and minerals and a vitamin D precursor.
- Fig. 8-15 has been condensed to simply how the B vitamins are essential components of many coenzymes involved in energy metabolism.
- The *Magnificent Microbiome* feature discusses endogenous vitamin production that occurs within our GI tract.
- Figure 8-25: Vitamin B-12 Digestion and Absorption has been expanded and reformatted to improve comprehension.
- Figure 8-30 has been condensed to highlight the dietary supplement industry's projected sales through 2024.
- New *Ask the RDN* by contributor Karen Collins discusses dietary supplements and current evidence surrounding their use. The Top 5 Dietary Supplements has been updated in Section 8.17.
- *COVID Corner* presents evidence and recommendations to support a healthy immune system to fight disease and enviromental insults.
- The "Nutrition and Your Health" section on nutrition and cancer contains the 2020 American Cancer Society's evidence-based guideline for diet and physical activity.
- A *Fake or Fact* feature in Section 8.18 dispels the myth that sugar feeds cancer.
- New *Concept Checks* and other questions have been added throughout to stimulate critical thinking.
- *Further Readings* have been updated to include 10 new articles.

Chapter 9: *Water and Minerals*

- There are two new *Fake or Fact* features in Chapter 9 that explain (1) the truth behind whether everyone needs to drink eight glasses of water a day and (2) if we should feed a fever.
- Food source figures for water and each mineral have been updated to be more attractive and include sources, as well as functions and recommendations, for water and minerals.

- Alternatives to bottled water use are discussed in the *Sustainable Solutions* feature.
- Section 9.2: The Water Balancing Act includes a new infographic (Figure 9-10) explaining the guidelines for the safe use of water bottles, and a new section entitled "Is Sparkling or Seltzer Water Harmful for Teeth?"
- This chapter presents the latest Dietary Reference Intakes for sodium and potassium released by the National Academies of Sciences in March 2019, including the new category Chronic Disease Risk Reduction Intake (CDRR).
- New information from the *Dietary Guidelines for Americans, 2020–25*, about sodium, potassium, and calcium has been included.
- New content on types of salt is included in the section "Table Salt, Kosher Salt, Sea Salt—Which One Is Best?"
- An additional *Farm to Fork* discusses bananas and ties into the section on "Getting Enough Potassium."
- The factors that enhance and inhibit calcium absorption are now shown in a new infographic (Figure 9-22) that includes a diagram of the gastrointestinal tract.
- There are two new *Newsworthy Nutrition* features summarizing research on (1) calcium supplements and cardiovascular disease risk and (2) the effect of dietary potassium and arterial stiffness.
- The interaction between iron and the intestinal microbiota is discussed in the *Magnificent Microbiome* feature.
- Section 9.17: Minerals and Hypertension highlights the new 2017 guidelines for the prevention, detection, evaluation, and management of high blood pressure in adults. Figure 9-33 has been updated with new effects of lifestyle changes on blood pressure. Also included are the goals and strategies from the recently released *The Surgeon General's Call to Action to Control Hypertension*.
- *COVID Corner* examines the following topics: (1) the suggestion to drink water frequently to help prevent COVID-19 infection; (2) the effect of nutrient supplements, including zinc, on the risk or severity of viral infections; (3) links between selenium status and COVID-19; and (4) the identification of hypertension as one of the strongest risk factors for suffering a severe case of COVID-19 infection.
- Fifteen new *Further Readings* are included.

Chapter 10: *Nutrition: Fitness and Sports*

- The Chapter 10 opening image has been updated, and physical activity recommendations throughout the chapter align with the revised *Physical Activity Guidelines for Americans* published by the U.S. Department of Health and Human Services.
- The *Fake or Fact* feature dispels the myth that higher protein intake alone equates to greater muscle mass.
- Figure 10-1 has been updated to present the latest research related to the physical and mental health benefits of physical activity.
- A *Magnificent Microbiome* feature in Section 10.2 presents ongoing research linking physical activity to health-promoting bacteria in the gut.
- Tips for measuring your heart rate and calculating your target heart rate have been simplified, and details on using the "try to talk test" have been added to a margin note.
- Table 10-1 has been updated to align with the new physical activity guidelines.
- The Rating of Perceived Exertion (RPE) scale in Figure 10-3 has been updated to reflect the common Borg Scale of Perceived Exertion.
- A new *Newsworthy Nutrition* feature presents an animal study evaluating the impact of branched-chain amino acids on health and lifespan.
- The *Farm to Fork* feature presents carrots and beets, root crops often consumed by athletes before, during, and after competition.
- Figure 10-11 and a new text section detailing relative energy deficiency in sport (RED-S) have been added to Section 10.4.
- A *Fake or Fact* feature dispels the myth that thirst is a valid indicator of hydration status, and a *Sustainable Solutions* feature discusses the waste associated with water intake when individuals use single-use containers.
- Tables 10-4 and 10-8 have been updated with new energy drink, bar, gel, and chew products and their nutrient contents.
- Tables 10-7 and 10-9 have been edited to reflect the latest USDA nutrient composition values and emphasize more plant-based meal options for sports nutrition.
- A new *Ask the RDN* related to enhancing metabolism presents recommendations to modify lifestyle behaviors to promote weight maintenance. An emphasis on plant-based protein sources is included and emphasized throughout the chapter.
- Based upon the evidence, the title for Section 10.5 has been changed to Recommendations for Endurance, Strength, and Power Athletes.
- The lists of commonly used sports supplements and illegal substances have been expanded and updated in Tables 10-11 and 10-12.
- Seven new *Further Readings* have been added.

Chapter 11: *Eating Disorders*

- A new *Fake or Fact* feature debunks some widely held myths about the origins of eating disorders.
- A new *Ask the RDN* by Alexis Joseph explains the connections among energy availability, regular menstrual function, and bone health.
- The *Magnificent Microbiome* feature explores the role of the gut microbiota in recovery from eating disorders.
- A new Figure 11-2 illustrates Russell's sign.

- *COVID Corner* examines the impact of stay-at-home orders (to prevent the spread of COVID-19) on the eating disorders community.
- Section 11.6 now includes content about the combined problems of disordered eating and binge drinking, a growing problem on college campuses.
- Twenty-two new articles have been incorporated into the list of *Further Readings*.

Chapter 12: Protecting Our Food Supply

- The *Fake or Fact* feature debunks the myth that organic products have increased nutritional value compared to conventional products.
- The chapter now begins with the section on Food Production Choices to discuss where our food comes from and how it is produced. Topics include organic food production, biotechnology, and sustainable agriculture.
- A new *Ask the RDN* feature by guest contributor and supermarket dietitian Leah McGrath answers questions about whether the positive effects of organic and non-GMO foods justify their added expense.
- The *Sustainable Solutions* features explain the sustainable practice of hydroponics, and what it means to be a LOHAS (lifestyles of health and sustainability) consumer.
- A new *Magnificent Microbiome* feature highlights the potential impact of fermented foods on gut health and the effect of the gut microbiome on norovirus infection.
- Figure 12-3 is a map from the CDC that graphically depicts the reported foodborne disease outbreaks across the U.S., and Figure 12-5 shows the step-by-step process by which reported outbreaks prompt an investigation and, once confirmed, are shared with the public.
- All foodborne illness prevalence data and food import data have been updated throughout the chapter.
- Information on recent examples, onset, symptoms, and sources of foodborne illness outbreaks has been updated and moved to Tables 12-5, 12-6, and 12-7 on the bacterial, viral, and parasitic causes of foodborne illnesses.
- The *COVID Corner* feature reviews the inability to contract COVID-19 from food or packaging.
- Twenty-one new resources are cited in the chapter and included in the *Further Readings.*

Chapter 13: Global Nutrition

- The chapter opening image has been updated to reinforce global dietary patterns.
- The new *Fake or Fact* feature dispels the myth that there is not enough food on the planet to meet our dietary needs.
- The most recent statistics on both domestic and global poverty and hunger from the Food and Agriculture Organization (FAO) of the United Nations and the U.S. Census Bureau are included.
- A new infographic, Figure 13-4, has been added to describe how food insecurity can contribute to wasting, stunting, and micronutrient deficiencies. Figure 13-5 has been revised to a simpler format.
- A new margin note details the top 10 countries at highest risk for a humanitarian crisis.
- The new *Fake or Fact* feature in Section 13.1 dispels the myth that malnutrition equates to hunger.
- Updates of the characteristics of users and impact of the federally subsidized nutrition programs, including SNAP, WIC, and Senior Nutrition Services that supply food for people in the U.S., has been expanded and updated in Table 13-2.
- A new infographic, Figure 13-6, visually displays the impact of malnutrition on health.
- This chapter's *COVID Corner* about the impact of the COVID-19 pandemic on food security levels and malnutrition is presented in Section 13.2.
- The title of Section 13.3 has been updated to Malnutrition in the Developing World to emphasize both under- and overnutrition influencing global malnutrition.
- The *Sustainable Solutions* feature describes the history of agricultural practices dating back 1.5 million years.
- Figure 13-7 presents the complex factors that contribute to malnutrition in developing countries.
- Figure 13-8 presents the data pertaining to global access to safe water aligning with the Sustainable Development Goal for clean water and sanitation.
- The *Farm to Fork* in this section highlights pineapples, often seen as a global staple providing key nutrients and an economic advantage for developing countries.
- A new *Newsworthy Nutrition* presents a case-control study assessing maternal depression and acute malnutrition in children.
- A new Sustainable Development Goal (SDG) progress report includes SDG updates on key goals and metrics.
- The new *Magnificent Microbiome* feature details the microbiome of a vibrant living community—our soil!
- Figure 13-10 is a new infographic, adapted from the FAO, describing the many facets of sustainable intensification in agriculture.
- A new *Ask the RDN,* authored by Chris Vogliano, presents the issues related to global food waste and details the EPA's Food Recovery Hierarchy to counter food waste.
- *Further Readings* includes 28 new references.

Chapter 14: *Nutrition During Pregnancy and Breastfeeding*

- This chapter includes three new *Fake or Fact* features. One examines the science behind pregnancy cravings. The second cautions against tight sodium restrictions during pregnancy. A third explains the lack of evidence to support maternal dietary restrictions for the prevention of food allergies.
- In Section 14.1, the latest evidence-based guidelines on treatment of polycystic ovary syndrome are discussed.
- In Section 14.4, the discussion of macronutrient needs of pregnant women has been separated into subsections

to improve readability. New tables have been added to summarize the energy needs of pregnant and lactating women. Also, a separate subsection on fluid needs during pregnancy has been added.

- The graphics in Figure 14-8 have been updated to match the latest version of MyPlate.
- In Section 14.7, we have included information about the Baby-Friendly Hospital Initiative and defined a new term: *human milk oligosaccharides.* We have also added a new section on expressing and storing human milk.
- The *Magnificent Microbiome* feature highlights the probiotic and prebiotic properties of human milk.
- The *Sustainable Solutions* feature touts the role of breastfeeding in meeting several Sustainable Development Goals of the United Nations.
- *COVID Corner* reviews safety issues regarding breastfeeding during the pandemic.
- *Further Readings* includes 56 updated resources.

Chapter 15: *Nutrition from Infancy Through Adolescence*

- A *Fake or Fact* feature reinforces the latest recommendations from the American Academy of Nutrition and Dietetics, American Academy of Pediatric Dentistry, American Academy of Pediatrics, and American Heart Association about healthy beverage choices. Information about selecting healthy beverages has been incorporated into sections 15.3, 15.4, 15.5, and 15.6.
- Figures 15-1 and 15-2 have been annotated to show students how to plot growth and BMI on growth charts.
- We have added several new margin notes throughout the chapter to summarize nutrient recommendations at various stages of childhood.
- In Section 15.2, information about iron supplementation has been updated to reflect the recommendations of the American Academy of Pediatrics.
- In Section 15.3, a new subsection has been added about baby-led introduction to solid foods and a new term has been defined: *responsive feeding.* Tables 15-5, 15-6, and 15-7 have been updated to match the newest *Dietary Guidelines*' healthy U.S.-style dietary patterns for various stages of childhood.
- Section 15.4 now includes the most recent recommendations from the *Physical Activity Guidelines for Americans.*
- A new *Ask the RDN* from child nutrition expert Sally Kuzemchak provides practical advice to help caregivers cope with picky eating. A new term, *neophobia*, is defined.
- The discussion about links between nutrition and autism spectrum disorder is updated.
- The *Magnificent Microbiome* feature reviews the role of the gut microbiota in the development and possible treatment of autism spectrum disorder.
- The *Sustainable Solutions* feature proposes partnerships between schools and local farmers as a way to promote child health and economic growth in communities.
- *COVID Corner* highlights the impact of the pandemic on nutrition security for families with children.
- An updated *Newsworthy Nutrition* feature describes recent research on the connections between dietary patterns and acne.
- Section 15.7 has been updated with new statistics about food allergies and intolerances and the latest recommendations from the *Dietary Guidelines* and the American Academy of Pediatrics for preventing food allergies.
- Fifty-nine new references have been added to the list of *Further Readings*.

Chapter 16: *Nutrition During Adulthood*

- All demographic and prevalence data on aging have been updated in Section 16.1. In addition, the entire chapter has been revised to emphasize healthy aging and active living during this stage of the life cycle.
- A *Fake or Fact* feature shows that longevity is not just genetic, but largely results from a lifetime of healthy behaviors.
- A new figure from the World Health Organization (WHO) (Fig. 16-2) on aging and health emphasizes key influences of aging and recommendations for healthy aging. A new box also highlights healthy aging.
- A new *Newsworthy Nutrition* feature highlights research assessing the impact of dietary patterns on telomeres, a biomarker of aging.
- Figure 16-4 has been updated to match the most recent version of the Nutrition Screening Initiative's Nutrition Checklist for Older Adults, which utilizes the DETERMINE mnemonic.
- The dietary reference intakes for sodium have been updated in Section 16.2, including Figures 16-5 and 16-6.
- Figure 16-7 has been revised to provide a more comprehensive array of strategies to cope with the physiological changes of aging as adapted by the National Institute on Aging.
- *COVID Corner* reviews the connections between malnutrition and COVID-related morbidity and mortality among older adults.
- A new Table 16-2 summarizes the key physical activity guidelines for adults and older adults.
- Table 16-3 has been updated with the latest research on popular herbal remedies used by American adults.
- A new Table 16-4 has been added to illustrate the healthy U.S.-style dietary patterns for older adults from the latest edition of the *Dietary Guidelines*.
- A box feature introduces the rising popularity of home-delivered meal kits and the most popular services available.
- Section 16.7 summarizes the role of nutrition for brain health throughout the life span with an emphasis on prevention of neurodegenerative diseases. *Newsworthy Nutrition* touts the benefits of a Mediterranean diet for prevention of Alzheimer's disease.
- *Further Readings* have been updated with 43 new references.

