

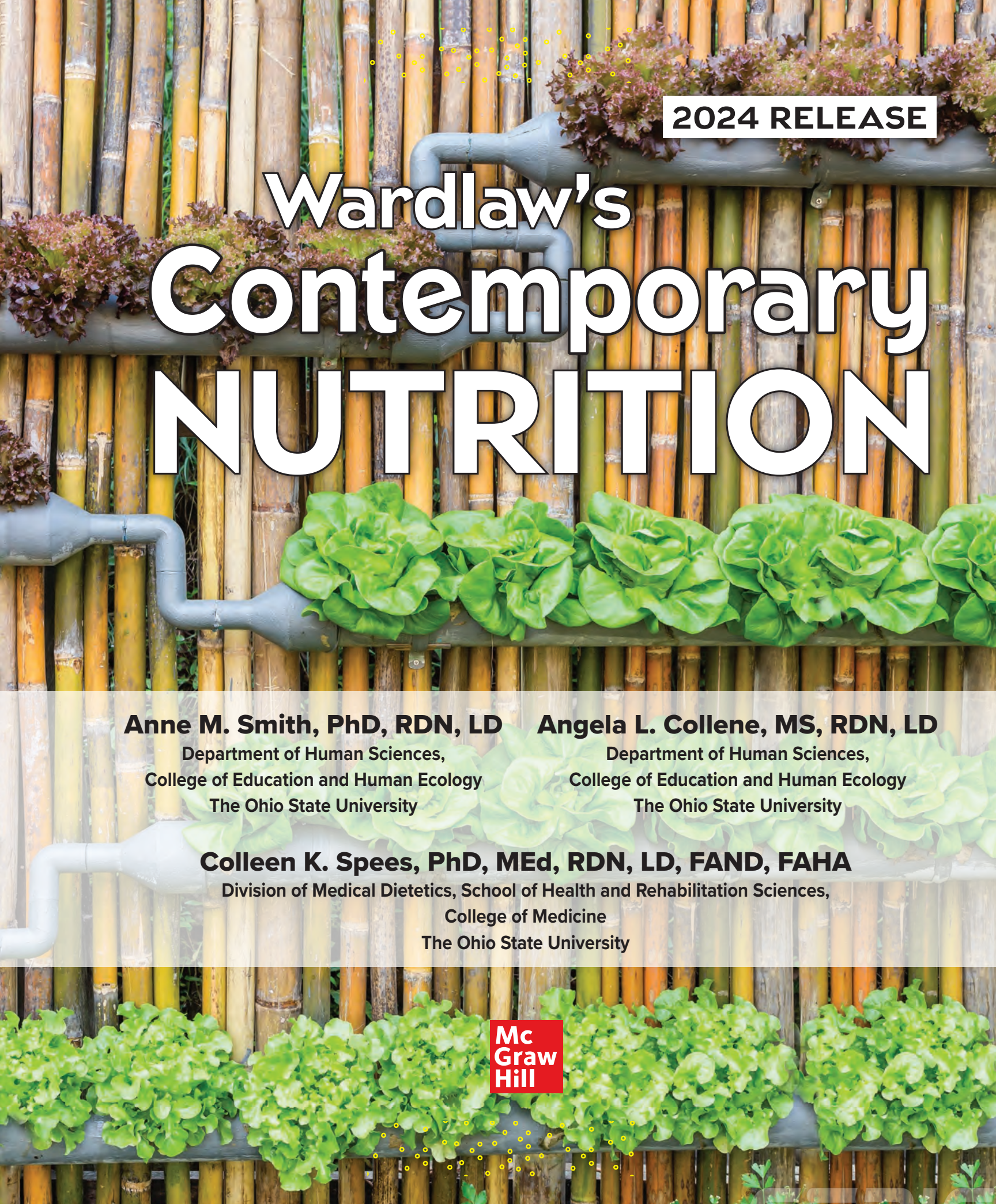
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2024 RELEASE

Wardlaw's Contemporary **NUTRITION**

Anne Smith | Angela Collene | Colleen Spees

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Wardlaw's Contemporary NUTRITION

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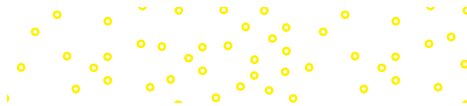
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WARDLAW'S CONTEMPORARY NUTRITION

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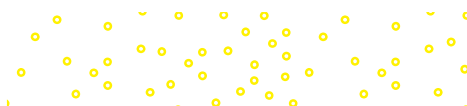
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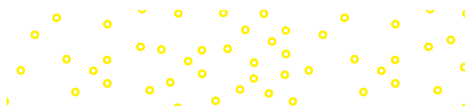
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Dear Students,

Welcome to the fascinating world of nutrition! Because we all eat several times a day and the choices we make can have a dramatic impact on our health, nutrition is our favorite area of science. At the same time, the science of nutrition can seem a bit confusing. The definition of *good nutrition* seems like a moving target; different *nutrition experts* and social media influencers have varying ideas of how we should eat, and often these do not align with the current scientific evidence.

The addition of new products to the marketplace can add to this complexity. Did you know that the average supermarket carries about 47,000 food and beverage products? With so many food manufacturers vying for your attention (and dollars), how can you identify a healthy product? As a nation, we consume many of our meals and snacks away from home. When we eat foods someone else has prepared, 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 timely and evidence-based nutrition information in a manner that is easy to understand for a diverse group of students. We teach complex scientific concepts at a level that will enable you to apply the material to your own life.

In this 2024 Release of *Wardlaw's Contemporary Nutrition*, we have expanded upon several popular features and added a few new features. To help sort fact from fiction, we start each chapter with a new **Fact Check** feature, which calls out common misconceptions about foods and health, then explains what science has to say. We have invited a few of our esteemed colleagues to share their expertise in several new **Ask the RDN** features. Our new **Roots** feature celebrates the culturally diverse origins of our eating patterns and how they impact overall health.

We have written this book to help you make informed choices about dietary patterns that will promote health and wellness throughout all life stages. With this information at your fingertips, you will be well equipped to nourish your body in a way that supports your physical and mental health for a lifetime.

There is much to learn, so let's get started!

Anne Smith
Angela Collene
Colleen Spees

About the Cover

Growing from the insights shared in our popular *Farm to Fork* and *Sustainable Solutions* features, we are excited to highlight the sustainable practice of hydroponics! 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.



Briana Zabala

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

About the Authors



Monty Soundpradith/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

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 girls—maternal and child nutrition. As a Senior Lecturer, Mrs. Collene teaches introductory nutrition and life cycle nutrition at The Ohio State University, where she received the Provost's Award for Distinguished Teaching by a Lecturer. She is a member of the Academy of Nutrition and Dietetics.



Ralphoto Studio

COLLEEN K. SPEES, PhD, MEd, RDN, LD, FAND, FAHA, 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 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 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 and the American Heart Association.

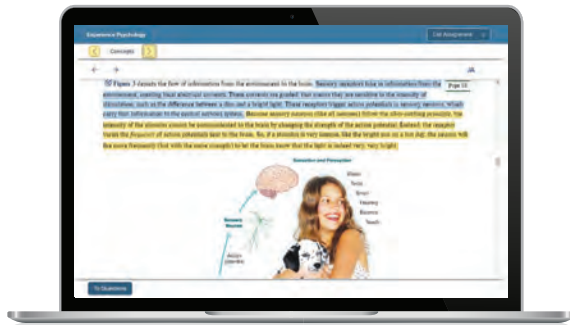


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Connecting Teaching and Learning

NutritionCalc Plus

NutritionCalc Plus is a **powerful dietary analysis tool** featuring more than 106,000 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®

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.



Pkchai/Shutterstock



Tegrity: Lectures 24/7

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. In fact, studies prove it. 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. With Tegrity, you also increase intent listening and class participation by easing students' concerns about note-taking. Using Tegrity in Connect will make it more likely you will see students' faces, not the tops of their heads.

McGraw Hill 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.

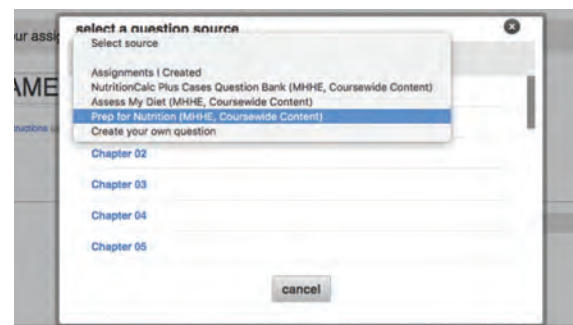
Writing Assignment

Available within Connect and Connect Master, the Writing Assignment tool delivers a learning experience to help students improve their written communication skills and conceptual understanding. As an instructor you can assign, monitor, grade, and provide feedback on writing more efficiently and effectively.



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Read or study when it's convenient for you with McGraw Hill's free ReadAnywhere app. Available for iOS or Android smartphones or tablets, ReadAnywhere gives users access to McGraw Hill tools including the eBook and SmartBook® 2.0 or Adaptive Learning Assignments in Connect. Take notes, highlight, and complete assignments offline—all of your work will sync when you open the app with WiFi access. Log in with your McGraw Hill Connect username and password to start learning—anytime, anywhere!