Contents

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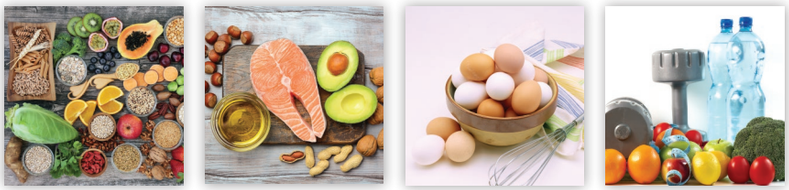
Breakfast bowl: Alexis Joseph/McGraw-Hill Education; happy family in the kitchen: Makistock/Shutterstock; chia pudding: Alexis Joseph/McGraw-Hill Education

Part Two: Energy Nutrients and Energy Balance



Dietary fiber health food: Marilyn Barbone/Shutterstock; healthy fat sources: Julija Dmitrijeva/123RF; eggs: Pixtal/AGE Fotostock; Supermarket, fruit and vegetable: PM78/iStock/Getty Images

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Part Three: Vitamins, Minerals, and Water


Micronutrients/phytochemicals: Alexis Joseph/McGraw-Hill Education; lemon water: Susan Rusnak

Part Four: Nutrition: Beyond the Nutrients




Swimmer: Erik Isakson/Blend Images LLC; woman sneaking cake: BananaStock/Getty Images; washing vegetables for a salad: KatarzynaBialasiewicz/Getty Images; eating dinner: Zurijeta/Shutterstock

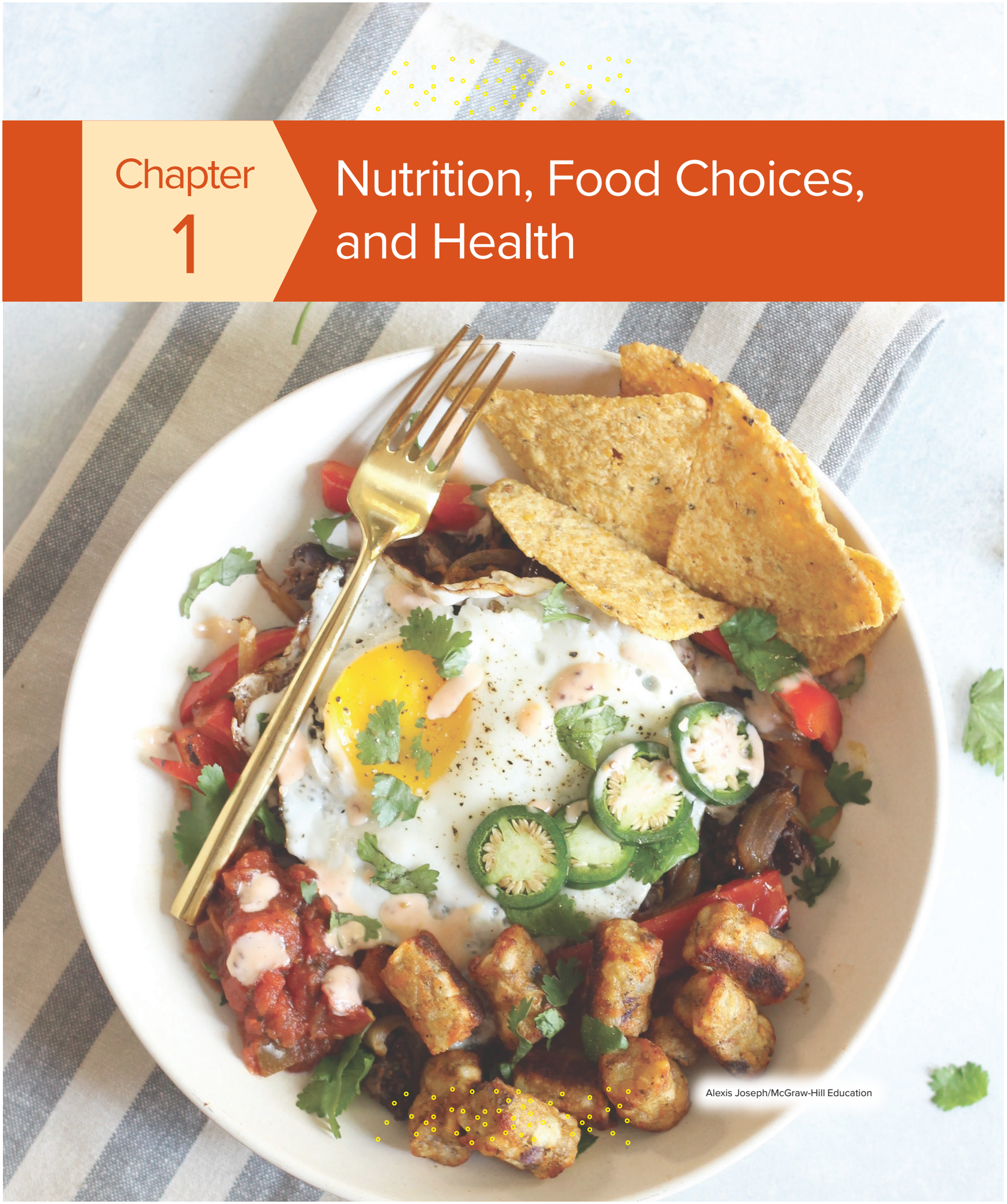
Part Five: Nutrition: A Focus on Life Stages



Portrait of a couple expecting a baby sitting on a park bench: Stockbyte/Getty Images; Germany, Bavaria, Munich, mother and daughter preparing salad, son eating: Westend61/Getty Images; Ingrid Adams: Mary Jon Ludy/McGraw-Hill Education

Chapter 1

Nutrition, Food Choices, and Health



Alexis Joseph/McGraw-Hill Education

Student Learning Outcomes

Chapter 1 is designed to allow you to:

1.1 Describe how our food choices are affected by the flavor, texture, and appearance of food; eating habits and food availability; advertising; dining out; convenience; cost; sustainability; nutrition; and hunger and appetite.

1.2 Identify dietary and lifestyle factors that contribute to the 10 leading causes of death in North America.

1.3 Define *nutrition, carbohydrate, protein, lipid, alcohol, vitamin, mineral, water, phytochemical, kilocalorie,* and *fiber.*

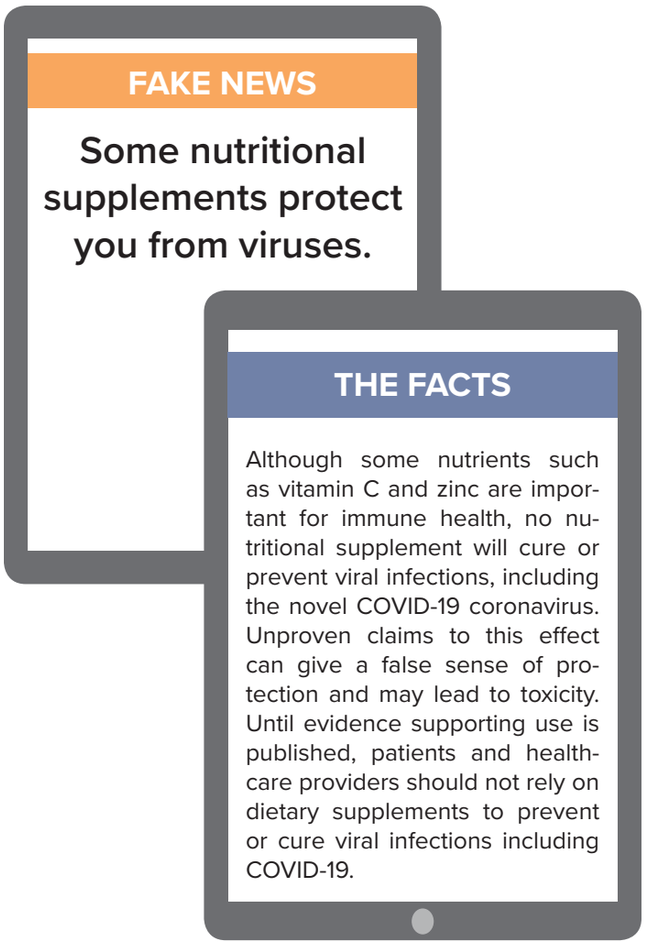
1.4 Determine the total calories (kcal) of a food or meal using the weight and calorie content of the energy-yielding nutrients, convert English to metric units, and calculate percentages, such as percent of calories from fat in a meal.

1.5 Understand the scientific method as it is used in forming and testing hypotheses in the field of nutrition; determine the strength of scientific evidence related to nutrition.

1.6 List the major characteristics of the North American dietary pattern, the food habits that often need improvement, and the aims of the "Nutrition and Healthy Eating" objectives of *Healthy People 2030*.

1.7 Describe a basic plan for health promotion and disease prevention and what to expect from good nutrition and a healthy lifestyle.

1.8 Compare benefits of moderate alcohol use to the risks of alcohol abuse.



Research has clearly shown that a lifestyle that includes a dietary pattern rich in fruits, vegetables, whole grains, and lean meat or plant protein, coupled with regular exercise, can enhance our current quality of life and keep us healthy for many years to come. Unfortunately, this healthy lifestyle is not always easy to follow. When it comes to "nutrition," it is clear that some of our eating patterns are out of balance with our metabolism, physiology, and physical activity level.

We begin this chapter with some questions. What influences your daily food choices? How important are factors such as taste, appearance, convenience, or cost? Is nutrition one of the factors you consider? Are your food choices influencing your quality of life and long-term health? By maintaining a healthy eating pattern, we can bring the goal of a long, healthy life within reach. This is the primary theme of this chapter and throughout this book.

The ultimate goal of this book is to help you find the best path to good nutrition. The information presented is based on emerging science that is translated into everyday actions that improve health. We begin each chapter with the Fake or Fact feature covering a relevant "Fake News" topic followed by the truth or "Facts" based on the state of reliable evidence. After completion of your nutrition course, you should understand the science behind the food choices you make and recommend to others. We call this achievement of making food choices that are healthy for you "nutrition literacy."

1.1 Why Do You Choose the Food You Eat?

In your lifetime, you will eat about 88,000 meals and 75 tons of food. Many factors—some internal, some external—influence our food choices. This chapter begins with a discussion of these factors and ends with a conversation about alcohol consumption and its relationship to our health. In between, we examine the powerful effect of eating patterns in determining overall health and take a close look at the general classes of nutrients—as well as the calories—supplied by the food we eat. We also discuss the major characteristics of North American eating patterns, the food habits that often need improvement, and where we stand on the "Nutrition and Weight Status" objectives of *Healthy People 2020*. A review of the scientific process behind nutrition recommendations is also included, along with an introduction to our *Farm to Fork*, *Newsworthy Nutrition*, *Magificent Microbiome, Sustainable Solutions,* and *Ask the RDN* features that appear in each chapter.

Understanding what drives us to eat and affects our food choices will help you understand the complexity of factors that influence eating, especially the effects of our routines and food advertising (Fig. 1-1). You can then appreciate why foods may have different meanings to different people and thus why others' food habits and preferences may differ from yours.

WHAT INFLUENCES YOUR FOOD CHOICES?

Food means much more to us than nourishment—it reflects much of what we think about ourselves. The Bureau of Labor Statistics estimated that in 2018, Americans spent 72 minutes a day eating and drinking.[1] If we live to be 80 years old, that will add up to 4 years of eating and drinking. Overall, our daily food choices stem from a complicated mix of biological and social influences (see Fig. 1-1). The 2019 Food and Health Survey

FIGURE 1-1 ▶ Food choices are affected by many factors. Which have the greatest impact on your food choices?
Florian Franke/Purestock/SuperStock

found that, from a list of six factors, 86% said that taste influenced their food purchases, followed by brand name (69%), price (68%), healthfulness (62%), convenience (57%), and environmental sustainability (27%).[2] Let's examine some of the key reasons why we choose what we eat and then ask your instructor about the *Rate Your Plate* activities: "Examine Your Eating Habits More Closely" and "Observe the Supermarket Explosion" in Connect.

Flavor, texture, and appearance are the most important factors determining our food choices. Creating more flavorful foods that are both healthy and profitable is a major focus of the food industry. The challenge is to combine the "taste" of the foods we prefer with the best nutrition and health characteristics. The good news is that chefs and "food bloggers" are dedicating themselves to creating nutritious food that is also delicious.

Early influences related to various people, places, and events have a continuing impact on our food choices. Many food customs, including ethnic eating patterns, begin as we are introduced to foods during childhood. Parents can lay a strong foundation knowing that exposure to food choices during early childhood is important in influencing later health behaviors. Developing healthy patterns during childhood will help ensure healthy preferences and choices when we are teenagers and adults.

Eating habits, food availability, and convenience strongly influence choices. Recent Food Availability and Consumption data from the United States Department of Agriculture (USDA) show that Americans consume more than the recommended amounts from the meat, eggs, and nuts group and the grains group. Potatoes and tomatoes are the most commonly consumed vegetables (Fig. 1-2), with French fries and pizza contributing to their popularity. Oranges and apples are the most commonly consumed fruits, but they are consumed mostly in juice form. Fluid milk and cheese, especially mozzarella cheese, comprise most of dairy consumption; fluid milk consumption has shown a big decline, while cheese consumption has doubled (Fig. 1-3).

Marketing and advertising are major tools for capturing the food interest of the consumer. Consumers have more food choices than ever, and the food industry in the United States spends billions on advertising. Some of this advertising is helpful, as it promotes the importance of healthy food components such as calcium and fiber. However, the food industry also advertises highly sweetened cereals, cookies, snacks, and soft drinks because they bring in the greatest profits. Studies have shown

▲ Exposing children to growing, preparing, and eating healthy food options, such as this veggie pasta, will lay a strong foundation for healthful choices throughout life. ©Jeff Laubert

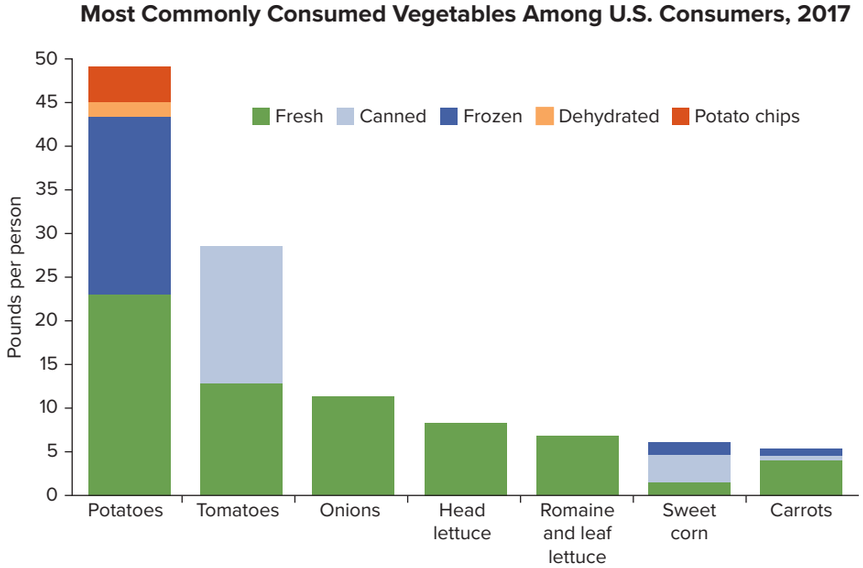
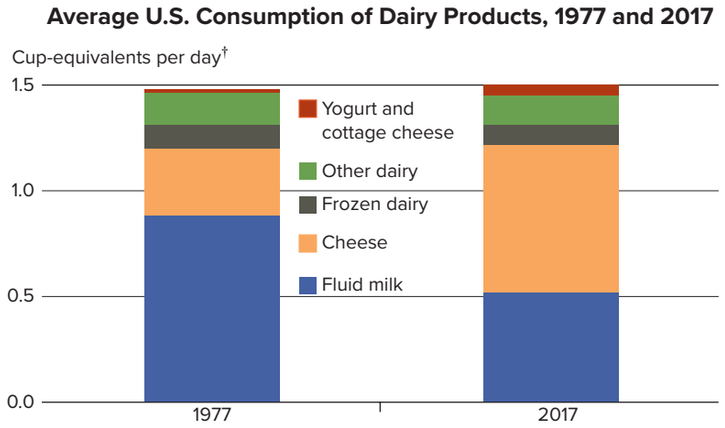


FIGURE 1-2 ◀ According to food availability data, the favorite vegetables of Americans are potatoes and tomatoes. In 2017, Americans consumed 49.2 pounds per person of potatoes and 28.7 pounds of tomatoes, with 56% as canned tomatoes. French fries and pizza contribute to the high consumption of these two vegetables. Onions were the third highest consumed vegetable at 11.3 pounds per person. USDA, Economic Research Service, Loss Adjusted Food Availability Data, 2017

FIGURE 1-3 ▶ According to food availability data from the USDA, Americans consumed a similar amount of dairy products (1.5 cup-equivalents of dairy products per person per day) in 1977 and in 2017. This is half the recommended amount for a 2000-calorie diet. Although the overall quantity is the same, the types of dairy products consumed have changed. Fluid milk consumption decreased from 0.9 to 0.5 cup per person per day, while cheese consumption has doubled.
USDA, Economic Research Service, Loss Adjusted Food Availability Data, 2017



†Based on a 2000-calorie-per-day diet. One cup-equivalent for dairy is: 1 cup milk or yogurt; 1½ ounces natural cheese or 2 ounces of processed cheese or ½ cup shredded cheese; 1 cup frozen yogurt or 1½ cups ice cream; 2 cups cottage cheese. Loss-adjusted food availability data are proxies for consumption. "Other dairy" includes evaporated milk, condensed milk, dry milk products, half and half, and eggnog.

Jacob is majoring in nutrition and is well aware of the importance of a healthy dietary pattern. He has recently been analyzing his meals and is confused. He notices that he eats a great deal of high-fat foods, such as peanut butter, cheese, chips, ice cream, and chocolate, and few fruits, vegetables, and whole grains. He also has become hooked on his daily cappuccino with lots of whipped cream. **What three factors may be influencing Jacob's food choices? What advice would you give him on how to have his dietary pattern match his needs?** Ingram Publishing

an association between TV advertising of foods and drinks and childhood obesity in the United States. A recent study found that preschoolers who were not hungry and who watched a show embedded with food advertisements consumed more calories from snacks than those who saw nonfood advertisements.[3] These findings suggest that exposure to food advertisements may encourage eating behaviors that promote obesity in the very young. Concern for the negative effects of advertising and marketing on the dietary patterns and health of children led the Council of Better Business Bureaus to establish the Children's Food and Beverage Advertising Initiative. Participants are 18 of the largest food and beverage companies that represent about 80% of child-directed television food advertising. The initiative is designed to shift the mix of foods advertised to children to encourage healthier dietary choices and healthy lifestyles.[4] Research also indicates that mass media influences the onset of eating disorders through its depiction of extremely thin models as stereotypes of attractive bodies.

Restaurant dining plays a significant role in our food choices. Restaurant food is often calorie dense, in large portions, and of poorer nutritional quality compared to foods made at home. Fast-food and pizza restaurant menus typically emphasize meat, cheese, fried foods, and carbonated beverages. In response to recent consumer demands, restaurants have placed healthier options on their menus, and many are listing nutritional content there as well. Posting of the calorie content of restaurant items is now mandated by law. The law requires chain restaurants with 20 or more locations to post the calorie content of their offerings on menus or menu boards with other nutritional information available upon request. The intent of the law is to provide consumers with clear and consistent nutrition information so that they can make informed and healthful choices. While research is showing that using calorie menu labels is associated with purchasing fewer calories, a study of customers at McDonald's restaurants found that there are significant socioeconomic disparities among customers who notice and use calorie menu labels.[5] These findings suggest that targeted education campaigns would help improve the use of menu labeling across all sociodemographic groups.

Time and convenience have become significant influences affecting food choices. Current lifestyles limit the time available for food preparation. A recent study in Seattle found that working adults who placed a higher priority on convenience than on home-cooked meals spent the least amount of time cooking. They spent more money eating away from home, especially at fast-food restaurants, suggesting that time is a key ingredient in the development of healthier eating habits.[6] Restaurants, supermarkets,

and meal delivery services have responded to our demanding work schedules and long hours away from home by supplying prepared meals, microwavable entrees, online grocery shopping and curbside pick-up, and quick-prep meals delivered to your door.

Cost and economics play a role in our food choices. The 2019 Food and Health Survey indicates that, after taste, cost is the number-two reason why people choose the food they do. While the average American now spends less on food than in the past, young adults and those with higher incomes spend the most on food. As income increases, so do meals eaten away from home, and as calorie intake increases, so does the food bill.

Sustainability is a relatively new factor that is affecting our food choices. With future generations in mind, many consumers are becoming more socially responsible to care for the environment. College students have become a big part of the movement to purchase local, seasonal, and sustainable food and to spread awareness that the way we produce and eat food can slow the rate of global warming, build strong communities, and improve our health. While the 2019 Food and Health Survey found that environmental sustainability was an important driver of food purchasing, 63% of consumers continue to find it hard to know whether the food choices they make are environmentally sustainable. These consumers agreed that environmental sustainability had a greater influence on food choices if it was easier to know which choices were in fact environmentally sustainable. When making environmentally sustainable animal protein purchases, consumers surveyed looked for labels such as "no added hormones," "grass-fed animals," and "locally raised."[7]

Nutrition—or what we think of as "healthy foods"—also directs our food purchases. North Americans who tend to make health-related food choices are often well-educated, middle-class professionals who are generally health oriented, have active lifestyles, and focus on weight control. The 2019 Food and Health Survey found that about 62% of consumers sometimes use healthfulness as a driver when purchasing food. The survey found that 23% of consumers say they actively seek out foods or follow a diet for health benefits such as weight loss, energy, digestive health, and heart health. Nutrition and health information on food package labels has also been shown to affect food choices. A recent study found that people are less likely to buy sugary drinks if they see warning labels that include graphic pictures of health consequences such as obesity, diabetes, and tooth decay.[8]

COVID CORNER

In 2020, online shopping and curbside pick-up of groceries increased dramatically as a result of the COVID-19 pandemic. The pandemic also had devastating effects on the economy which severely impacted the food budget of many families.

More than half (54%) of the respondents to the *2019 Food and Health Survey* said that environmental sustainability is important when they purchase and consume foods. Being labeled as locally grown, sustainably sourced, non-GMO/not bioengineered, and organic are the primary characteristics used to identify sustainable foods, along with foods with recyclable or minimal packaging.

Sustainable Solutions

WHY ARE YOU SO HUNGRY?

Two drives, **hunger** and **appetite,** influence our desire to eat. These drives differ dramatically. Hunger is primarily our physical, biological drive to eat and is controlled by internal body mechanisms. For example, as foods are digested and absorbed, the stomach and small intestine send signals to the liver and brain telling us to reduce further food intake.

hunger The primarily physiological (internal) drive to find and eat food.

appetite The primarily psychological (external) influences that encourage us to find and eat food, often in the absence of obvious hunger.

Appetite, our primarily psychological drive to eat, is affected by many of the external factors we discussed in the preceding section, such as environmental and psychological factors and social cues and customs (see Fig. 1-1). Appetite can be triggered simply by seeing a tempting dessert or smelling popcorn at the movie theater. Fulfilling either or both drives by eating sufficient food normally brings a state of **satiety,** a feeling of satisfaction that temporarily halts our desire to continue eating.

satiety A state in which there is no longer a desire to eat; a feeling of satisfaction.

The *feeding center* and the *satiety center* are in the **hypothalamus,** a region of the brain that helps regulate satiety. They work in opposite ways, like a tug-of-war, to promote adequate availability of nutrients at all times. When we haven't eaten for a while, stimulation of the feeding center signals us to eat. As we eat, the nutrient content in the blood rises, and the satiety center is stimulated. This is why we no longer have a strong desire to seek food after a meal. Admittedly, this concept of a tug-of-war between the feeding and satiety centers is an oversimplification of a complex process. The various feeding and satiety messages from body cells to the brain do not single-handedly determine what we eat. We often eat because food comforts us.[9] Almost everyone has encountered a mouthwatering dessert and devoured it,

hypothalamus A region of the forebrain that controls body temperature, thirst, and hunger.

even on a full stomach. It smells, tastes, and looks good. We might eat because it is the right time of day, we are celebrating, or we are seeking emotional comfort to overcome the blues. After a meal, memories of pleasant tastes and feelings reinforce appetite. If stress or depression sends you to the refrigerator, you are mostly seeking comfort, not food calories. Appetite may not be a physical process, but it does influence food intake.

When food is abundant, appetite—not hunger—more frequently triggers eating. Satiety associated with consuming a meal may reside primarily in our psychological frame of mind. Also, because satiety regulation is not perfect, body weight can fluctuate. We become accustomed to a certain amount of food at a meal. Providing less than that amount leaves us wanting more. One way to use this observation for weight-loss purposes is to train your eye to expect less food by slowly decreasing serving sizes to more appropriate amounts. Your appetite then readjusts as you expect less food. You should now understand that daily food consumption is a complicated mix of biological and social influences. Keep track of what triggers your eating for a few days. Is it primarily hunger or appetite?

COVID CORNER

Early in 2020, a novel coronavirus, COVID-19, resulted in a worldwide public health emergency that disrupted every aspect of our lives. To limit the spread of the virus and contain the disease, global measures of self-isolation and physical distancing were instituted. Most institutions and businesses, with the exception of hospitals and essential services, were closed. These drastic measures significantly impacted food access and utilization and the ability to maintain a healthy diet.[10]

The outbreak quickly led to an imbalance in the food supply chain with: (1) an excess of food that would have gone to restaurants and schools; (2) an increased demand for food at supermarkets and food pantries; and (3) widespread hoarding of supplies, food, and water. Older adults and individuals with preexisting medical conditions were particularly vulnerable to the coronavirus infection and at greatest risk for nutrition imbalance. There are no reports of contracting the virus from consuming contaminated food. Fortunately, the virus dies off rapidly on most surfaces, so there is likely very low risk of spread from food products or packaging.

When confined to your home during a pandemic, it is important to maintain a healthy lifestyle to support your immune system. This includes an eating pattern high in fruits and vegetables, engaging in regular physical activity, and maintaining a healthy body weight. Regarding specific foods or nutritional supplements, none can ward off the virus, and unproven claims to this effect can give a false sense of protection and eventually may lead to toxicity. The impact of this pandemic on the food system and nutrition-related issues are discussed in upcoming chapters.

CONCEPT CHECK 1.1

1. What are the factors that influence our food choices?
2. Which two vegetables are the most commonly consumed in the U.S. and why?
3. How do hunger and appetite differ in the way they influence our desire to eat?
4. What factors influence satiety?

1.2 How Is Nutrition Connected to Good Health?

Fortunately, the foods we eat can support good health in many ways, depending on their components. You just learned, however, that lifestyle habits and other factors may have a bigger impact on our food choices than the food components themselves. Unfortunately, many North Americans suffer from diseases that could have been prevented if they had known more about the foods and, more importantly, had applied this knowledge to plan meals and design their eating pattern. We will now look at the effect these choices are having on our health both today and in the future.

WHAT IS NUTRITION?

Nutrition is the science that links foods to health. It includes the processes by which the human organism ingests, digests, absorbs, transports, uses, and excretes food substances.