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.



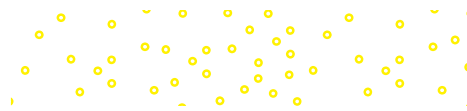
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Remote Proctoring & Browser-Locking Capabilities

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 the assessment experience by verifying identification, restricting browser activity, and monitoring student actions.

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.



Create

Your Book, Your Way

McGraw Hill's Content Collections Powered by Create® is a self-service website that enables instructors to create custom course materials—print and eBooks—by drawing upon McGraw Hill's comprehensive, cross-disciplinary content. Choose what you want from our high-quality textbooks, articles, and cases. Combine it with your own content quickly and easily, and tap into other rights-secured, third-party content such as readings, cases, and articles. Content can be arranged in a way that makes the most sense for your course, and you can include the course name and information as well. Choose the best format for your course: color print, black-and-white print, or eBook. The eBook can be included in your Connect course and is available on the free ReadAnywhere® app for smartphone or tablet access as well. When you are finished customizing, you will receive a free digital copy to review in just minutes! Visit McGraw Hill Create—www.mcgrawhillcreate.com—today and begin building!

OLC-Aligned Courses

Implementing High-Quality Online Instruction and Assessment through Preconfigured Courseware

In consultation with the Online Learning Consortium (OLC) and our certified Faculty Consultants, McGraw Hill has created pre-configured courseware using OLC's quality scorecard to align with best practices in online course delivery. This turnkey courseware contains a combination of formative assessments, summative assessments, homework, and application activities, and can easily be customized to meet an individual's needs and course outcomes. For more information, visit <https://www.mheducation.com/highered/olc>.

Polling

Every learner has unique needs. Uncover where and when you're needed with the new Polling tool in McGraw Hill Connect. Polling allows you to discover where students are in real time. Engage students and help them create connections with your course content while gaining valuable insight during lectures. Leverage polling data to deliver personalized instruction when and where it is needed most.

NewsFlash Articles

NewsFlash brings the real world into your classroom. These activities in Connect tie current news stories to key concepts. After interacting with a contemporary news story, students are assessed on their ability to make the connections between real-life events and course content.

Test Builder in Connect

Available within Connect, Test Builder is a cloud-based tool that enables instructors to format tests that can be printed, administered within a Learning Management System, or exported as a Word document. Test Builder offers a modern, streamlined interface for easy content configuration that matches course needs, without requiring a download.

Test Builder allows you to:

- access all test bank content from a particular title.
- easily pinpoint the most relevant content through robust filtering options.
- manipulate the order of questions or scramble questions and/or answers.
- pin questions to a specific location within a test.
- determine your preferred treatment of algorithmic questions.
- choose the layout and spacing.
- add instructions and configure default settings.

Test Builder provides a secure interface for better protection of content and allows for just-in-time updates to flow directly into assessments.



Connecting Students to Today's Nutrition

Understanding Our Audience

We have written *Wardlaw's Contemporary Nutrition* 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 and infographics 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 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

Part One Nutrition: A Key to Health

- 1 Nutrition, Food Choices, and Health
- 2 Designing a Healthy Eating Pattern
- 3 The Human Body: A Nutrition Perspective

Part Two Energy Nutrients and Energy Balance

- 4 Carbohydrates
- 5 Lipids
- 6 Proteins
- 7 Energy Balance

Part Three Vitamins, Minerals, and Water

- 8 Vitamins and Phytochemicals
- 9 Water and Minerals

Part Four Nutrition: Beyond the Nutrients

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- 11 Eating Disorders
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Part Five Nutrition: A Focus on Life Stages

- 14 Nutrition During Pregnancy and Breastfeeding
- 15 Nutrition from Infancy Through Adolescence
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Wardlaw's Contemporary Nutrition: A Functional Approach

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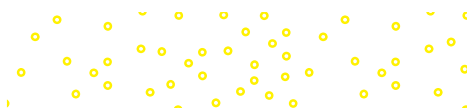
- 8 Overview of Micronutrients and Phytochemicals
- 9 Fluid and Electrolyte Balance
- 10 Nutrients Involved in Body Defenses
- 11 Nutrients Involved in Bone Health
- 12 Micronutrient Function in Energy Metabolism
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Part Four Nutrition: Beyond the Nutrients

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Connecting with Features

Featuring the Latest Evidence-Based Guidelines and Nutrition Research

Nutrition is a dynamic field. This release has been carefully updated to reflect current scientific understanding, as well as the latest health and nutrition guidelines. And in response to feedback from students and instructors, we are excited to introduce several new and updated features—all designed to engage students and encourage more discussion in the classroom.

Applying Nutrition on a Personal Level

Throughout this release, 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.

The new **Roots** feature digs down to discover the diverse factors that influence our food choices and nutritional status. Cultural traditions, religious observances, and our genetic code impact our dietary patterns.



Roots

Religious Customs Affect Vitamin D Status

In this chapter, you have learned that vitamin D can be synthesized by the skin upon exposure to sunlight. How do religious customs, such as the Quran dress code for Muslim females, affect vitamin D status? The Quran dress code requires Muslim females to cover their bodies except for their hands and face. Some conservative branches of Islam require females to cover the hands and face, as well. Clinical research shows that vitamin D status is significantly lower among Muslim females who wear concealing clothing compared to females who do not follow religious dress codes. Recognizing that vitamin D deficiency may affect not only bone health but also immune function and risk for some chronic diseases, females who are not able to expose skin to natural sunlight must emphasize dietary or supplemental sources of vitamin D to prevent vitamin D deficiency.

Source: Chouraqui J-P, Turck D, Briand A, Darmaun D; Committee on Nutrition of the French Society of Pediatrics. Religious dietary rules and their potential nutritional and health consequences. *Int J Epidemiol*. 2021 Mar 3;50(1):12-26. doi: 10.1093/ije/dyaa182

Considering the continued expansion of the body of research related to the gut microbiome and its impact on human health, we have added several new **Magnificent Microbiome** features that explore relevant interactions between nutrition and the gut microbiota.

magnificent

Irritable Bowel Syndrome

An imbalance between beneficial and pathogenic microbes in the gut may play a role in the development of irritable bowel syndrome. Microorganisms influence intestinal function in many ways:

- They stimulate the production of a protective layer of mucus by the intestinal cells.
- They affect the permeability of the intestinal lining, which regulates the movement of substances (both good and bad) from the intestine to the bloodstream.
- They can upregulate or downregulate the inflammatory response.
- They affect nerve signals from the gut to the brain, which may influence the rate of motility in the intestine and the perception of pain.

Researchers are interested in the potential for foods or supplements with probiotics or prebiotics to promote healthier gut function in individuals with IBS.

Source: Simon E, Cailinou LF, Mitrea L, Vodnar DC. Probiotics, prebiotics, and synbiotics: implications and beneficial effects against irritable bowel syndrome. *Nutrients*. 2021 Jun 20;13(6):2112. doi: 10.3390/nu13062112

microbiome

We continue to build upon our popular **Farm to Fork** feature, presenting a food item and its path to our plates. You will learn where it is grown, how to select the most flavorful and nutritious varieties, and the best methods to store and prepare these foods to maximize their nutritional value. Cashews and olive oil are new in this release.

FARM to FORK Cashews



Kittiphat Inthornprasti/123RF

Cashews are rich in fiber, unsaturated fats, plant protein, and beneficial phytochemicals that may help reduce inflammation and protect us from disease. Cashews are also a good source of copper, a mineral essential for energy production, healthy brain development, and a strong immune system, and magnesium and manganese, important for bone health. They are low in sugar and have been linked to benefits like weight loss, improved blood sugar control to protect against type 2 diabetes, and a healthier heart through lowering blood pressure, triglycerides, and cholesterol. More research is needed, however, to confirm these benefits. Cashews are classified as tree nuts. Therefore, people allergic to tree nuts may have a higher risk of also being allergic to cashews.

Grow

- Cashews are the seeds of a tropical evergreen shrub cultivated in warm, humid climates and related to mango, pistachio, and poison ivy. The cashew seed hangs from the bottom of a cashew apple. Fresh cashew apples taste delicious but are highly perishable.
- The kidney-shaped cashew seed is harvested by hand and is encased in a hard shell with two layers. Between these two layers is a toxic resin, urushiol (also found in poison ivy), which can trigger a skin reaction.
- During processing, the cashew kernels are shelled and cooked to remove the toxic urushiol, and the resulting product is sold as “raw” cashews.

Shop

- Cashews are sold in bags or in bulk bins and may be salted, unsalted, or flavored.
- For the freshest cashews, make sure there is no evidence of moisture or insects and that the cashews are not shriveled. If buying in bulk, smell the cashews to ensure they are not rancid. Cashews sold in vacuum-packed jars or cans will stay fresh longest.
- Cashews sold as “roasted” have been cooked twice—once during the shelling process and then roasted to deepen the color and enhance the flavor, sometimes with salt. Dry-roasted nuts are cooked without any added oil.
- For the most nutritional benefits and to limit excess salt or added fats, consider choosing dry roasted or “raw” unsalted cashew varieties whenever possible.

Store

- Because cashews are high in unsaturated fatty acids, they are susceptible to oxidation and rancidity and should be stored in an airtight container to minimize air exposure.
- Refrigerate or freeze cashews in tightly sealed containers to help them last longer. Cashews can last up to 6 months in the refrigerator and up to 1 year in the freezer.

Prep

- Cashews can be eaten “raw” or roasted and are a portable snack. Whole cashews can be used in stir-fries, soups, salads, and stews. Asian and Indian cuisines frequently include whole or chopped cashews as a stir-fry ingredient and in curries.
- Owing to their creamy texture when blended, cashews are used to make several dairy alternatives. These include cashew milk, cream and cream sauces, cheese, mayonnaise, butter, and pesto.
- To make cashew butter, roast cashews at 330°F/165°C for 10 to 15 minutes, until golden in color and fragrant. After the nuts have cooled, blend them in a food processor until smooth (about 12 to 15 minutes). Cashew butter can be spread on toast, stirred into yogurt or oatmeal, or mixed with oats and dried fruit to make no-bake energy bites.
- To make dairy-free sour cream or cream cheese, soak cashews and blend them with apple cider vinegar or lemon juice. A probiotic can also be used to ferment the cream cheese (<https://www.hummusapien.com/vegan-cashew-cream-cheese-recipe/>).

Sources: Are cashews good for you? Nutrition, benefits, and downsides. *Healthline*. Updated June 10, 2020. <https://www.healthline.com/nutrition/are-cashews-good-for-you>
Oliveira NN, Mothe CG, Mothe MC, de Oliveira LG. Cashew nut and cashew apple: a scientific and technological monitoring worldwide review. *J Food Sci Technol*. 2020 Jan;57(1):12-21. doi: 10.1007/s13197-019-04051-7



Brent Hofacker/123RF

To counter the steady flow of nutrition misinformation from multiple media outlets, we open each chapter with the **Fact Check** feature. The feature highlights a relevant nutrition-related topic, provides a science-based explanation of the current state of the evidence, and points students to the location within each chapter where more details can be found.

FACT CHECK

Should I take collagen for healthy skin?

Collagen accounts for approximately one-third of all the proteins in your body. It has a structural role in bones, joints, muscles, blood vessels, and skin. Many people are interested in the potential for collagen supplements to improve the elasticity, hydration, and firmness of skin to reduce the signs of skin aging. Collagen proteins in food are not absorbed intact but are broken down into small peptides and individual amino acids during digestion. The collagen found in dietary supplements comes from cows, pigs, chickens, and fish and has been hydrolyzed (broken down into small peptides) to promote absorption. Once absorbed, these raw materials can be used to synthesize collagen in cells if it is needed. Other nutrients, such as vitamin C and zinc (sometimes added to collagen supplements), are also required for collagen synthesis. Besides providing the building blocks for protein synthesis, collagen peptides may play

a role in regulating the breakdown and synthesis of proteins within the cell. Results of clinical trials show that collagen supplements are well tolerated and can increase skin hydration and elasticity, which decreases the appearance of skin aging. However, further research is underway to determine the best dose and combination of ingredients to support skin health. Should you take a collagen supplement? There is no evidence of adverse effects, and studies do show a benefit for skin outcomes. However, the cost of supplements is a consideration. A varied dietary pattern can provide the building blocks necessary for collagen synthesis at a reasonable cost. In Section 6.6 you will learn more about the structural role of collagen in the body.

Source: de Miranda RB, Weiner P, Rossi RC. Effects of hydrolyzed collagen supplementation on skin aging: a systematic review and meta-analysis. *Int J Dermatol*. 2021;60(12):1449-1461. doi:10.1111/ijd.15518



Ask the RDN continues to appear 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 experts in their fields to answer questions. This feature highlights the ability of the RDN to translate the latest scientific findings into easy-to-understand, practical, and applicable nutrition information.

ASK THE RDN CBD

Dear RDN: My friend recently began taking CBD. She said it helps her sleep better and manage her anxiety. What are the pros and cons of taking CBD?

CBD (cannabidiol) is a cannabinoid found in cannabis and hemp. Many people report that CBD helps manage anxiety, as well as pain, inflammation, muscle spasms, insomnia, seizures, inflammatory bowel disease, IBS, migraines, neurodegenerative disorders, and more. CBD is non-intoxicating. THC (tetrahydrocannabinol), another cannabinoid found in cannabis (and in small amounts in hemp), is known for its intoxicating or "high" effect.

The body processes cannabinoids through a neurotransmitter system (the *endocannabinoid system*) whose function is to promote homeostasis in the body. CBD helps to regulate this system. In fact, our body makes its own cannabinoid, called anandamide, also known as the *bliss molecule*. CBD allows our body to keep more of this *feel good* compound, which may explain why many find relief from anxiety using CBD.

There is pronounced synergy between the cannabinoids, terpenes (responsible for the unique aroma in plants), and flavonoids (that contribute antioxidant and anti-inflammatory effects) in cannabis and hemp. Each individual component of the plant may provide therapeutic benefits on its own, but when combined, the so-called *entourage effect* is dramatic.

CBD comes in many forms, including sublingual tinctures, water-soluble tinctures, edibles/softgels, topicals, and hemp flower/vape cartridges. There are three types of CBD: full spectrum, broad spectrum, and CBD isolate. Full spectrum products contain all the plant's components, including cannabinoids, terpenes, and flavonoids. Broad-spectrum CBD products contain all these synergistic components, minus the THC. CBD isolate is pure CBD, meaning that it does not contain other synergistic plant compounds, which may decrease efficacy and increase side effects.

Dosing of CBD is very individual, depending on the condition being treated and method of administration. Some people find relief with just 2 milligrams and others may require 50 milligrams or more. It's best to start low and go slow to find the minimum effective dose.

Today's market is inundated with CBD products, including many of inferior quality. The Food and Drug Administration found that 70% of CBD products sold online are mislabeled, with some containing zero CBD. It's important to buy CBD products from a trusted and safe source. Look for a certificate of analysis (COA) from an independent lab before buying a product.

A word of caution. Taking orally ingested CBD (i.e., edibles/softgels) with other medications that are contraindicated with grapefruit may result in an adverse event, so it's important to talk with a knowledgeable health care professional. Including CBD in your self-care routine may be effective for managing anxiety, but it's also important to work on other aspects of your life that may promote wellness: engage in regular physical activity, adhere to a healthy eating pattern, get adequate sleep, practice meditation or yoga, and seek professional help from a licensed mental health provider if symptoms of anxiety are severe.

Yours in health,

Janice Newell Bissex, MS, RDN, FAND
Holistic Cannabis Practitioner



Channing Johnson

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

Social media use and body dissatisfaction among college-age females

INTRODUCTION: Body dissatisfaction may lead to depression, restrictive dieting, and disordered eating behaviors. Previous research has shown a relationship between body dissatisfaction and exposure to traditional forms of media, such as print and television content. Social media may be especially problematic because it is used frequently and it facilitates social comparisons. However, the relationship between social media use and body dissatisfaction has not been adequately assessed.

OBJECTIVE: In this cross-sectional study, the researchers aimed to assess the relationships among social media use (e.g., Facebook, Twitter, and Instagram), body dissatisfaction, and negative affect (i.e., depression). **METHODS:** The researchers used a technique called ecological momentary assessment, in which they contacted subjects in their natural setting on their own schedule. This method has been used to overcome the limitations of retrospective assessments, which may be inaccurate and underestimate social media use. A sample of 30 college students who identified as female at Missouri State University were contacted through their smartphones five times per day for 6 days (1 practice day and 5 test days) to answer a series of questions about social media use (including time spent on social media as well as number of sites visited), mood (the Positive and Negative Affect Schedule-Expanded Form), and body image (the Body Image States Scale). Each assessment took approximately 5 minutes to complete. **RESULTS:** Number of sites visited, but not time spent on social media, was a predictor of body dissatisfaction. Social media use (time spent and number of sites visited) also predicted general negative affect, sadness, and guilt. **CONCLUSION:** This observational study showed that social media use, unlike other forms of media, predicts negative affect and body dissatisfaction. Specifically, consistent messaging about unrealistic body weight or shape across several sites may reinforce body dissatisfaction. This information may assist in the development of media literacy interventions to modify the use of social media and improve and/or develop coping skills. Future studies may employ similar assessment techniques in a larger, more diverse population and should examine the bidirectionality of the relationships between depression or body dissatisfaction and social media use.

Source: Bennett BL, Whisenhunt BL, Hudson DL, et al. Examining the impact of social media on mood and body dissatisfaction using ecological momentary assessment. *J Am Coll Health*. 2020 Jul;68(5):502-508. doi: 10.1080/07448481.2019.1583236

Each chapter presents a relevant **Case Study**, which presents a real-world scenario and challenges the students to apply their knowledge. This translational application can be used as a teaching strategy in traditional, hybrid, or remote learning. Answers are provided to instructors in Connect.