NUTRIENTS COME FROM FOOD

What is the difference between food and **nutrients**? Food provides the energy (in the form of calories) as well as the compounds needed to build and maintain all body cells. Nutrients are the substances obtained from food that are vital for growth and maintenance of a healthy body throughout life. For a substance to be considered an **essential nutrient,** three characteristics are needed:

- At least one specific biological function of the nutrient must be identified in the body.
- Omission of the nutrient from the dietary pattern must lead to a decline in certain biological functions, such as production of blood cells.
- Replacing the omitted nutrient in the dietary pattern before permanent damage occurs will restore those normal biological functions.

nutrients Chemical substances in food that contribute to health, many of which are essential parts of a dietary pattern. Nutrients nourish us by providing calories to fulfill energy needs, materials for building body parts, and factors to regulate necessary chemical processes in the body.

essential nutrient In nutritional terms, a substance that, when left out of a dietary pattern, leads to signs of poor health. The body either cannot produce this nutrient or cannot produce enough of it to meet its needs. If added back to a dietary pattern before permanent damage occurs, the affected aspects of health are restored.

WHY STUDY NUTRITION?

We all may feel like nutrition experts because we all eat several times a day. Nutrition knowledge can be confusing, however, and seem like a moving target. Recommendations may seem to differ depending on their source, and there are so many choices when shopping for food or eating out. You just learned that nutrition is only one of many factors that influence our eating habits. Studying nutrition will help you erase any misconceptions you have about food and nutrition and will assist you in making informed choices about the foods you eat and their relationship to health.

Nutrition is a lifestyle factor that is a key to developing and maintaining an optimal state of health. A poor dietary pattern and a sedentary lifestyle are known to be **risk factors** for life-threatening **chronic** diseases such as **cardiovascular (heart) disease, hypertension,** type 2 **diabetes,** and some forms of **cancer.** Together, these and related disorders account for two-thirds of all deaths in North America (Fig. 1-4).[11] Not meeting nutrient needs in our younger years makes us more likely to suffer health consequences, such as bone fractures from the disease **osteoporosis,** in later years. In 2020, COVID-19 was a major cause of death in the United States, with older adults and people with preexisting medical conditions such as heart or lung disease or diabetes at higher risk.

The combination of a poor eating pattern and too little physical activity may be the second-leading cause of death in the United States. In fact, U.S. government statistics indicate that a poor eating pattern combined with a lack of sufficient physical activity contributes to hundreds of thousands of fatal cases of cardiovascular disease, cancers, and diabetes each year. In addition, **obesity,** which the American Medical Association declared as a disease in 2013, is considered the second-leading cause of preventable death in North America (use of tobacco products is the first). Obesity and other chronic diseases are often preventable, and the cost of prevention, usually when we are children and young adults, is small compared to the cost of treating these diseases when we are older.

The good news is that an increased interest in health, fitness, and nutrition in Americans has been associated with long-term decreasing trends for heart disease, cancers, and **stroke** (three of the leading causes of death). Mortality from heart disease, the leading cause of death, has been declining steadily since 1980. As you gain understanding about your nutritional habits and increase your knowledge about optimal nutrition, you will have the opportunity to dramatically reduce your risk for many common health problems. Recent research has shown that those following the healthiest eating pattern overall had a 65% lower risk of dying from cancers, or any other cause, than those who had followed the worst eating pattern. A healthy eating pattern was defined as one with a high proportion of vegetables, fruits, whole grains, proteins, and dairy.[12]

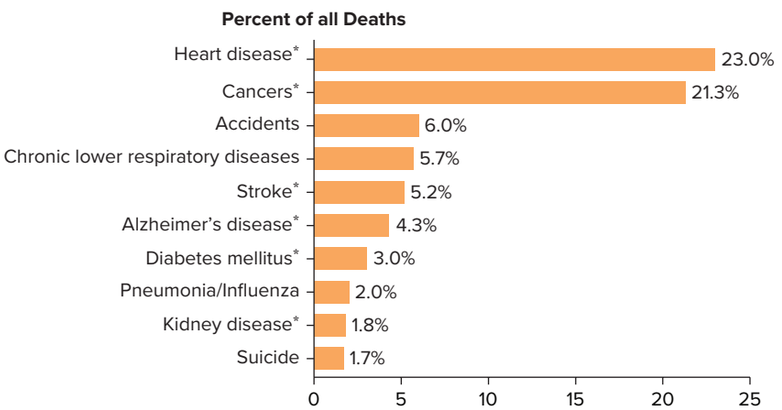


FIGURE 1-4 ▲ Ten leading causes of death in the United States.

Source: Centers for Disease Control and Prevention, *National Vital Statistics Report,* Deaths: Leading Causes for 2017.

* Causes of death in which diet plays a part.

risk factors A term used frequently when discussing the factors contributing to the development of a disease. A risk factor is an aspect of our lives, such as heredity, lifestyle choices (e.g., use of tobacco products), or nutritional habits.

chronic Long-standing, developing over time. When referring to disease, this term indicates that the disease process, once developed, is slow and lasting. A good example is cardiovascular disease.

cardiovascular (heart) disease A general term that refers to any disease of the heart and circulatory system. This disease is generally characterized by the deposition of fatty material in the blood vessels (hardening of the arteries), which in turn can lead to organ damage and death. Also termed *coronary heart disease (CHD)* or simply, *heart disease,* as the vessels of the heart are the primary sites of the disease.

hypertension A condition in which blood pressure remains persistently elevated. Obesity, inactivity, alcohol intake, excess salt intake, and genetics may each contribute to the problem.

diabetes A group of diseases characterized by high blood **glucose.** Type 1 diabetes involves insufficient or no release of the hormone insulin by the pancreas and therefore requires daily insulin therapy. Type 2 diabetes results from either insufficient release of insulin or general inability of insulin to act on certain body cells, such as muscle cells. Persons with type 2 diabetes may or may not require insulin therapy.

glucose A six-carbon sugar that exists in a ring form; found as such in blood, and in table sugar bound to fructose; also known as *dextrose,* it is one of the simple sugars.

cancer A condition characterized by uncontrolled growth of abnormal cells.

osteoporosis The presence of a stress-induced fracture or a T-score of −2.5 or lower. The bones are porous and fragile due to low mineral density.

obesity Disorder involving excessive body fat that increases the risk of health problems.

stroke A decrease or loss in blood flow to the brain that results from a blood clot or other change in arteries in the brain. This in turn causes the death of brain tissue. Also called a *cerebrovascular accident.*

CONCEPT CHECK 1.2

1. How do we define *nutrition?*
2. What are the three leading causes of death in which the dietary pattern plays a part?

1.3 What Are the Classes and Sources of Nutrients?

To begin the study of nutrition, let's start with an overview of the six classes of nutrients. You are probably already familiar with the terms **carbohydrates, lipids** (fats and oils), **proteins, vitamins,** and **minerals.** These nutrients, plus **water,** make up the six classes of nutrients found in food.

Nutrients can be assigned to three functional categories: (1) those that primarily provide us with calories to meet energy needs (expressed in **kilocalories [kcal]**); (2) those important for growth, development, and maintenance; and (3) those that act to keep body functions running smoothly. Some overlap in function exists among these categories (Fig. 1-5). The energy-yielding nutrients (carbohydrates, lipids, and protein) along with water are needed in relatively large amounts, so they are called **macronutrients.** Vitamins and minerals are needed in such small amounts in the dietary pattern that they are called **micronutrients.**

carbohydrate A compound containing carbon, hydrogen, and oxygen atoms. Most are known as *sugars, starches,* and *fibers.*

lipid A compound containing much carbon and hydrogen, little oxygen, and sometimes other atoms. Lipids do not dissolve in water and include fats, oils, and cholesterol.

protein Food and body compounds made of more than 100 amino acids; proteins contain carbon, hydrogen, oxygen, nitrogen, and sometimes other atoms in a specific configuration. Proteins contain the form of nitrogen most easily used by the human body.

vitamin An essential organic (carbon-containing) compound needed in small amounts in the dietary pattern to help regulate and support chemical reactions and processes in the body.

mineral Element used in the body to promote chemical reactions and to form body structures.

water The universal solvent; chemically, H_2O. The body is composed of about 60% water. Water (fluid) needs are about 9 (women) or 13 (men) cups per day; needs are greater if one exercises heavily.

kilocalorie (kcal) Heat energy needed to raise the temperature of 1000 grams (1 L) of water 1 degree Celsius.

macronutrient A nutrient needed in gram quantities in a dietary pattern.

micronutrient A nutrient needed in milligram or microgram quantities in a dietary pattern.

simple sugar Monosaccharide or disaccharide in the diet.

complex carbohydrate Carbohydrate composed of many monosaccharide molecules. Examples include glycogen, starch, and fiber.

starch A carbohydrate made of multiple units of glucose attached together in a form the body can digest; also known as *complex carbohydrate.*

CARBOHYDRATES

Chemically, carbohydrates can exist in foods as simple sugars and complex carbohydrates. **Simple sugars,** frequently referred to as *sugars,* are relatively small molecules. These sugars are found naturally in fruits, vegetables, and dairy products. Table sugar, known as sucrose, is a simple sugar that is added to many foods we eat. Glucose, also known as blood sugar or dextrose, is a simple sugar in your blood. **Complex carbohydrates** are formed when many simple sugars are joined together. Plants store carbohydrates in the form of **starch,** a complex carbohydrate made up of hundreds of

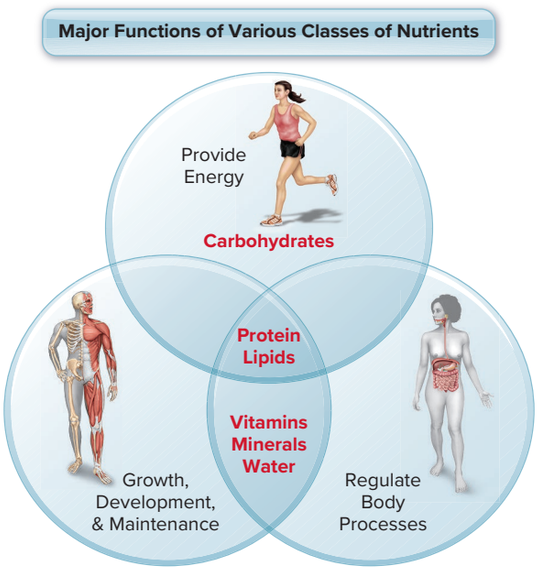


FIGURE 1-5 ▲ Major functions of carbohydrates, protein, lipids, vitamins, and minerals. Notice that proteins and most lipids participate in all of the major function categories, whereas carbohydrates function primarily as sources of energy.

glucose units. Breads, cereals, grains, and starchy vegetables are the main sources of complex carbohydrates.

During digestion, complex carbohydrates are broken down into single sugar molecules (such as glucose) and absorbed into the bloodstream via **cells** lining the small intestine. However, the **bonds** between the sugar molecules in certain complex carbohydrates, called **fiber,** cannot be broken down by human digestive processes. Fiber passes through the small intestine undigested to provide bulk for the stool (feces) formed in the large intestine (colon).

cell The structural basis of plant and animal organization. In animals it is bounded by a cell membrane. Cells have the ability to take up compounds from and excrete compounds into their surroundings.

bond A linkage between two atoms formed by the sharing of electrons, or attractions.

fiber Substances in plant foods not digested in the human stomach or small intestine. These add bulk to feces. Fiber naturally found in foods is also called *dietary fiber.*

Aside from enjoying their taste, we need sugars and other carbohydrates in our eating patterns primarily to help satisfy the calorie needs of our body cells. Carbohydrates provide a major source of calories for the body, on average 4 kcal per gram. Glucose, a simple sugar that the body can derive from most carbohydrates, is a major source of calories for most cells. When insufficient carbohydrate is consumed, the body is forced to make glucose from proteins—not a healthy alternative. Most foods high in carbohydrates, such as fruits, vegetables, and whole grains, are also excellent sources of vitamins, minerals, and phytochemicals.

LIPIDS

Lipids (mostly fats and oils) in the foods we eat also provide energy. Lipids yield more calories per gram than do carbohydrates—on the average, 9 kcal per gram—because of differences in their chemical composition. They are also the main form for energy storage in the body.

In this book, the more familiar terms *fats* and *oils* will generally be used, rather than *lipids.* Lipids do not dissolve in water. Generally, fats are lipids that are solid at room temperature, and oils are lipids that are liquid at room temperature. We obtain fats and oils from animal and plant sources. Animal fats, such as butter or lard, are solid at room temperature. Plant oils, such as corn or olive oil, tend to be liquid at room temperature. To promote heart health, most people would benefit from using more plant oils in place of solid fats.

Certain fats are essential nutrients that must come from our dietary pattern. These key fats that the body cannot produce, called essential fatty acids, perform several important functions in the body: they help regulate blood pressure and play a role in the synthesis and repair of vital cell parts. However, we need only about 4 tablespoons of a common plant oil (such as olive or soybean oil) each day to supply these essential fatty acids. A serving of fatty fish, such as salmon or tuna, at least twice a week is another healthy source of fats. The unique fatty acids in these fish complement the healthy aspects of common plant oils.

▲ Salmon is a fatty fish that is a healthy source of essential fatty acids.
Olga Nayashkova/Shutterstock

PROTEINS

Proteins are the main structural material in the body. For example, proteins constitute a major part of bone and muscle; they are also important components in blood, body cells, **enzymes,** and immune factors. Proteins can also provide calories for the body—on average, 4 kcal per gram. Typically, however, the body uses little protein for the purpose of meeting daily calorie needs. Proteins are formed when **amino acids** are bonded together. Some amino acids are essential nutrients.

enzyme A compound that speeds up the rate of a chemical reaction but is not altered by the reaction. Almost all enzymes are proteins (some are made of genetic material).

amino acid The building block for proteins containing a central carbon atom with nitrogen and other atoms attached.

vegetarian Referring to a dietary pattern that includes primarily foods of plant origin.

Protein in our eating pattern comes from animal and plant sources. The animal products meat, poultry, fish, dairy, and eggs are significant sources of protein in most eating patterns. Beans, grains, nuts, seeds, and some vegetables are good plant protein sources and are important to include in **vegetarian** eating patterns. If protein consumption is greater than what is needed for body functions, the excess is used for calorie needs and carbohydrate production but ultimately can be converted to and stored as fat.

VITAMINS

The main function of vitamins is to enable many **chemical reactions** to occur in the body. Some of these reactions help release the energy trapped in carbohydrates, lipids,

chemical reaction An interaction between two chemicals that changes both chemicals.

and proteins. Remember, however, that vitamins themselves contain no usable calories for the body.

organic compounds In chemistry, any chemical compounds that contain carbon.

fat-soluble Soluble in fats, oils, or fat solvents.

water-soluble Capable of dissolving in water.