CASE STUDY Worried About Bone Health

Grace, a 23-year-old female of Korean descent, is in her final year of nursing school in Boston. She also works 20 hours per week at a local pharmacy. Grace is worried after a phone call she just received from her father. While out on her walk yesterday, Grace's mother caught her foot on an uneven section of the sidewalk, fell, and broke her hip. The doctor diagnosed Grace's mother with osteoporosis, and the family is worried about the long recovery ahead. As a nursing student, Grace knows how devastating a hip fracture can be. She also knows that osteoporosis can run in families. Grace resolves to do whatever she can to learn about osteoporosis and strengthen her bones now.

She searches online and finds the Osteoporosis Risk Check at <https://riskcheck.osteoporosis.foundation>. The online tool from the International Osteoporosis Foundation focuses mainly on nonmodifiable risk factors for osteoporosis: age, family history, chronic conditions, and use of medications that can influence bone health. The site also highlights some modifiable risk factors: weight status, exposure to sunlight, physical activity level, intake of good food sources of calcium and vitamin D, and use of alcohol or tobacco products.

Grace is 5'4" and weighs 105 pounds. Currently, she does not have any chronic health conditions. She does not take any medications or dietary supplements. Grace wonders if her intakes of calcium and vitamin D are adequate. She cooks traditional Korean dishes for half of her meals but eats fast food or sandwiches for the rest. Her go-to beverages are water and unsweetened tea. She admits she has not been able to fit physical activity into her busy schedule lately. On weekends, she goes out with friends and may have a glass or two of wine. Grace does not smoke.

Answer the following questions about Grace's bone health.

1. Go to <https://riskcheck.osteoporosis.foundation> and fill out the risk assessment using Grace's information. Identify two nonmodifiable risk factors for Grace.
2. Identify two modifiable risk factors for Grace.
3. What are the environmental conditions that inhibit Grace from adequately synthesizing vitamin D? How can she overcome some of them?
4. What are some calcium and vitamin D sources in traditional Korean dishes? (See <http://www.pbs.org/hiddenkorea/food.htm> for information about traditional Korean food.)
5. Give Grace some tips to increase her calcium and vitamin D intake at fast-food restaurants without significantly increasing costs or calories.
6. Based on her current dietary pattern, do you think Grace should take any dietary supplements? If so, which one(s)?

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



Grace is exploring ways she can decrease her risk for osteoporosis. Dennis Wae/Digital Vision/Getty Images

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

Sustainable Solutions

Offal

Does consuming offal sound awful? Offal refers to the entrails and organs, sometimes called *variety meats* or the *odd bits* of animals. Compared to other regions of the world, the United States is one of the lowest consumers of offal. In fact, nearly 60% of U.S. variety meats are exported to Asia. However, if you choose to consume animal products, including offal in your dietary pattern is a sustainable choice. From an agricultural standpoint, consuming everything *from nose to tail* is an efficient use of agricultural resources and cuts down on food waste. From environmental and economic perspectives, consuming these products locally helps to decrease the costs of exporting variety meats to other countries. Furthermore, organ meats are nutrient dense—especially for blood health! They are rich in high-quality protein and provide more iron, zinc, vitamin B-6, and vitamin B-12 than lean muscle meat.

Source: Ratliff E. Offal—health benefits of organ meat. *Today’s Dietitian*. 2020 May;22(5):44.

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

Anticoagulants

People who are prone to develop blood clots may take anti-coagulants or *blood thinners*. One commonly prescribed anticoagulant is Coumadin® (warfarin). This medication inhibits vitamin K–dependent coagulation factors. When taking Coumadin or similar drugs, it is important to keep dietary intake of vitamin K consistent from day to day.

©Peter Dazeley/Photographer’s Choice/Getty Images

Source: Hull RD, Garcia DA, Vasquez SR. Patient education: Warfarin (beyond the basics). UpToDate. Updated June 16, 2021. Accessed February 14, 2022. <https://www.uptodate.com/contents/warfarin-beyond-the-basics/print>

At the end of each chapter, **Nutrition and Your Health** provides an opportunity to explore current nutrition-related health and disease. With topics spanning from nutritional genomics to brain health to healthy aging, this feature provides an opportunity for in-depth classroom or remote discussions on a variety of timely topics.

16.5 Nutrition and Your Health: Lifestyles Linked with Longevity



Erik Isakson/Getty Images

However, it would not be desirable to add years to your life without adding life to your years. In other words, we want to know how to extend a healthy life without the burden of chronic diseases. With chronic diseases becoming more and more common in old age, there is increased interest in the behaviors common to people who live exceptionally long lives. Good health and longevity are dependent on numerous factors, including lifestyle and nutrition. Your genetic makeup is also important in determining your lifespan and risk of diseases, but your lifestyle is thought to have an even greater impact.⁴

The Blue Zones

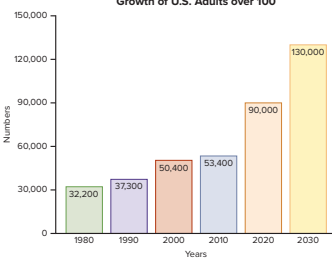
The blue zones are geographic areas whose inhabitants have lived longer and had lower rates of chronic disease than people from other regions of the world. *Blue zones* is a term first used in 2000 by Dan Buettner after leading a *National Geographic* expedition to find the secrets of longevity. The team discovered five regions around the world where people typically live to be over 100 years old.^{33,34}

To be considered a certified blue zone, the population lived significantly longer compared to national rates. These populations displayed various behaviors related to their lifestyle, nutrition, genetics, and physical environmental conditions that might be determinants for life quantity and quality. Using epidemiological data, statistics, birth certificates, and other data, five regions on the planet were identified with the highest density of centenarians. These people lived long, healthy, highly active lives and reached age 100 at 10 times greater rates than others in the United States. These regions are described next and in Figure 16-12.³⁵

- **Sardinia, Italy:** Some of the oldest men in the world lived in the mountainous Ogliastra region of Sardinia and typically worked on farms and drank one or two glasses of red wine each day.
- **Okinawa, Prefecture of Japan:** The world’s oldest females were found in this area, where the dietary pattern was rich in soy-based foods and tai chi, a meditative form of physical activity, was practiced.
- **Icaria, Greece:** People in this area consumed a Mediterranean diet rich in olive oil, red wine, and homegrown vegetables.
- **Nicoya Peninsula, Costa Rica:** People of this area regularly performed physical jobs into old age. Plant-based foods, such as beans and corn tortillas, formed the base of their dietary pattern.
- **Seventh-day Adventists of Loma Linda, California:** This religious organization followed a strict vegetarian dietary pattern and lived in closely faith-connected communities. In 2020, the Adventist Health system made a commitment to lead the blue zone well-being transformation movement that is the foundation of their 150-year Seventh-day Adventist heritage.

The U.S. Census Bureau indicates that the number of adults in the United States who have reached their 100th birthday grew to over 90,000 in 2020. By 2030, it is estimated that there will be over 130,000 centenarians in the U.S.³² (Fig. 16-11).

Growth of U.S. Adults over 100



Year	Estimated Number of U.S. Adults over 100
1980	32,200
1990	37,300
2000	50,400
2010	53,400
2020	90,000
2030	130,000

FIGURE 16-11 Estimated growth of U.S. adults living to 100 by the year 2030.

Source: U.S. Census Bureau and Texas A&M.

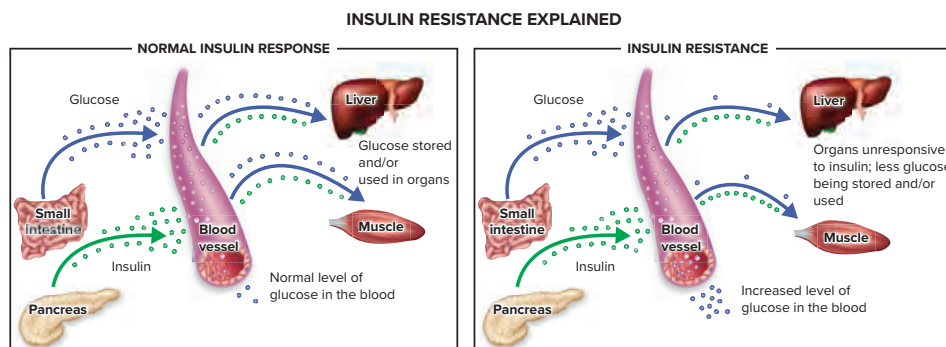
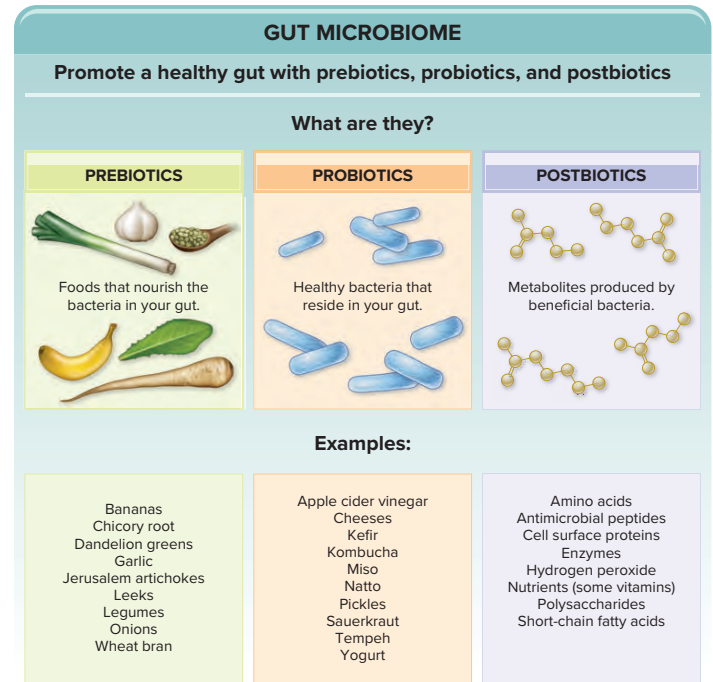
Connecting to Engaging Visuals

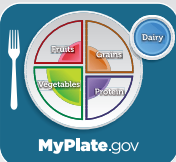
Attractive, Accurate Artwork

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 written explanations and illustrations 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.

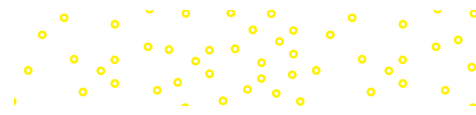
The final result is a striking visual program that holds readers' attention and supports comprehension and critical thinking. The attractive layout and design of this release are clean, bright, and inviting. This creative presentation of the material is geared toward engaging today's visually oriented students.



	Fats & Oils		Calcium	Dairy	
	Sour cream (1 T)	14.5 mg	 MyPlate.gov	Plain low-fat yogurt (1 c)	448 mg
	Cream cheese (1 T)	14.1 mg		Part-skim mozzarella (1.5 oz)	333 mg
	Butter (1 T)	3.4 mg		Nonfat milk (1 c)	299 mg
	Fruits			Grains	
	Fortified orange juice (1 c)	348 mg		White bread (1 slice)	73 mg
	Dried figs (½ c)	121 mg		Raisin bran (1 c)	24 mg
	Raisins (½ c)	36 mg		Corn tortilla (1 med)	23 mg
	Vegetables			Protein	
	Cooked turnip greens (½ c)	99 mg		Canned salmon (3 oz)	181 mg
	Cooked kale (½ c)	47 mg		Tofu (with calcium sulfate) (½ c)	138 mg
	Fresh broccoli (1 c)	42 mg		Cooked chickpeas (½ c)	40 mg
MAIN FUNCTIONS					
Major role in bone growth, maintenance, and repair, a function that utilizes 99% of the calcium in the body. Supports normal muscle and nerve function. Regulates metabolism via various enzymes and hormones. Maintains cell membrane integrity, normal blood pressure, glucose concentration, and cellular differentiation.					
RECOMMENDATIONS					
RDA: 1000 milligrams DV: 1300 milligrams UL: 2500 milligrams					
SPECIAL NOTES					
Blood values of calcium do not reflect recent dietary intake; blood levels are tightly regulated by hormones that control the deposition or release of calcium from bones, absorption of calcium from the small intestine, and excretion or retention of calcium by the kidneys. Inadequate calcium intake over time can lead to excessive losses of the mineral from bone and contribute to the development of osteoporosis.					

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: ChooseMyPlate.gov, U.S. Department of Agriculture

Connecting with the Latest Updates



Global Changes

- **Diversity, Equity, and Inclusion:** McGraw Hill is dedicated to creating products that foster a culture of belonging and are accessible to all the diverse, global customers we serve. Within this release content has been reviewed to implement inclusive content guidelines around topics including generalizations and stereotypes, gender, abilities/disabilities, race/ethnicity, sexual orientation, diversity of names, and age.
- **Art Accessibility:** Strengthened art guidelines improve accessibility by ensuring meaningful text and images are distinguishable and perceivable by users with limited color vision and moderately low vision.
- All chapters now open with a new feature, *Fact Check*, which grabs the student's attention and immediately shows how the chapter will be relevant to everyday life. The topics include recent trends or common misperceptions about nutrition. The concise feature at the chapter opening then points students to a later section of the chapter for a detailed discussion of that topic.
- The new *Roots* feature digs down to discover the diverse factors that influence our food choices and nutritional status.
- Several new *Ask the RDN* features have been included with contributions from content experts in the fields of health disparities, campus food insecurity, ketogenic diets, fertility, and cannabis.
- Two new *Farm to Fork* features (cashews and olive oil) have been added.
- Throughout the text, the language used to describe a healthy dietary pattern has been modified to be more **weight inclusive**.
- Many tables and figures have been created and others transformed into new, **eye-catching infographics** that help students to map complex concepts.
- In several chapters, we have **updated terminology** to be consistent with current usage in public health, nutrition, and medicine. For example, the outdated, stigmatizing term *failure to thrive* has been replaced with *pediatric malnutrition*. In addition, the term *nutrition security* has been applied to expand the previous terminology surrounding *food security*.
- We have revised several chapters and the Appendices to include the updated 2023 *Dietary Reference Intakes for Energy* published by the National Academies of Sciences, Engineering, and Medicine.
- Throughout the text, we have emphasized **dietitians as the experts** on nutrition.

- Unlike most nutrition texts on the market, our ancillary materials (Connect test banks and question banks, concept checks, end-of-chapter questions and answer keys, PowerPoint lecture slides, instructor's manual, and teaching strategies) have been reviewed and **revised by the authors!**

Chapter-by-Chapter Revisions

Chapter 1: Nutrition, Food Choices, and Health

- The new *Fact Check* in Chapter 1 introduces this new chapter opener feature and highlights the science of nutrition.
- Figure 1-1 has been updated to include food access and genetics as key factors that influence our food choices.
- The section *What Influences Your Food Choices* has been updated with results from the latest Food and Health Survey.
- The *USDA Food Availability and Consumption Data* has been updated (Figs. 1-2 and 1-4) and a new figure (Fig. 1-3) has been included to present food consumption patterns in the U.S.
- The 10 leading causes of death have been updated and presented in Figure 1-5. COVID-19 ranked third for the causes of death in 2021.
- A new *Ask the RDN* in section 1.2 answers the question, *Why Dietetics?* and presents the many facets of evidence-based nutrition and innovations in the field of dietetics.
- A new infographic, Figure 1-6, was created to simplify the macronutrients relative to their energy content, intake recommendations, food sources, and functions.
- Section 1.4 has been reorganized to improve the flow of the content. In addition, a new infographic, Figure 1-8, has been included to simplify metric conversions for students.
- Obesity prevalence rates by U.S. states have been updated and the new data presented in Figure 1-12.
- A new *Newsworthy Nutrition* focusing on the role of diet and lifestyle in early-onset colorectal cancer in Section 1.6. This is a timely feature as the rates of early-onset cancer are growing in the U.S.
- This chapter's *Roots* feature introduces and celebrates global dietary patterns.
- A second and new *Ask the RDN* is featured in Section 1.6 and focuses on *Food is Medicine* initiatives following the *White House Conference on Hunger, Nutrition, and Health*.
- Section 1.7 content has been updated to focus more on healthy lifestyle behaviors instead of the emphasis on body weight.

- The standard alcoholic drink sizes (Fig. 1-13) have been updated to include hard seltzers and flavored malt beverages. The addition of *mocktails* as a growing area of popularity are also presented in this section.
- The *Case Study on Choosing a Healthy Breakfast* was expanded to include lifestyle behaviors and now includes recommendations related to alcohol consumption and sleep.

Chapter 2: Designing a Healthy Eating Pattern

- This chapter's *Fact Check* helps students understand where beans, peas, and lentils fit in the MyPlate food source categories.
- A new subsection in Section 2.1 describes how food processing affects the nutrient density of foods.
- A new *Magnificent Microbiome* feature explores how dietary patterns—particularly those high in ultraprocessed foods—may influence the gut microbiota.
- The new Figure 2-2 illustrates a simple and relevant way for students to estimate portion sizes.
- An updated Figure 2-4 outlines the key recommendations of the *Dietary Guidelines for Americans*.
- A new *Roots* feature presents the *Latin American Diet Pyramid*.
- An updated *Newsworthy Nutrition* presents a systematic review and meta-analysis of research relating various assessments of dietary quality to health outcomes.
- A narrative description of *Acceptable Macronutrient Distribution Ranges* has been added to the discussion of nutrient recommendations in Section 2.6. Also, a new Table 2-3 summarizes the various types of nutrient recommendations.
- Section 2.8 has been revised to include new content on food labeling policies and clear guidance for interpreting Nutrition Facts labels. Figure 2-16 has been streamlined and updated.
- The *Case Study* on college student eating habits has been revised to stimulate critical thinking about the content presented in Chapter 2.
- A new *Ask the RDN* feature describes the relationship between nutrition and academic performance.
- This chapter includes 13 new references.

Chapter 3: The Human Body: A Nutrition Perspective

- The new Figure 3-8 illustrates hormones with nutritional significance, orienting the student to many hormones that will be addressed again in subsequent chapters.
- *Farm to Fork: Onions and Garlic* has moved from Chapter 9 to Chapter 3, near Section 3.7 on the Immune System.
- The new *Roots* feature explains some of the benefits of eating fermented foods.