The 13 vitamins are **organic compounds** divided into two groups: four are **fat-soluble** because they dissolve in fat (vitamins A, D, E, and K); nine are **water-soluble** because they dissolve in water (the B vitamins and vitamin C). The two groups of vitamins have different sources, functions, and characteristics. Water-soluble vitamins are found mainly in fruits and vegetables, whereas dairy products, nuts, seeds, oils, and fortified breakfast cereals are good sources of fat-soluble vitamins. Cooking destroys water-soluble vitamins much more readily than it does fat-soluble vitamins. Water-soluble vitamins are also excreted from the body much more readily than are fat-soluble vitamins. Thus, the fat-soluble vitamins, especially vitamin A, have the ability to accumulate in excessive amounts in the body, which then can lead to **toxicity.**

toxicity Capacity of a substance to produce injury or illness at some dosage.

MINERALS

inorganic Any substance lacking carbon atoms bonded to hydrogen atoms in the chemical structure.

atom Smallest combining unit of an element, such as iron or calcium. Atoms consist of protons, neutrons, and electrons.

Minerals are structurally simple, **inorganic** substances that do not contain carbon **atoms.** Minerals such as sodium and potassium typically function independently in the body, whereas minerals such as calcium and phosphorus function together in tissue, such as bone. Because of their simple structure, minerals are not destroyed during cooking, but they can still be lost if they dissolve in the water used for cooking and that water is then discarded. Minerals provide no calories for the body but are critical players in nervous system functioning, water balance, structural (e.g., skeletal) systems, and many other cellular processes.

major mineral Vital to health, a mineral that is required in the dietary pattern in amounts greater than 100 milligrams per day.

trace mineral Vital to health, a mineral that is required in the dietary pattern in amounts less than 100 milligrams per day.

electrolyte A mineral that separates into positively or negatively charged ions in water. Electrolytes are able to transmit an electrical current.

The essential minerals required in the dietary pattern for good health are divided into two groups—**major minerals** and **trace minerals**—because dietary needs and concentrations in the body vary enormously. If daily needs are less than 100 milligrams, the mineral is classified as a trace mineral; otherwise, it is a major mineral. Minerals that function based on their electrical charge when dissolved in water are also called **electrolytes;** these include sodium, potassium, and chloride. Many major minerals are found naturally in dairy products and fruits, whereas many trace minerals are found in meats, poultry, fish, and nuts.

WATER

solvent A liquid substance in which other substances dissolve.

Water makes up the sixth class of nutrients. Although sometimes overlooked as a nutrient, water (chemically, H_2O) has numerous vital functions in the body. It acts as a **solvent** and lubricant, as a vehicle for transporting nutrients and waste, and as a medium for temperature regulation and chemical processes. For these reasons, and because the human body is approximately 60% water, the average man should consume about 3 liters—about 13 cups—of water and/or other fluids every day; women need closer to 2.2 liters or about 9 cups per day. Fluid needs vary widely, however, based on differences in body mass and environmental conditions.

Water is obviously available from all beverages and is also the major component in some foods, such as many fruits and vegetables (e.g., lettuce, grapes, and melons). The body even makes some water as a by-product of **metabolism.**

metabolism Chemical processes in the body by which energy is provided in useful forms and vital activities are sustained.

OTHER IMPORTANT COMPONENTS IN FOOD

phytochemical A chemical found in plants. Some phytochemicals may contribute to a reduced risk of cancer or cardiovascular disease in people who consume them regularly.

Another group of compounds called **phytochemicals** are found in foods from plant sources, especially within the fruit and vegetable groups. Although these phytochemicals are not considered essential nutrients, they provide significant health benefits. Considerable research is focused on the ability of various phytochemicals to reduce the risk for certain diseases. For example, evidence from animal and laboratory studies indicates that compounds such as polyphenols in blueberries and strawberries prevent the growth of certain cancer cells. Research also suggests that

PHYTOCHEMICALS FOUND IN PLANT PIGMENT COLORS		FOUND IN	GOOD FOR
	CAROTENOIDS & HESPERETIN	Carrots, sweet potatoes, oranges, lemons	Eye health, immune function, heart health
	ANTHOCYANOSIDES & RESVERATROL	Blueberries, blackberries, grapes, beets, eggplants	**Antioxidants,** anti-inflammatory, heart health, cognition
	SULFORAPHANE & LUTEIN	Leafy greens, broccoli, cabbages, green tea	Anti-carcinogenic, anti-inflammatory, liver function, eye health
	ALLYL SULFIDES & FLAVONOIDS	Garlic, onions, leeks, apples, buckwheat	Cholesterol lowering, immune function, anti-allergy, estrogen metabolism
	LYCOPENE & ELLAGIC ACID	Tomatoes, cherries, radishes, strawberries	Antioxidants, heart health, immune function

FIGURE 1-6 ◀ Plant foods are packed with colorful and powerful phytochemicals that support health. Eating plant foods from a variety of color families will provide a variety of health benefits. oranges: Lluis Real/AGE Fotostock; berries: Noppadon sakulsom/Janecocoa/123RF; broccoli: spafra/iStock/Getty Images; garlic: Maks Narodenko/Shutterstock; tomatoes: Tim UR/Shutterstock

antioxidant A substance that has the ability to prevent or repair the damage caused by oxidation.

the health benefits of phytochemicals are best obtained through the consumption of whole foods rather than dietary supplements. Food sources of phytochemical compounds under study include soybeans and other legumes, which provide isoflavones, and cruciferous vegetables, especially broccoli, which provide isothiocyanates and indoles.

Foods with high phytochemical content are sometimes called "superfoods" because of the health benefits they are thought to confer. There is no legal definition of the term *superfood,* however, and there is concern that it is being overused in marketing certain foods. Figure 1-6 lists some noteworthy phytochemicals that are under study according to their plant pigment or color family. Although there is not enough evidence to link individual phytochemicals with specific health benefits, there is enough proof to suggest that consuming phytochemical-rich foods and beverages may help prevent disease. Tomatoes are an important source of phytochemicals and are discussed in this chapter's *Farm to Fork* feature. (*Farm to Fork* appears in every chapter and presents practical information on how to grow, shop, store, and prepare various fruits and vegetables to obtain and preserve their flavor and nutrients.)

SOURCES OF NUTRIENTS

Now that we know the six classes of nutrients, it is important to understand the quantities of the various nutrients that people consume. On a daily basis, we consume about 500 grams, or about 1 pound, of protein, fat, and carbohydrate combined. In contrast, the typical daily mineral intake totals about 20 grams (about 4 teaspoons), and the daily vitamin intake totals less than 300 milligrams (1/15 of a teaspoon). Although we require a gram or so of some minerals, such as calcium and phosphorus, we need only a few milligrams or less of other minerals, such as zinc, each day.

The nutrient content of the foods we eat also differs from the nutrient composition of the human body. This is because growth, development, and later maintenance of the human body are directed by the genetic material (DNA) inside body cells. This genetic blueprint determines how each cell uses the essential nutrients to perform body functions. These nutrients can come from a variety of sources. Cells are not concerned about whether available amino acids come from animal or plant sources. The

FARM to FORK Tomatoes

Adrian Burke/Getty Images

Tomatoes are very good sources of the antioxidants lycopene and vitamin C and are also rich in beta-carotene, manganese, and vitamin E.

Grow

- Naturally ripened tomatoes are more nutritious and flavorful than the artificially ripened tomatoes sold in supermarkets. Look for local tomatoes, including heirloom varieties, at nearby farmers' markets.
- Consider growing your own tomatoes, even in containers, to enjoy nutritious varieties harvested at the peak of ripeness.

Shop

- Choose tomatoes with the darkest red color for the most nutrients and highest amount of the phytochemical lycopene.
- Purchase smaller tomatoes for their sweetness and flavor, and the most lycopene and vitamin C.
- Buy processed tomato products, including jars or cans of paste and sauce, for their highly bioavailable lycopene.
- Choose tomato products in glass jars, aseptic-coated paper containers, or BPA-free cans. BPA, or bisphenol A, is a synthetic estrogen found in the coatings of some food cans and has possible health effects.

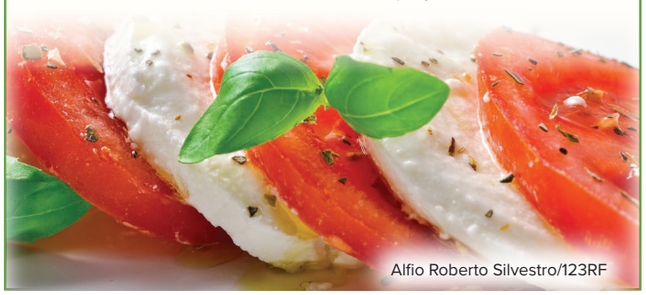
Store

- To preserve the flavor of fresh tomatoes, store them stem side up at room temperature. Flavor and aroma quickly decrease when tomatoes are stored in the refrigerator.
- Grape tomatoes should be stored in plastic clamshells (i.e., original packaging) to prevent them from drying out.
- Tomatoes are ripe and ready to eat when they are a deep color but still firm. Eat ripe tomatoes within two or three days.

Prep

- Use the whole tomato. The juice contains the flavor enhancer glutamate, and the skin and seeds provide vitamin C and lycopene.
- Snack on nutrition-packed grape tomatoes, and slice or chop them for salads, omelets, sandwiches, or tacos.
- Cooking tomatoes increases the bioavailability of nutrients and phytochemicals.
- Add tomato paste to recipes as a concentrated source of flavor, color, nutrients, and phytochemicals, with no added sugar or salt.

Source: Robinson J: Tomatoes: Bringing back their flavor and nutrients. In *Eating on the Wild Side*. New York: Little, Brown and Company, 2013.



Alfio Roberto Silvestro/123RF

carbohydrate glucose can come from sugars or starches. The food that you eat provides cells with basic materials to function according to the directions supplied by the genetic material (genes) housed in body cells.

✓ CONCEPT CHECK 1.3

1. What are the six classes of nutrients?
2. What are the three general functions of nutrients in the body?
3. What are phytochemicals?

1.4 What Math Concepts Will Aid Your Study of Nutrition?

CALORIES

We obtain the energy we need for body functions and physical activity from various calorie sources: carbohydrates (4 kcal per gram), fats (9 kcal per gram), and proteins (4 kcal per gram). Foods generally provide more than one calorie source. Plant oils, such as soybean or olive oil, are one exception; these are 100% fat at 9 kcal per gram.

Alcohol is also a potential source of calories, supplying about 7 kcal per gram. It is not considered an essential nutrient, however, because it is not required for human function. Still, alcoholic beverages, such as beer—also rich in carbohydrate—are a contributor of calories to the eating patterns of many adults. The nutritional implications of alcohol consumption are discussed in Section 1.8.

The body releases energy (measured in calories) from the chemical bonds in carbohydrate, protein, and fat (and alcohol) in order to:

- Build new compounds.
- Perform muscular movements.
- Promote nerve transmission.
- Maintain electrolyte balance within cells.

The energy in food is often expressed using the term *calories* on food labels. A calorie is the amount of heat energy it takes to raise the temperature of 1 gram of water 1 degree Celsius (1°C, centigrade scale). A calorie is a tiny measure of heat relative to the amount of calories we eat and use. Food energy is more conveniently expressed in terms of the kilocalorie (kcal), which equals 1000 calories. (If the "c" in calories is capitalized, this also signifies kilocalories.) A kilocalorie is the amount of heat energy it takes to raise the temperature of 1000 grams (1 liter) of water 1°C. The abbreviation *kcal* is used throughout this book. On food labels, the word *calorie* (without a capital "C") is also used loosely to mean *kilocalorie.* Any values given on food labels in calories are actually in kilocalories (Fig. 1-7). A suggested intake of 2000 calories per day on a food label is technically 2000 kcal.

Fullerene/iStock/Getty Images

WHOLE WHEAT BREAD

Nutrition Facts

19 servings per container

Serving size **1 slice (36g)**

Amount per serving

Calories **80**

	% Daily Value*
Total Fat 1g	**2**%
Saturated Fat 0g	**0**%
Trans Fat less than 1g	**
Cholesterol 0mg	**0**%
Sodium 200mg	**8**%

	% Daily Value*
Total Carbohydrate 15g	**5**%
Dietary Fiber 2g	**8**%
Total Sugars 3g	
Includes 2g Added Sugars	**4**%
Protein 3g	

Vitamin D 0mcg 0% • Calcium 30mg 3% • Iron 1mg 5% • Potassium 70mg 2%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

FIGURE 1-7 ▲ Use the nutrient values on the Nutrition Facts label to calculate calorie content of a food. Based on carbohydrate, fat, and protein content, a serving of this food (whole wheat bread) contains 81 kcal ([15 × 4] + [1 × 9] + [3 × 4] = 81). The label lists 80, suggesting that the calorie value was rounded down.

▲ Calorie content of energy nutrients and alcohol. The weights illustrate their relative energy potential per gram.

CALCULATING CALORIES

The calorie estimates for carbohydrate, fat, protein, and **alcohol** (4-9-4-7) can be used to determine the calorie content of a food. Consider these foods:

alcohol Ethyl alcohol or ethanol (CH_3CH_2OH) is the compound in alcoholic beverages.

Burke/Triolo/Brand X Pictures

1 Grilled Chicken Sandwich

Carbohydrate	46 grams × 4 = 184 kcal
Fat	14 grams × 9 = 126 kcal
Protein	45 grams × 4 = 180 kcal
Alcohol	0 gram × 7 = 0 kcal
Total	**490 kcal**

C Squared Studios/Getty Images

8-Ounce Piña Colada

Carbohydrate	57 grams × 4 = 228 kcal
Fat	5 grams × 9 = 45 kcal
Protein	1 gram × 4 = 4 kcal
Alcohol	23 grams × 7 = 161 kcal
Total	**438 kcal**

You can also use the 4-9-4 estimates to determine what portion of total kilocalorie intake is contributed by the various calorie-yielding nutrients. Assume that one day you consume 290 grams of carbohydrates, 60 grams of fat, and 70 grams of protein. This adds up to a total of 1980 kcal ([290 × 4] + [60 × 9] + [70 × 4] = 1980). The percentage of your total kilocalorie intake derived from each nutrient can then be determined:

$$\begin{aligned}
\%\text{ of kcal as carbohydrate} &= (290 \times 4) \div 1980 = 0.59\ (\times 100 = 59\%)\\
\%\text{ of kcal as fat} &= (60 \times 9) \div 1980 = 0.27\ (\times 100 = 27\%)\\
\%\text{ of kcal as protein} &= (70 \times 4) \div 1980 = 0.14\ (\times 100 = 14\%)
\end{aligned}$$

Check your calculations by adding the percentages together. Do they total 100%?