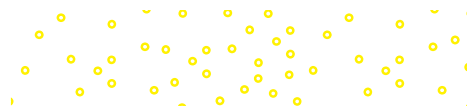
- A new *Magnificent Microbiome* feature focuses on the role of the microbiome in irritable bowel syndrome.
- *Newsworthy Nutrition* has been updated to present recent research on fecal transplant as a treatment for irritable bowel syndrome.
- This chapter includes 21 new references.

Chapter 4: Carbohydrates

- This chapter's *Fact Check* questions the safety and controversies related to artificial sweeteners including the recent carcinogenic claims regarding aspartame.
- A new *Farm to Fork* feature on corn on the cob was added to section 4.1. Corn provides fiber and is a good source of many vitamins and minerals.
- Table 4-1 is new and classifies dietary fibers while providing food sources for each fiber type.
- The new *Sustainable Solutions* features whole grains as a leading source of energy and dietary fiber in global eating patterns.
- Figure 4-11 was added to show common sources of added sugars in typical dietary patterns.
- Two new *Magnificent Microbiome* features, located in sections 4.1 discuss how microbes contribute to metabolism.
- This chapter's new *Roots* feature celebrates the *African Heritage Dietary Pattern* with an accompanying figure (Fig. 4-13) depicting the main dietary components.
- A new *Newsworthy Nutrition* reports the sugar-sweetened beverage consumption in 185 countries.
- A new infographic, Figure 4-18, is now included to provide a simplified graphic detailing the criteria used to diagnose diabetes.
- A new and timely *Ask the RDN* authored by Dr. Carmen Blakely highlights *Nutrition and Health Disparities*.
- Chapter 4 has been updated with seven new references.

Chapter 5: Lipids

- Section 5.1 has been renamed as *Lipids: What Are They?*
- Figure 5-4 has been revised to include diglycerides and monoglycerides and annotated to explain the key features of the various forms of lipids.
- Figure 5-11 has been revised and annotated to further describe the absorption of dietary lipids.
- A new Figure 5-13 illustrates the four main lipoproteins in the bloodstream.
- Figure 5-14 has been updated to present a more detailed and accurate view of an adipose cell.
- Table 5-5 has been updated with the latest dietary advice from the *American Heart Association*.
- The new *Roots* feature presents the Nordic diet as a culturally appropriate alternative to the well-known Mediterranean diet.



- The *Case Study* about a heart-healthy eating pattern has been revised to stimulate more critical thinking about the content presented in Chapter 5.
- Dr. Steven Hertzler explains the pros and cons of the keto diet for weight loss in a new *Ask the RDN* feature.
- The *Nutrition and Your Health* section now includes *Life's Essential 8*, emphasizing a more holistic approach to heart health.
- A new *Farm to Fork* investigates the origins and uses of olive oil.
- Chapter 5 has been updated with nine new references.

Chapter 6: Proteins

- The chapter opens with a new *Fact Check* feature about collagen supplements.
- Some content within this chapter has been reordered. The discussion of plant-based dietary patterns now appears immediately after the section about protein in foods.
- A new section has been added for *Special Health Concerns Related to Protein Intake*, which includes protein-calorie malnutrition, food allergies, kidney disease, and inborn errors of metabolism.
- All content about nutritional genomics and personalized nutrition has been moved to the revamped *Nutrition and Your Health* section at the end of the chapter.
- A new Figure 6-6 shows examples of denaturation of proteins.
- Figure 6-9 has been updated to include a distinct category for legumes.
- The new *Sustainable Solutions* feature in Section 6.3 examines the role of animal-sourced proteins in planetary health.
- A new *Roots* feature highlights the plant-based dietary patterns of Seventh-day Adventists.
- An updated *Newsworthy Nutrition* feature discusses the influence of plant-based dietary patterns on cardiovascular disease.
- Figure 6-12 has been revised to clearly show how protein status can influence fluid balance in the body.
- The new Figure 6-16 is an infographic that summarizes advice related to protein intake from the *Dietary Guidelines*.
- In the new section about *Special Health Concerns Related to Protein Intake*, the discussion of food allergies and Figure 6-18 now include references to sesame allergy, the ninth most common food allergen and newest addition to the labeling requirements for food allergens.
- Chapter 6 has been updated with 32 new references.
- This chapter's *Fact Check* helps students understand how weight bias impacts health outcomes.
- Figure 7-1 has been updated with the latest available CDC obesity prevalence data.
- A new infographic, Figure 7-5, provides the percentages of energy use by various organs.
- Section 7.2 and Appendix F have been updated to include the Estimated Energy Requirements aligning with the new 2023 DRIs for energy.
- The American Medical Association's position statement on BMI has been added to Section 7.3.
- Figure 7-16 has been updated to display both upper and lower body fat distribution patterns for both sexes.
- The *Asian Diet Pyramid* is highlighted in this chapter's *Roots* feature with an accompanying figure (Fig. 7-19) presenting the main components.
- The addition of content related to the new World Health Organization's (WHO) position against the use of non-sugar sweeteners to control weight can be found in Section 7.5.
- A new infographic (Fig. 7-20) highlights the CDC guidelines for physical activity for healthy adults.
- Tools for successful weight management and a new *SMART goal worksheet* (Table 7-5) were created to assist students in self-monitoring, goal setting, and other proven behavioral approaches to promote behavior change.
- A section on non-diet strategies to improve health has been added to Section 7.7. These data are based on the recently published systematic literature review by the Academy of Nutrition and Dietetics.
- Table 7-7 presents the latest medications approved for obesity treatment. This now includes the popular GPL-1 agonists (such as Wegovy and Ozempic).
- A weight gain checklist, organized by food groups, has been added in a new Figure 7-28.
- Presentation of the five best overall diet plans has been updated in Table 7-9. The top-rated weight loss plans are further detailed in the text.
- Seven new references have been added to this chapter.

Chapter 8: Vitamins and Phytochemicals

- The Chapter 8 *Fact Check* provides details on the vitamin D content of various milk and dairy alternatives.
- A new section (8.2) has been added to this chapter to emphasize phytochemicals including sources, functions, and tips for incorporating more into your dietary pattern.
- This chapter contains several *Roots* features: supertasters describes a genetic variant that can influence acceptability of phytochemical-rich plant sources (section 8.2); religious customs that affect vitamin D status (section 8.4); andnixtamalization, a native method of corn preparation (section 8.10).

Chapter 7: Energy Balance

- Chapter 7 content has been updated with verbiage presenting a more weight-inclusive approach to energy balance and the evidence-based recommendations for those choosing to reduce their body weight.

- A new infographic (Fig. 8-2) compares water-soluble and fat-soluble vitamins relative to absorption, storage, excretion, toxicity, and deficiencies.
- A new *Farm to Fork* feature on pomegranates is included in section 8.6. These unique fruits are rich in phytochemicals and vitamins.
- A new *Newsworthy Nutrition* details the seminal SELECT trial assessing the impact of selenium and vitamin E supplementation on prostate cancer prevention.
- There are two *Ask the RDN* features in this chapter: one describing the evidence pertaining to detox diets (section 8.8); and one that details the role of nutrition in supporting our immune system (section 8.19).
- Section 8.9 presents a *Case Study* on potential nutrient deficiencies from following a vegan and gluten-free dietary pattern, and section 8.19 presents a case study on choosing dietary and physical activity patterns associated with cancer prevention.
- Choline was relocated to its own section (8.17) given its unique vitamin-like properties.
- A new *Nutrition and Your Health* section has been added to emphasize the state of the science pertaining to dietary supplements.
- A new figure (Fig. 8-35) was created to simplify the three phases of carcinogenesis, and new Figure 8-36 lists the early symptoms of cancer.
- Chapter 8 has been updated with 21 new references.
- The content on osteoporosis has been moved from Section 9.6 and expanded to create a new *Nutrition and Your Health* feature.
- The content on dairy alternatives has been condensed into a new *Ask the RDN* feature.
- A new *Farm to Fork* feature reviews the surprising origin of cashews and highlights the use of cashews as a dairy alternative.
- The new *Roots* feature discusses selenium's role in immunity and the regional differences in the selenium content of food sources.
- Expanded content in Section 9.12 includes a discussion of goitrogens. An updated *Newsworthy Nutrition* feature further explores the impact of goitrogens on iodine status.
- In the *Nutrition and Your Health* section about hypertension, *Newsworthy Nutrition* has been updated with an article that discusses the results of a cross-sectional study about the DASH diet and blood pressure among college students.
- Figure 9-27 has been updated to illustrate the stages of hypertension more clearly.
- A new *Magnificent Microbiome* feature explores the connections among dietary sodium, the gut microbiota, and blood pressure regulation.
- Chapter 9 includes 66 new references.

Chapter 9: Water and Minerals

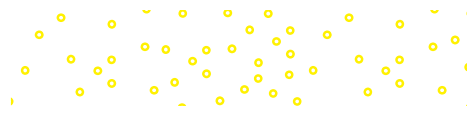
- The new *Fact Check* explains how red meat can fit into a healthy dietary pattern.
- Section 9.1 on Water has been reorganized to be consistent with the presentation of other nutrients.
- The new Figure 9-11 summarizes MyPlate food sources of minerals.
- Section 9.3 now includes a brief explanation of osmosis, solutes, solvents, and concentration to help clarify these important concepts for students with minimal background in science.
- In a new *Ask the RDN* feature, students learn about steps they can take during young adulthood to keep blood pressure in check throughout life.
- In Section 9.6, the narrative explanations of the functions of calcium have been expanded and revised.
- A revised Figure 9-16 illustrates the roles of calcitonin, parathyroid hormone, and vitamin D in the regulation of blood calcium levels.
- The new *Sustainable Solutions* feature evaluates the sustainability of dairy foods.
- A new Figure 9-18 illustrates factors that can increase or decrease calcium absorption from foods.

Chapter 10: Nutrition: Fitness and Sports

- The new *Fact Check* answers the question, "If I eat more protein, will I gain more muscle?"
- A new *Roots* features the health of hunter-gatherers, their dietary patterns, and subsequent energy expenditures.
- The FITT equation has been updated to include volume and progression (now FITT-VP).
- Figure 10-2 is a new infographic showing tips to manually measure your own heart rate.
- A new infographic, Figure 10-11, has been added to assist students with understanding the nutritional requirements of athletes.
- Figure 10-13 is a new heat-related illness infographic to help students identify common symptoms and recommended actions to take.
- A new and engaging CDC infographic detailing heat related illnesses appears in Figure 10-12.
- The lists of commonly used sports supplements and illegal substances have been expanded and updated in Table 10-10.

Chapter 11: Eating Disorders

- A new *Fact Check* feature explores the demographics of eating disorders.
- In Section 11.1, a new *Roots* feature presents recent research on the genetic underpinnings of eating disorders.



- An updated *Newsworthy Nutrition* feature examines the role of social media in the development of eating disorders.
- In Section 11.2, the discussion of the physical effects of anorexia nervosa has been shortened to improve readability.
- In Section 11.5, two new subsections provide information on rumination disorder and avoidant-restrictive food intake disorder. Also, the explanation of subthreshold eating disorders has been expanded.
- Section 11.6 has been updated to include a recently published consensus statement from a panel of experts on the definition and diagnostic criteria for orthorexia nervosa.
- Chapter 11 includes 37 new references.

Chapter 12: Protecting Our Food Supply

- The new *Fact Check* feature highlights the pros and cons of purchasing organic products and points to additional details presented later in the chapter.
- This 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 Figure 12-4 details components of the food production chain and areas presenting risk for contamination.
- Figure 12-5 has been updated with the most recent data on foodborne illness outbreaks across the country.
- A new CDC infographic has been added to show the steps taken in a foodborne outbreak investigation once suspected or detected.
- A new *Newsworthy Nutrition* focuses on foodborne illness outbreaks linked to unpasteurized milk consumption.
- A new CDC Figure 12-8 displays the causes and prevalence of foodborne illness.
- Section 12.4 has been revamped and simplified to present the key bacterial, viral, and parasitic causes of foodborne illnesses (Fig. 12.9, Fig. 12.11, and Fig. 12.13).
- Figure 12-14 is a new infographic showing the amount of caffeine in common beverages.
- The new *Roots* feature discusses global spices and the potential risk for contamination if mishandled.
- Section 12.6 has been reorganized around the CDC's four steps to food safety to simply these concepts and guidelines for keeping your food safe.
- The WHO's golden rules for safe food preparation have been added to emphasize the main recommendations.

Chapter 13: Global Nutrition

- The new *Fact Check* explains the difference between malnutrition and hunger. These terms are often used interchangeably with students.
- Figure 13-1 is new and visually presents the prevalence and regions of global hunger.

- Terminology throughout has been updated to reflect the adoption of the term *nutrition security*, with inclusion of diet quality and health equity to food security.
- Figure 13-5 and 13-6 are both new and highlight the main components of nutrition security and its impact on health in the U.S.
- Information on the Farm Bill and resource allocations are now included in Figure 13-5.
- Section 13.2 has been updated and includes a new infographic, Figure 13-5, that displays the Farm Bill resource categories.
- Also in this section, the federal nutrition assistance content has been expanded to include additional details about SNAP, School Breakfast and Lunch Programs, Congregate Meals, and WIC.
- A new *Ask the RDN* on college food and nutrition insecurity is included in Section 13.2.
- This chapter's new *Roots* feature details the practice known as entomophagy, or insect farming, and its contributions towards food and nutrition security.
- Figure 13-9 has been updated and presents the data pertaining to global access to safe water aligning with the Sustainable Development Goal for clean water and sanitation.
- A new *Sustainable Solution* on offal consumption—basically eating everything from nose to tail of an animal. Although not practiced widely in the U.S., this is an efficient use of agricultural resources and cuts down on food waste.
- Chapter 13 has been updated with six new references.

Chapter 14: Nutrition During Pregnancy and Breastfeeding

- A new *Fact Check* feature explains the lack of evidence to support maternal dietary restrictions for the prevention of food allergies.
- Section 14.1 has been updated with the latest evidence-based guidelines for the assessment and management of polycystic ovary syndrome.
- Also in Section 14.1, a new *Ask the RDN* feature from Lauren Manaker, MS, RDN, LD, CLEC, author of *Fueling Male Fertility*, describes nutritional strategies to improve male fertility.
- A new Figure 14-3 illustrates important food safety practices for individuals during pregnancy.
- An updated *Newsworthy Nutrition* feature examines the effects of prenatal folic acid supplementation on the cognitive development of the offspring throughout childhood.
- The discussion of energy needs during pregnancy and lactation and Figure 14-9 have been revised to reflect the recently updated DRIs for energy.
- The new *Roots* feature discusses pica, the practice of eating nonfood items, during pregnancy.

- In Section 14.7, use of high-dose vitamin D supplements during breastfeeding is described as an alternative to vitamin D supplementation for infants who are breastfed.
- Chapter 14 includes 38 new references.

Chapter 15: Nutrition from Infancy Through Adolescence

- In Section 15.1, we have included additional information about assessing infant and child growth. The term *failure to thrive* has been replaced with *pediatric malnutrition*.
- Information about the calculation of energy needs from infancy through adolescence reflects the latest DRIs for energy.
- Table 15-3 has been updated to include the latest research on the nutrient content of human milk.
- In Section 15.3, we have altered the language in several places to ensure that formula feeding is recognized as a safe and nutritious way to feed an infant when human breast milk is not available.
- The new *Roots* feature reviews the history of wet nursing.
- We present the latest data about the safety of infant foods, including ways to protect infants from exposure to heavy metals and food allergens.
- In Section 15.5, the discussion of childhood obesity has been revised to reflect current evidence from several systematic reviews. Also, a new Figure 15-6 illustrates the consequences of childhood obesity. We have included new content about weight bias.
- Section 15.7 has been updated with new statistics about food allergies and intolerances and new laws that add sesame to the list of common food allergens that must be declared on food labels.
- A new *Ask the RDN* feature discusses the nutrition implications of alpha-gal syndrome, an allergy to red meat that can arise as a result of a tick bite.
- Chapter 15 includes 47 new references.

Chapter 16: Nutrition During Adulthood

- This chapter begins with a new *Fact Check* discussing the influence of genetics and environmental exposures on longevity.
- 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 for this life stage.
- Table 16-1 has been replaced by a new Figure 16-4 and presents the 12 main components of the *Hallmarks of Aging* with accompanying text detailing each component.
- The new *Magnificent Microbiome* focuses on the biological changes that occur with normal aging.
- Essential oils and aromatherapy are highlighted in the new *Sustainable Solutions*.
- A new *Newsworthy Nutrition* presents research on the impact of nutrition on aging.
- A new Figure 16-5 highlights malnutrition risk factors for older adults.
- An *Ask the RDN* authored by Janice Newell Bissex details the pros and cons of taking CBD in this informative new feature.
- Table 16-5 has been replaced by a new Figure 16-10 infographic emphasizing healthy eating tips for older adults.
- We have added a second *Nutrition and Your Health* feature in this chapter to promote healthy lifestyles linked to healthy longevity. This section introduces the popular blue zones phenomenon.
- Global bread intake from the blue zones is highlighted in the new *Roots* feature.
- Chapter 16 has been updated with three new references.

Acknowledgments

It is because of the tireless efforts of a cohesive team of talented professionals that we can bring you the 2024 Release 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 leads the day-to-day efforts of the entire editorial team. We especially appreciate her longevity over many releases of the *Contemporary Nutrition* products and value her keen eye for detail, strong work ethic, and organizational expertise. We are grateful to our Senior Core Content Project Manager, Diane Nowaczyk, and her staff for their patience and careful coordination of the numerous production efforts needed to create this very appealing and accurate release. We thank Brent dela Cruz, our Lead Assessment Content Project Manager, for his efforts and assistance. We appreciate the meticulous work of our proofreader, Susan Gall, and our Content Licensing Manager, Melissa Homer. 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. We are privileged to work alongside our colleagues Alaa Ilayan, Julia Richardson, and Rachel Williams, whose careful review and creative contributions enhance the quality of the book and digital tools. Finally, we are indebted to our colleagues, friends, and families for their constant encouragement, honest feedback, and shared passion for the science of nutrition.