PERCENTAGES

You will use a few mathematical concepts in studying nutrition. Besides performing addition, subtraction, multiplication, and division, you need to know how to calculate percentages and convert English units of measurement to metric units.

The term *percent* (%) refers to a part of the total when the total represents 100 parts. For example, if you earn 80% on your first nutrition examination, you will have answered the equivalent of 80 out of 100 questions correctly. This equivalent also could be 8 correct answers out of 10; 80% also describes 16 of 20 (16/20 = 0.80 or 80%). The decimal form of percents is based on 100% being equal to 1.00. Percentages are used frequently when referring to menus and nutrient composition as we saw in the previous calculation of the percentage of total calorie intake from each nutrient. The best way to master this concept is to calculate some percentages. Some examples follow:

Question	Answer
What is 6% of 45?	6% = 0.06, so 0.06 × 45 = 2.7
What percent of 99 is 3?	3/99 = 0.03 or 3% (0.03 × 100)
Joe ate 15% of the adult Recommended Dietary Allowance for iron (RDA = 8 milligrams) at lunch. How many milligrams did he eat?	0.15 × 8 milligrams = 1.2 milligrams

THE METRIC SYSTEM

The basic units of the metric system are the meter, which indicates length; the gram, which indicates weight; and the liter, which indicates volume. Appendix F in this textbook lists conversions from the metric system to the English system (feet, pounds, and cups) and vice versa. Here is a brief summary:

A centimeter is 1/100 of a meter, 2.54 centimeters equals 1 inch.

A gram (g) is about 1/30 of an ounce (an ounce weighs 28 grams).

5 grams of sugar or salt is about 1 teaspoon.

A pound (lb) weighs 454 grams.

A kilogram (kg) is 1000 grams, equivalent to 2.2 pounds.

To convert weight in pounds to kilograms, divide it by 2.2.

A 154-pound man weighs 70 kilograms (154/2.2 = 70).

A gram can be divided into 1000 milligrams (mg) or 1,000,000 micrograms (μg or mcg).

10 milligrams of zinc (approximate adult need) would be a few grains of zinc.

Liters are divided into 1000 units called milliliters (ml); 100 milliliters is a deciliter (dl).

One teaspoon equals about 5 milliliters (ml), 1 cup is about 240 milliliters, and 1 quart (4 cups) equals almost 1 liter (L) (0.946 liter to be exact).

Examples:
You see on the label that a 5.3-ounce (oz) container of Greek yogurt contains 15 grams of sugar. How many teaspoons of sugar does this equal?

Answer: 15 grams ÷ 5 grams/teaspoon = 3 teaspoons of sugar in the 5.3-oz yogurt.

You are trying to drink at least 8 cups of water each day. You know 8 cups equals 64 ounces or 2 quarts of water because there are 8 ounces in a cup. Your water bottle, however, holds 500 milliliters (ml). How many milliliters or liters should you drink to equal 8 cups?

Answer: 8 cups × 240 ml/cup = 1920 ml = 1.92 liters (almost four 500 ml bottles).

If you plan to work in any scientific field, you will need to learn the metric system. In the field of nutrition, it is important to remember that a kilogram equals 2.2 pounds, an ounce weighs 28 grams, 2.54 centimeters equals 1 inch, and a liter is almost the same as a quart. In addition, know the fractions that the following prefixes represent: micro (1/1,000,000), milli (1/1000), centi (1/100), and kilo (1000).

☑ CONCEPT CHECK 1.4

1. What are the energy (kilocalorie) values for each of the "energy nutrients"?
2. If you weigh 154 pounds, what is your weight in kilograms?

CASE STUDY Choosing a Quick but Healthy Breakfast

Harrison was awake last night until 2:30 A.M. finishing a class project. Unfortunately, his Psychology 101 class meets at 9:00 A.M. this morning. When his alarm goes off at 7:30 A.M., he decides to sleep those extra 20 minutes it would take to sit down and enjoy breakfast at the dining hall. When Harrison finally rolls out of bed he must decide what to do about a morning meal. He considers skipping breakfast altogether, grabbing a snack and coffee from a vending machine, eating cereal and yogurt in his room, or picking up a breakfast sandwich to eat during class. Answer the questions below to determine the healthiest yet time-saving breakfast option.

1. Harrison is considering skipping breakfast and consuming a few extra calories at lunch and dinner. How will this plan affect Harrison's morning energy levels? What do we know about eating breakfast and weight control?
2. Would a low-fat granola bar and iced coffee from the vending machines in his dorm be a good source of calories and nutrients? Would this choice satisfy his hunger for very long?
3. Harrison has the quickest breakfast choice in his own room: a quick bowl of whole grain cereal with a banana and low-fat milk along with a yogurt. Explain why this convenient choice might also be the most nutritious choice.
4. Harrison could also pick up a ham, egg, and cheese bagel to eat during class. How do the calorie, fat, and sodium contents of this fast-food breakfast sandwich compare to the other options? Would this be a healthy breakfast choice every day?

Complete the Case Study. Responses to these questions can be provided by your instructor.

▲ With a little bit of planning, breakfast can be both quick and healthy. Stockbyte/Getty Images

1.5 How Do We Know What We Know About Nutrition?

The knowledge we have about nutrient needs comes from research. Like other sciences, the research that sets the foundation for nutrition knowledge has developed using the *scientific method,* a testing procedure designed to detect and eliminate error.

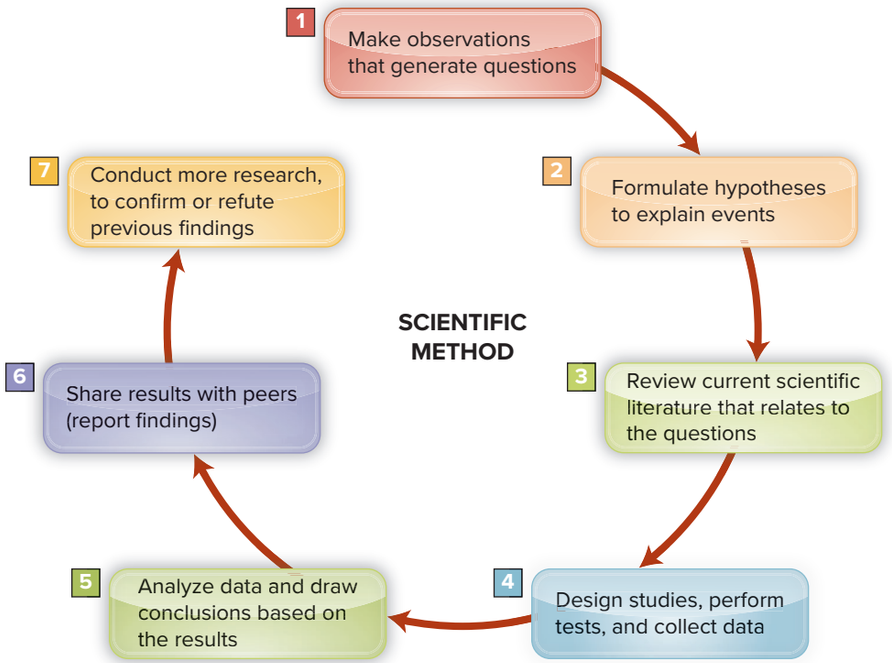


FIGURE 1-8 ▶ The scientific method. Scientists consistently follow these steps when testing all types of hypotheses. Scientists do not accept a nutrition or other scientific hypothesis until it has been thoroughly tested using the scientific method.

THE SCIENTIFIC METHOD

hypotheses Tentative explanations by a scientist to explain a phenomenon.

scurvy The vitamin C deficiency disease characterized by weakness, fatigue, slow wound healing, bone pain, fractures, sore and bleeding gums, diarrhea, and pinpoint hemorrhages on the skin.

epidemiology The study of how disease rates vary among different population groups.

theory An explanation for a phenomenon that has numerous lines of evidence to support it.

peer review Evaluation of work by professionals of similar competence (peers) to the producers of the work to maintain standards of quality and credibility. Scholarly peer review is used to determine if a scientific study is suitable for publication.

The first step of the scientific method is the observation of a natural phenomenon (Fig. 1-8). Scientists then suggest possible explanations, called **hypotheses,** for the phenomenon. At times, historical events have provided clues to important relationships in nutrition science, such as the link between the need for vitamin C and the development of the disease **scurvy.** Another approach is for scientists to study dietary and disease patterns among various populations, a research method called **epidemiology.**

Thus, hypotheses about the role of the dietary pattern in various health problems can be suggested by historical and epidemiological findings. *Proving* the role of particular dietary components, however, requires controlled experiments. The data gathered from experiments may either support or refute each hypothesis. If the results of many experiments support a hypothesis, scientists accept the hypothesis as a **theory.** Often, the results from one experiment suggest a new set of questions. Figure 1-8 shows how the scientific method is used to test a hypothesis.

Once an experiment is complete, scientists summarize the findings and seek to publish the results in scientific journals. Generally, before articles are published in scientific journals, they undergo a critical **peer review** by other scientists familiar with the subject, which helps to ensure that only high-quality, objective research findings are published. Peer review occurs between steps 5 and 6 in Figure 1-8.

Keep in mind that one experiment is never enough to prove a particular hypothesis or provide a basis for nutritional recommendations. Rather, through follow-up studies, the results obtained in one laboratory must be confirmed by similar experiments conducted in other laboratories and, possibly, under varying circumstances. Only then can we really trust and use the results.

STRENGTH OF SCIENTIFIC EVIDENCE

systematic review A thorough summary of the results of available carefully designed health care studies (controlled trials) in a particular area.

When answering questions about nutrition needs, we look for the best available evidence. The hierarchy of evidence (Fig. 1-9) is based on the rigor (strength and precision) of the research methods used and provides a framework to help us locate the best evidence. The first step is to search for a recent well-conducted **systematic review.** A

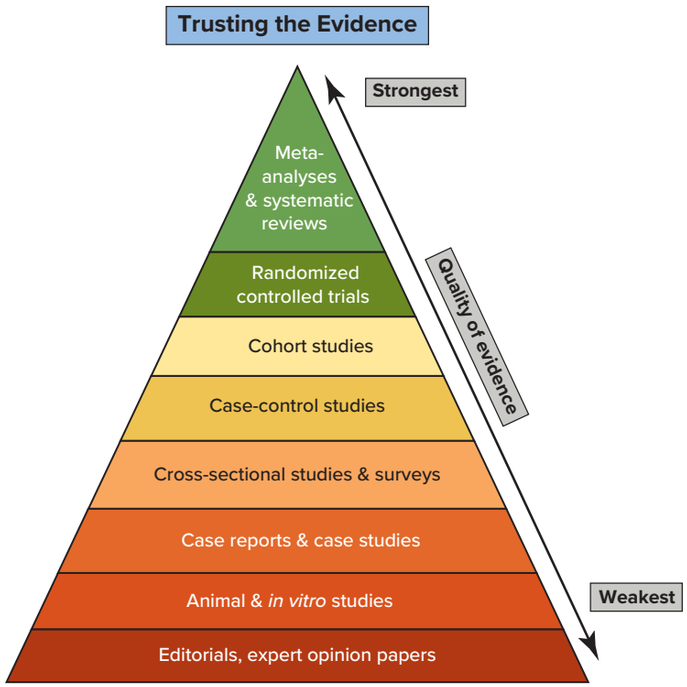


FIGURE 1-9 ◀ Hierarchy of scientific evidence with the strongest types of evidence at the top progressing to the weakest types of evidence at the bottom. *Adapted from thelogicofscience.com.*

systematic review is a thorough analysis of the results of all available studies in a particular area. If the studies have the same outcome measures, a systematic review may include a **meta-analysis** of the statistical results of the studies.

If a current systematic review is not available, we move down to the next level of evidence, the primary studies. The most rigorous type of controlled experiment, a **randomized controlled trial,** follows a study design that is **double-blind** and **placebo** controlled. In this type of study, a group of participants—the experimental group—follows a specific protocol (e.g., consuming a certain food or nutrient), and participants in a corresponding **control group** follow their normal habits or consume a placebo. People are randomly assigned to each group. Scientists then observe the experimental group over time to see if there is any effect not found in the control group.

Cohort studies are further down the hierarchy because they are observational studies that look at large groups of people and examine their exposure to certain risk factors for disease. If data are gathered going forward, they are called prospective studies; if data that are already collected are assessed, they are considered retrospective studies. The Nurses' Health Study is an example of a cohort study that has followed hundreds of thousands of women in North America and found many links between lifestyle choices and health.

A **case-control study** is typically retrospective and compares individuals who have a disease or condition, such as lung cancer, to individuals who do not have the condition. A **cross-sectional study** looks at data from a population group at one specific point in time. **Case reports** are descriptive studies based on uncontrolled observations of patients.

While all of these human experiments provide convincing evidence about relationships between nutrients and health, they are often not practical or ethical to conduct. Thus, much of what we know about human nutritional needs and functions has been gleaned from **animal experiments.** The use of animal experiments to study the role of nutrition in certain human diseases depends on the availability of an animal model in which a disease in laboratory animals closely mimics a particular human disease. Often, if no animal model is available and human experiments are ruled out, scientific knowledge cannot advance beyond what can be learned from epidemiological studies.

Finally, editorials and expert opinion papers provide an overview of a specific topic but do not qualify as adequate evidence to answer research questions. It is just as important to understand what is not scientific evidence. Personal anecdotes, YouTube videos,

meta-analysis A statistical examination of data from multiple scientific studies of the same subject in order to determine overall trends.

randomized controlled trial An experimental design that is double-blind and placebo controlled.

double-blind A study or trial in which any information which may influence the behavior of the tester or the subject is withheld until after the test.

placebo Generally, an inactive medicine or treatment used to disguise the treatments given to the participants in an experiment.

control group Participants in an experiment who are not given the treatment being tested.

cohort studies Observational studies that look at large groups of people, prospectively or retrospectively, studying their exposure to certain risk factors for disease.

case-control study A study in which individuals who have a disease or condition, such as lung cancer, are compared with individuals who do not have the condition.

cross-sectional study Type of observational study that analyzes data from a population group at one specific point in time and based on particular variables of interest.

case reports Descriptive studies based on uncontrolled observations of individual patients.

animal experiments Use of animals to study disease to understand more about human disease.

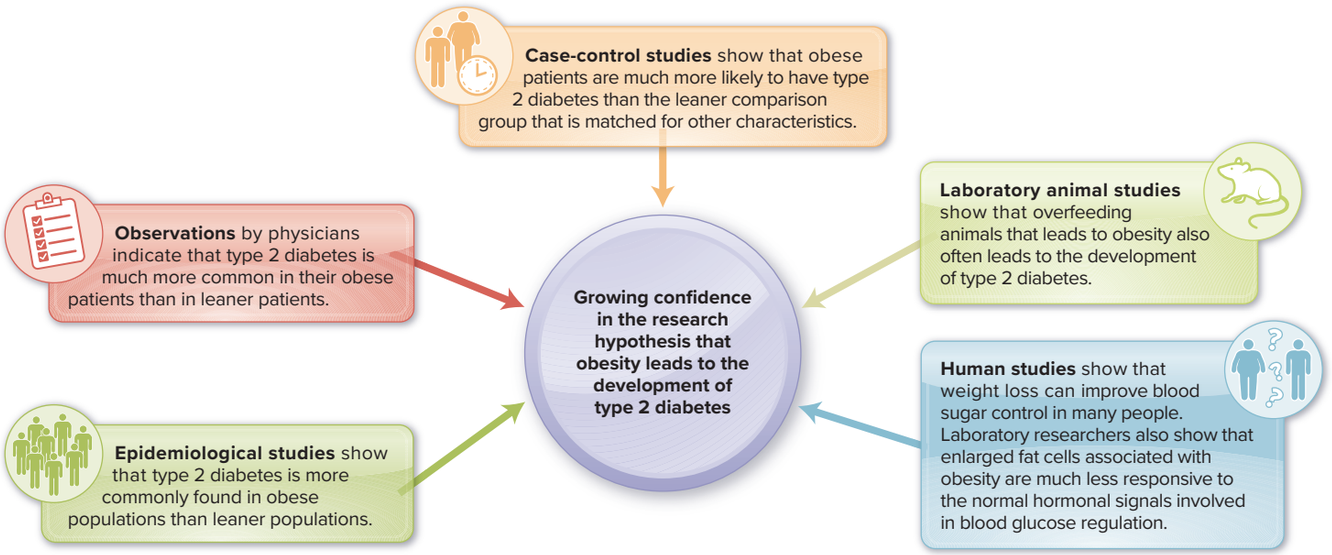


FIGURE 1-10 ▲ Data from a variety of sources can come together to support a research hypothesis. This diagram shows how various types of research data support the hypothesis that obesity leads to the development of type 2 diabetes.

Newsworthy Nutrition

Throughout this textbook, we have highlighted the use of the scientific method in research studies in the feature *Newsworthy Nutrition*. These are recently published studies that relate to chapter topics and that have made a significant impact on our nutrition knowledge. We have selected articles that have used a variety of study designs from the hierarchy of scientific evidence. You will find the first *Newsworthy Nutrition* study in Section 1.6 on the increased incidence of obesity-related cancer in young adults.

and websites like mercola.com, naturalnews.com, greenmedinfo.com, and whale.to are not credible sources of scientific information.

As shown in Figure 1-10, the more lines of evidence available to support an idea, the more likely it is to be true. Epidemiological studies may suggest hypotheses, but controlled experiments are needed to rigorously test hypotheses before nutrition recommendations can be made. For example, epidemiologists found that smokers who regularly consumed fruits and vegetables had a lower risk for lung cancer than smokers who ate very few fruits and vegetables. Scientists proposed that beta-carotene, a pigment present in many fruits and vegetables, may be responsible for reducing the damage caused by tobacco smoke in the lungs. They hypothesized that providing dietary supplements of beta-carotene would reduce the risk of lung cancer. However, in double-blind studies of heavy smokers, the risk of lung cancer was *higher* for those who took beta-carotene supplements than for those who did not (this is not true for the small amount of beta-carotene found naturally in foods). Soon after these results were reported, two other large federally funded studies using beta-carotene supplements were stopped on the basis that these supplements are ineffective in preventing both lung cancer and cardiovascular disease.

✓ CONCEPT CHECK 1.5

1. What are the seven steps used in the scientific method?
2. Name the various types of research studies that can be done to test a hypothesis.

1.6 What Is the Current State of North American Eating Patterns and Health?

DOES OBESITY THREATEN OUR FUTURE?

There is no doubt that the obesity epidemic threatens the future health of Americans. It is estimated that 39.8% of adults were obese in 2015–2016, with *obesity* defined as having an excessive amount of body fat relative to lean tissue. Considered more broadly,

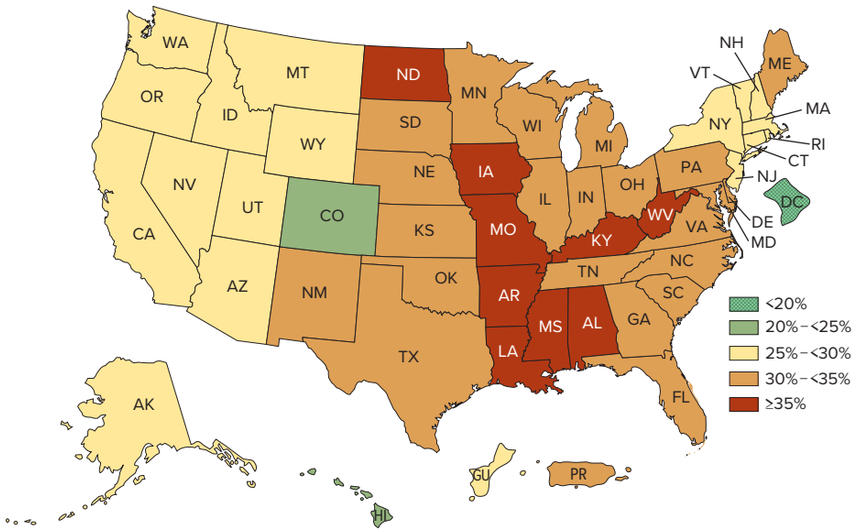


FIGURE 1-11 ▲ Percents of adults who are obese,* by state, 2018.

Source: CDC, Prevalence of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2018.

*Body mass index (BMI) > 30, or about 30 pounds overweight for a 5′9″ person, based on self-reported weight and height.

two-thirds of adults and one-third of children are **overweight** or obese. According to the Centers for Disease Control and Prevention (CDC), in 2015–2016 the average American adult man weighed 197.9 pounds, and the average American adult woman weighed 170.6 pounds. Where you live is also a factor, with **obesity** rates varying by state. State by state, self-reported obesity data from the CDC (Fig. 1-11) indicate that in 2018, 22 states and Puerto Rico had an adult obesity rate of 30% to less than 35% and 9 states (Alabama, Arkansas, Iowa, Kentucky, Louisiana, Mississippi, Missouri, North Dakota, and West Virginia) had the highest adult obesity rates—over 35%. In 2018, most states with the lowest obesity rates were in the Northeast or the West, and the South and the Midwest had the highest prevalence of obesity.[13] In 2006, only one state was above 30%.

All the data from national surveys indicate that the adult obesity rate has been rising for decades.[14] Although obesity rates held at around 34% and 35% between 2005 and 2012, the most recent data show the rates approaching 40%. There is work being done, however, to help combat these obesity trends. The annual *State of Obesity* reports have documented how policies and programs at the local, state, and federal levels have helped Americans eat healthier.[15]

It is well documented that this extra weight will continue to have dangerous consequences. Obesity plays a role in chronic illness, including heart disease, stroke, high blood pressure, high cholesterol, diabetes, arthritis, and certain cancers. An increase in the incidence of obesity-related cancers has been found in young adults and is discussed in the *Newsworthy Nutrition* feature in this section.[16] It is estimated that obesity kills more than 200,000 Americans each year. Because of its role in so many chronic disorders, obesity is an expensive condition, with more than $190 billion spent annually on health care related to obesity. Because of numerous medical conditions, obese individuals are absent from work more often than those of healthy weight. Health economists estimate that obesity-related absenteeism costs employers as much as $8.65 billion a year, whereas loss of on-the-job productivity due to pain, shortness of breath, or other obstacles costs another $30 billion.[17] It has become obvious that the answers to the obesity crisis are not simple. From a nutrition perspective, however, the problem can be clearly stated. Most of us continue to eat too much, especially foods with a high number of calories and a low number of nutrients, and we do not engage in enough physical activity.

overweight A ratio of weight to height that is moderately higher than what is associated with optimal health. For adults, this is defined as BMI within the range of 25.0 up to 30. For children, this is defined as BMI-for-age from the 85th up to the 95th percentile.

obesity Ratio of weight to height that is significantly higher than what is associated with optimal health, usually due to excessive body fat. For adults, this is defined as BMI of 30 or higher. For children, this is defined as BMI-for-age at the 95th percentile or higher.

COVID CORNER

During 2020 obesity was linked to a higher risk of developing severe symptoms and complications of COVID-19, independent of other illnesses, such as cardiovascular disease.

Newsworthy Nutrition

▲ From 1995 to 2014, the incidence of 12 obesity-related cancers increased in young adults. Maria Dryfhout/Cutcaster

Obesity-related cancers on rise in young adults

INTRODUCTION: There is concern that the increased prevalence of overweight and obesity among young people could be increasing their risks of obesity-related cancers and reverse recent progress made in reducing cancer mortality. An increase in early onset colorectal cancer, which could partly reflect the obesity epidemic, was found in a previous study. **METHODS:** In this *cohort study,* 20 years of incidence data were examined for 30 common cancers, including 12 associated with obesity and excess body weight, among adults ages 25 to 84, in 25 states from the North American Association of Central Cancer Registries' Cancer in North America database. Data were separated into five-year age cohorts. **RESULTS:** Incidence of six of the 12 cancers related to obesity (colorectal, endometrial, multiple myeloma, gallbladder, kidney, and pancreatic cancers) increased significantly from 1995 to 2014 in adults between the ages of 25 and 49. Steeper rises were found in successively younger generations. For example, the risk of colorectal, endometrial, pancreas, and gallbladder cancers in millennials was found to be about double the rate baby boomers faced at the same age. Of the 18 additional cancers analyzed, the incidence of only two–non-cardia gastric cancer and leukemia–increased among young adults in the same time period. **CONCLUSIONS:** Although the results do not provide sufficient information to determine a causal relationship, the risk of developing an obesity-related cancer seems to be increasing in a stepwise manner in successively younger birth cohorts in the U.S. Further studies are needed to determine exposures responsible for these emerging trends, including excess bodyweight and other risk factors.

Source: Sung H and others: Emerging cancer trends among young adults in the USA: Analysis of a population-based cancer registry. *The Lancet* 4(3):PE137, 2019. DOI: 10.1016/S2468d-2667(18)30267-6.

ASSESSING THE CURRENT NORTH AMERICAN EATING PATTERN

▲ Although positive changes in eating habits have begun, about half the carbohydrates that North Americans consume come from simple sugars; and the other half come from starches in foods such as pastas, breads, and potatoes. Two-thirds of protein consumption is from animal sources such as the burgers, cheese, and hot dogs shown in this pile of "junk" food. mphillips007/iStock/Getty Images

With the aim of finding out what North Americans eat, federal agencies conduct surveys to collect data about food and nutrient consumption and the connections between dietary patterns and health. In the United States, the U.S. Department of Health and Human Services monitors food consumption with the National Health and Nutrition Examination Survey (NHANES). In Canada, this information is gathered by Health Canada in conjunction with Agriculture and Agrifood Canada. Survey data from 2013–2014 indicate that North American adults consume about 16% of their calorie intake as proteins, 48% as carbohydrates, 34% as fats, and 3% as alcohol. These percentages fall within the ranges recommended by the Food and Nutrition Board (FNB) of the National Academy of Sciences. The FNB advocates that 10% to 35% of calories come from protein, 45% to 65% from carbohydrate, and 20% to 35% from fat. These standards apply to people in both the United States and Canada.

Food-consumption data also indicate that about two-thirds of protein intake is from animal sources for most North Americans, whereas plant sources supply only about one-third. In many other parts of the world, it is just the opposite: plant proteins—from rice, beans, corn, and other grains and vegetables—dominate protein intake. About half the carbohydrate in North American dietary patterns comes from simple sugars; the other half comes from starches (such as in pastas, breads, and potatoes). About 60% of dietary fat comes from animal sources and 40% from plant sources.

Evidence of positive changes in eating patterns have begun to appear. Results from the recent NHANES show that calories consumed daily by the typical U.S. adult are declining for the first time in over 40 years. One of the most significant declines has been in the amount of sugar-sweetened soda consumed. Keep in mind that while these changes in calories consumed are a step in the right direction and appear to stem from

our growing awareness of the dangers of eating and drinking too much, we often do not choose the foods that will meet all our nutrient needs.

In the next section, we discuss recommendations to consume a variety of nutrient-dense foods within and across the food groups, especially whole grains, fruits, vegetables, low-fat or fat-free milk or milk products, and lean meats and other protein sources. These foods will provide nutrients that are often overlooked, including various vitamins, minerals, fiber, and many phytochemicals. Daily intake of a balanced multivitamin and mineral supplement is another strategy to help meet nutrient needs but does not make up for a poor eating pattern. Also keep in mind that use of nutrient supplements should be discussed with your primary care provider to avoid potentially harmful side effects.

Experts also recommend that we pay more attention to balancing calorie intake with needs. An excess intake of calories is usually tied to overindulgence in sugar, fat, and alcoholic beverages. Many North Americans would benefit from a healthier balance of food in their eating patterns. Moderation is the key for some foods that are high in sugar and fat calories. For other foods, such as fruits and vegetables, increased quantity and variety are warranted. Few adults currently meet the recommendation to "fill half your plate with fruits and vegetables" promoted by many health authorities.

HEALTH OBJECTIVES FOR THE UNITED STATES

Health promotion and disease prevention have been public health strategies in North America for the past several decades. Every 10 years, the U.S. Department of Health and Human Services (HHS) issues a collection of health objectives for the nation. These objectives are developed by experts in federal agencies, target major public health concerns, and set goals for the coming decade.

In August 2020, the HHS's Office of Disease Prevention and Health Promotion released *Healthy People 2030,* the nation's 10-year plan for addressing our most critical public health priorities and challenges. *Healthy People 2030* is the fifth edition of *Healthy People,* and includes 355 core, measurable objectives with 10-year targets. Objectives are organized under five topics (1) health conditions; (2) health behaviors; (3) populations; (4) settings and systems; and, for the first time, (5) social determinants of health. *Healthy People 2030* continues to emphasize objectives from the past decade that prioritize health disparities, health equity, and health literacy. There are also new objectives related to opioid use disorder and youth e-cigarette use, and resources for adapting *Healthy People 2030* to emerging public health threats like COVID-19.

The overarching goals of *Healthy People 2030* are to:

- Attain healthy, thriving lives and well-being free of preventable disease, disability, injury, and premature death.
- Eliminate health disparities, achieve health equity, and attain health literacy to improve the health and well-being of all.
- Create social, physical, and economic environments that promote attaining the full potential for health and well-being for all.
- Promote healthy development, healthy behaviors, and well-being across all life stages.
- Engage leadership, key constituents, and the public across multiple sectors to take action and design policies that improve the health and well-being of all.

Healthy People 2030 includes a specific nutrition topic area called Nutrition and Healthy Eating, and its overall goal is to improve health by promoting healthy eating and making nutritious foods available. The Nutrition and Healthy Eating objectives aim to help people get the recommended amounts of healthy foods—like fruits, vegetables, and whole grains—to reduce their risk for chronic

▲ An increase in the consumption of some foods, such as fruits and vegetables, can lead to a healthier balance of food in the North American eating pattern. xefstock/Getty Images

diseases and improve their health and also focus on helping people get recommended amounts of key nutrients, like calcium and potassium.

Healthy People 2030 includes 14 general Nutrition and Healthy Eating objectives which aim to encourage public health interventions to: (1) reduce household food insecurity and hunger; (2) eliminate very low food security in children; (3) reduce iron deficiency in children aged 1 to 2 years; and (4) increase the proportion of schools that don't sell less healthy foods and drinks. Additional objectives for people aged 2 years and over aim to increase consumption of fruits; vegetables (particularly dark green vegetables, red and orange vegetables, and beans and peas); whole grains; calcium; potassium; and vitamin D; and reduce consumption of added sugars; saturated fat; and sodium. In addition to these general nutrition objectives, there are others that relate to nutrition issues specific to different life stages and diseases, including obesity, as well as objectives that focus on physical activity as well as food safety.

Progress on the *Healthy People* objectives are evaluated throughout each respective decade. At the midcourse progress review of *Healthy People 2020* in 2016, some of the Nutrition and Weight Status objectives were met or improved, but there was little or no detectable change for several of them. Objectives that showed improvement were these: very low food security among children in the past 12 months; mean daily intake of whole grains; mean percent of total daily calorie intake from solid fats and **added sugars;** and mean total daily calcium intake. The only target that exceeded the objective was schools not offering calorically sweetened beverages.[18]

added sugars Nutritive sweeteners (e.g., sugars and syrups) that are not naturally present in foods, but are added during processing for the purpose of flavoring and/or preserving foods.

✓ CONCEPT CHECK 1.6

1. Surveys indicate that we could improve our eating patterns by increasing which types of food sources?
2. The consumption of which types of foods should be reduced to attain and maintain good health?

1.7 What Can You Expect from Good Nutrition and a Healthy Lifestyle?

The obesity epidemic and prevalence of chronic diseases in the United States show that something is not right with many of our eating patterns and/or lifestyles. The strong association between obesity and poor health is clear. The reverse is also well documented: when an overweight person loses just 5% to 10% of body weight, that person's risks of many chronic diseases are greatly reduced.

HEALTHY WEIGHT

▲ Access to fresh fruits and vegetables through farmers' markets and community gardens is important to a healthy lifestyle. Mary-Jon Ludy/McGraw-Hill Education

Because weight gain is one of the greatest lifelong nutrition challenges, we encourage you to seek a lifestyle that will make gaining weight more difficult and maintaining a healthy weight easier. Preventing obesity in the first place is the easiest approach. Unfortunately, many aspects of our society make it hard not to gain weight. The earlier (preferably in childhood) we develop lifestyle habits of good nutrition, regular physical activity, and the avoidance of addictions to salt, fat, sweets, high-calorie foods, and sedentary lifestyles, the better our chances for a long, healthy life. Aim to live in a city or town that has opportunities for physical activity such as bike paths, walking trails, and parks, as well as access to fresh fruits and vegetables through farmers' markets and community gardens. Seek out and join running or walking clubs. Shop at grocery stores that offer a good selection of fruits, vegetables, and other healthy foods. When dining out, choose restaurants that have tasty but healthy options on their menu.

Fortunately, many eating habits have improved during the past decade. Today, we can choose from a wide variety of food products as a result of continual innovation by food manufacturers. Our cultural diversity, varied cuisines, and general lack of nutrient deficiencies should be points of pride for North Americans.

LONGER, HEALTHIER LIVES

Today, North Americans live longer than ever and enjoy better general health, partly because of better medical care and dietary patterns. Affluence, however, has also led to sedentary lifestyles and high intakes of animal fat, salt, and alcohol. This lifestyle pattern has led to problems such as cardiovascular disease, hypertension, diabetes, and, of course, obesity. Greater efforts are needed by the general public to lower intake of animal fats and to improve variety in our dietary patterns, especially from fruits, vegetables, and whole grains. With better technology and greater choices, we can have a much healthier eating pattern today than ever before—if we know what choices to make!

THE TOTAL DIETARY PATTERN

Nutrition experts generally agree that there are no "good" or "bad" foods, but some foods provide relatively few nutrients in comparison to calorie content. Health experts have prepared many reports and outlined numerous objectives to get us closer to being a "Healthy People." As you reexamine your nutritional habits, remember your health is largely your responsibility. Your body has a natural ability to heal itself. Offer it what it needs, and it will serve you well. Be aware that confusing and conflicting health messages hinder change in our eating patterns. We have addressed some of these conflicting health messages or myths in our *Fake or Fact* feature in every chapter.

Prevention of disease is an important investment of one's time, even during the college years. The following recommendations will help promote your health and prevent chronic diseases: (1) consume enough essential nutrients, including fiber, while moderating calories, solid fat, and added sugar; (2) engage in adequate, regular physical activity (at least 30 to 60 minutes on most or all days); (3) minimize alcohol intake (no more than two drinks per day for men and one drink for women); and (4) do not use tobacco products or e-cigarettes. In addition to these recommendations, you can optimize your health by getting adequate sleep (7 to 9 hours per night), consuming sufficient water (9 to 13 cups per day from foods and beverages), reducing stress, using medications prudently, and, of course, abstaining from use of illicit drugs. Because of the widespread use and abuse of alcohol, Section 1.8 provides more information on the nutritional implications of alcohol consumption.

▲ Regular physical activity complements a healthy dietary pattern. Whether it is all at once or in segments throughout the day, incorporate 30 to 60 minutes or more of such activity into your daily routine. Monkey Business Image/age fotostock

☑ CONCEPT CHECK 1.7

1. What are some eating patterns, physical activities, and lifestyle recommendations for health promotion and disease prevention?

registered dietitian (RD) A person who has completed a baccalaureate degree program approved by the Accreditation Council for Education in Nutrition and Dietetics (ACEND), performed at least 1200 hours of supervised professional practice, passed a registration examination, and complies with continuing education requirements.

registered dietitian nutritionist (RDN) The RDN is the updated credential formerly abbreviated RD. The credential was updated to better reflect the scope of practice of the dietitian and to align with the new name of the professional organization for dietitians, the Academy of Nutrition and Dietetics.

ASK THE RDN Who's the Expert?

Dear RDN: *I am interested in making positive changes to my eating pattern to reach a healthy weight and feel better. How can I find a qualified nutrition expert who will give me personalized nutrition advice?*

You have already made a big step toward better nutrition by taking this nutrition course! The information in this textbook is written by authors who are all qualified nutrition experts, namely *registered dietitian nutritionists* (RDN). The textbook and your instructor will provide a solid foundation in nutrition, but be aware that some people call themselves "nutritionists" without qualified training in nutrition. The best approach to finding answers about your personal nutritional state is to consult your primary care provider, **registered dietitian (RD),** or **registered dietitian nutritionist (RDN).** The RD/RDN has been certified by the Commission on Dietetic Registration of the Academy of Nutrition and Dietetics (Academy) after completing rigorous classroom and clinical training in nutrition. The RD/RDN must also complete continuing education. The RD credential was recently updated to RDN to better reflect the scope of practice of dietitians. While both titles signify the same credential, we will use RDN when referring to dietitians in this book.

You can begin your search for a local RDN by asking your instructor, primary care provider, or health insurance company for a referral. You can also find an RDN by using the Academy national referral service, called *Find a Registered Dietitian Nutritionist.* This service links consumers with qualified nutrition practitioners who are members of the Academy and provide reliable, objective nutrition information. Visit the Academy's website, www.eatright.org, and click on "Find an Expert." (In Canada, visit the Dietitians of Canada website, www.dietitians.ca, and click on "Find a Dietitian.") Enter your zip code or state to display the providers in your area. Select additional specialties that may apply to your specific needs. The website will display a list of providers. A professional with the RD or RDN credential after his or her name is a qualified nutrition expert who is trained to help you separate facts from fads and optimize your health with better food choices. You can trust an RDN to translate the latest scientific findings into easy-to-understand nutrition information.

We will use this feature, *Ask the RDN,* in every chapter to answer questions about topics that may seem to have conflicting viewpoints.

Monty Soungpradith/ Open Image Studio LLC

Your nutrition expert,

Anne M. Smith, PhD, RDN, LD

Associate Professor Emeritus, The Ohio State University,
Author of *Contemporary Nutrition*

▶ An RD or RDN is a qualified nutrition expert trained to help you separate facts from fads and to optimize your health with better food choices. You can trust an RDN, like this supermarket dietitian, to translate the latest scientific findings into easy-to-understand nutrition information.
Hero Images/Getty Images

1.8 Nutrition and Your Health

Nutrition Implications of Alcohol Consumption

Given the wide spectrum of alcohol use and abuse, knowledge of alcohol consumption and its relationship to overall health is essential to the study of nutrition. Alcoholic beverages contain the chemical form of alcohol known as **ethanol.** Although not a nutrient per se, alcohol is a source of calories (about 7 kcal per gram). Over half of American adults drink alcohol. On average, alcohol accounts for about 5% of total calories in the average North American dietary pattern.

The *Dietary Guidelines for Americans* defines an alcoholic drink equivalent as 14 grams of alcohol[19]. For beer or wine coolers, this equates to a 12-fluid-ounce serving. Most cans or bottles of beer are 12 fluid ounces, but some may contain as much as 40 fluid ounces. Malt liquor and most craft beers have a slightly higher alcohol content than regular beer, so the equivalent drink size is 8 fluid ounces. For wine, a 5-fluid-ounce glass is the equivalent. An equivalent drink of hard liquor, such as whiskey or rum, is the size of a shot glass—1.5 fluid ounces. The alcohol, carbohydrate, and calorie contents of standard drink sizes are depicted in Figure 1-12.

Moderate drinking is defined by the CDC as up to two drinks per day for men and up to one drink per day for women. **Heavy drinking** is usually defined as consuming 15 or more drinks per week for men and 8 or more drinks per week for women. **Binge drinking** is characterized by a pattern of drinking within a short period of time (usually within a few hours) causing blood alcohol concentration (BAC) to rise above the legal limit of 0.08%. It is defined as five or more drinks for men or four or more drinks for women in about two hours. Although binge drinking is certainly linked to negative effects on physical and emotional health, it is not necessarily an **alcohol use disorder,** which will be discussed next.

Moderate consumption of alcohol by most adults is viewed as an acceptable practice with mixed health benefits.[20] However, only about half of alcohol consumed is done so in moderation. One in six U.S. adults binge drinks, consuming about eight drinks per binge, about four times a month. Binge drinking is most common among younger adults ages 18 to 34 and is about twice as prevalent among men as among women.[21] Problem drinking that becomes severe is given the medical diagnosis of alcohol use disorder. Over 16 million people in the United States suffer from an alcohol use disorder (often referred to as *alcohol dependence* or *alcoholism*). By far, alcohol is the most commonly abused drug. In 2010, the cost of excessive alcohol consumption in the U.S. was almost $250 billion.[22]

How Alcoholic Beverages Are Produced

The basis of alcohol production is fermentation, a process by which microorganisms break down simple sugars (e.g., glucose or maltose) to alcohol, carbon dioxide, and water in the absence of oxygen. High-carbohydrate foods encourage the growth of yeast, the microorganism responsible for alcohol production. Wine is formed by the fermentation of grape or other fruit juices. Beer is made from malted cereal grain. Distilled spirits (e.g., vodka, gin, and whiskey) are made from any number of fruits, vegetables, and grains. Production temperatures, the composition of the food used for fermentation, and aging techniques determine the characteristics of the product. Alcohol proof represents twice the volume of alcohol in percentage terms. Thus, 80 proof vodka contains 40% alcohol.

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ethanol Chemical term for the form of alcohol found in alcoholic beverages.

moderate drinking For men, consuming no more than two drinks per day, and for women, consuming no more than one drink per day.

heavy drinking Any pattern of alcohol consumption defined as consuming 15 drinks or more per week for men and 8 drinks or more per week for women.

binge drinking Drinking sufficient alcohol within a 2-hour period to increase blood alcohol content to 0.08% or higher; for men, consuming 5 or more drinks in a row; for women, consuming 4 or more drinks in a row.

alcohol use disorder Problem drinking characterized by a compulsive pattern of alcohol use that leads to significant impairment or distress.