Ask the RDN Contributors

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

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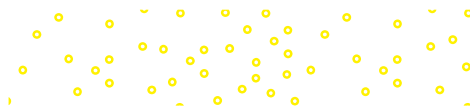
Chris Vogliano, PhD, RDN

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 each new release 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.” It has been a privilege for us to join Dr. Wardlaw as coauthors of this textbook. 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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Breakfast bowl: Alexis Joseph/McGraw Hill; happy family in the kitchen: Makistock/Shutterstock; chia pudding: Alexis Joseph/McGraw Hill

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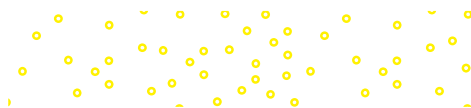
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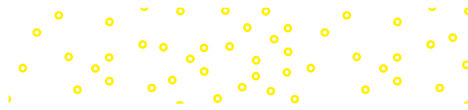
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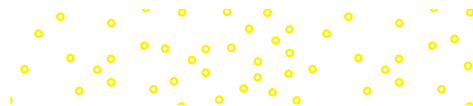
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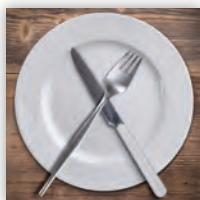
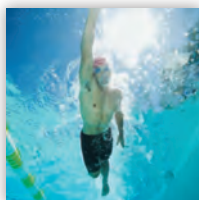
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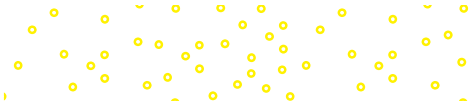
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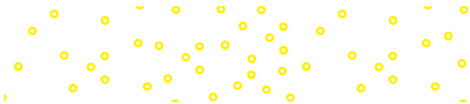
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A vertical hydroponic system is shown against a wall made of vertical bamboo poles. Four horizontal grey pipes are mounted at different heights, each containing a row of lettuce. The top and bottom rows are red-leafed lettuce, while the middle two rows are green-leafed lettuce. Grey PVC pipes connect the horizontal pipes to a vertical supply line on the left. The text '2024 RELEASE' is in a white box in the upper right, and the title 'Wardlaw's Contemporary NUTRITION' is centered over the middle rows of lettuce.

2024 RELEASE

Wardlaw's
Contemporary
NUTRITION

Chapter 1

Nutrition, Food Choices, and Health



Chapter 1 is designed to allow you to:

- ## FACT CHECK

And, after completion of this course, you should understand the science behind the food choices and lifestyle behaviors you make that impact your mental and physical health throughout life. 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?

dietary pattern The quantity, proportion, variety, or combination of different foods, drinks, and nutrients in diets, and the frequency with which they are habitually consumed.

physical activity Any movement of skeletal muscles that requires energy.

nutrition literacy Degree to which individuals obtain, process, and understand nutrition information and the skills needed in order to make appropriate nutrition-related decisions.

alcohol Ethyl alcohol or ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) is the compound in alcoholic beverages.

In your lifetime, you will likely consume about 85,000 meals and 40 tons of food. Although this consumption pattern is based on American dietary patterns, keep in mind that food consumption varies around the world based on different cultures, traditions, availability, local customs, and dietary preferences. Many factors—some internal, some external—influence our food choices and behaviors. This chapter begins with a discussion of these factors and ends with current information about **alcohol** consumption and its relationship to our health. In between, we examine the powerful effect of dietary patterns in determining overall health and take a close look at the general classes of nutrients—as well as the calories—supplied by what we eat and drink. We also present the major characteristics of the *Dietary Guidelines for Americans* and our progress toward meeting nutrition-related objectives of *Healthy People 2030*. A review of the scientific process behind nutrition recommendations is also included, along with an introduction to our timely features that appear in each chapter: *Fact Check*, *Farm to Fork*, *Newsworthy Nutrition*, *Magnificent Microbiome*, *Sustainable Solutions*, *Case Studies*, and *Ask the RDN*. Our newest feature, *Roots*, celebrates the various cultures, customs, and lifestyles specific to nutrition and health.

Identifying what drives us to eat and what affects our food choices will help us 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 various individuals and cultures and thus why others' dietary patterns and preferences may differ from yours.

FIGURE 1-1 Food choices are affected by many factors. Florian Franke/Purestock /SuperStock



WHAT INFLUENCES YOUR FOOD CHOICES?

North American adults spent almost 75 minutes a day eating and drinking.¹ If we live to be 80 years old, we will have spent over 4 years eating and drinking! Overall, our daily food choices stem from a complicated mix of biological and social influences. The *Food and Health Survey* found that, from a list of key factors, the majority (87%) said that taste influenced their food and beverage purchases, followed by price (76%), healthfulness (62%), convenience (61%), and environmental sustainability (34%).² In addition, 68% of respondents reported that familiarity was another important factor in making purchasing decisions. Now, let's examine some of the key reasons we choose what we eat and drink.

Flavor, texture, and appearance, also known as *taste*, are some of 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 most nutritious and healthy 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 behaviors and food availability strongly influence choices. Food Availability and Consumption Data from the U.S. Department of Agriculture (USDA) show that adults consume more than the recommended amounts from the proteins 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. Apples and oranges are the most commonly consumed fruits, but they are consumed mostly in juice form (Fig. 1-3). Milk and cheese, especially mozzarella cheese, comprise most of the dairy consumption; milk consumption has shown a big decline, while cheese consumption has doubled and yogurt consumption increased (Fig. 1-4).

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 an association between TV advertising of foods and drinks and childhood **obesity** in the United States.³ These findings suggest that exposure to food advertisements may encourage eating behaviors that do not align with healthy dietary recommendations for our youth. Research also indicates that mass media influences the onset of eating disorders through its depiction of extremely thin models as stereotypes of attractive bodies.⁴

Restaurant dining plays a significant role in our food choices. Americans eat and drink about one-third of their calories from foods prepared away from home. Restaurant food is often calorie dense, served in larger portions, and of poorer nutritional quality compared to foods made at home. To help individuals make informed and more healthy decisions, many eating establishments and chain restaurants list the calorie content of foods and beverages on their menus or menu boards and include additional nutrition information upon request. More information can be found at fda.gov/CaloriesOnTheMenu.

Time and convenience have become significant influences affecting food choices. Current lifestyles limit the time available for food preparation. 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.



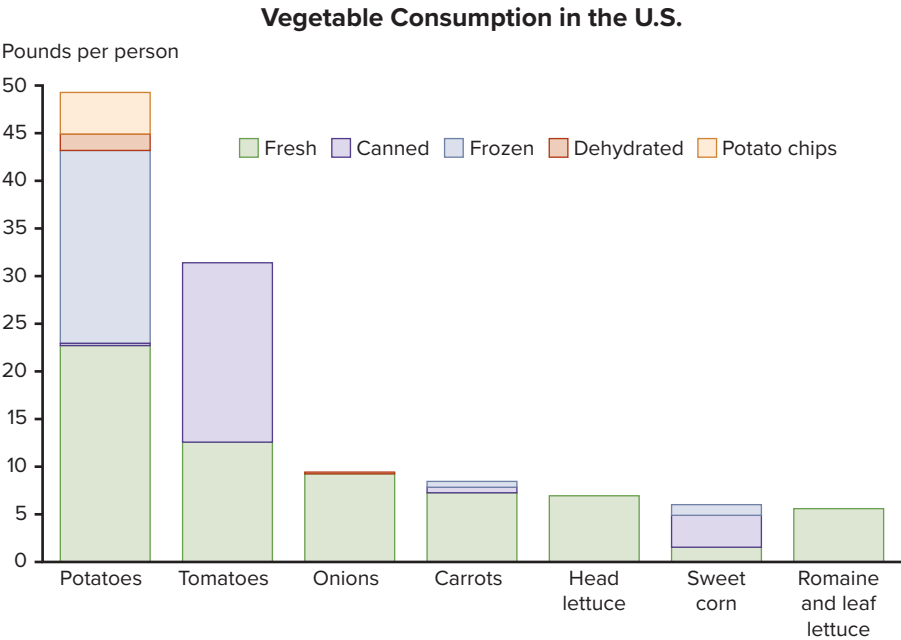
This beautiful child, a survivor of brain cancer, is participating in a garden-based program for families designed to improve dietary and physical activity patterns. Here, she is making zoodles, or zucchini noodles.

Exposing children to growing, preparing, and eating healthy foods, such as this veggie pasta, lays a strong foundation for healthful choices throughout life. Indeed, children become more *adventurous eaters* and are willing to try new foods when they participate in the growing, harvesting, and preparation of foods. **Can you think of other ways to encourage children to become more adventurous eaters?** Jeff Laubert

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 most often defined as BMI of 30 or higher. For children, this is often defined as BMI-for-age at the 95th percentile or higher.

FIGURE 1-2 According to food availability data, the favorite vegetables of individuals in the United States are potatoes and tomatoes. North Americans consumed 49 pounds of potatoes per person and 31 pounds of tomatoes, with 60% as canned tomatoes. Onions were the third highest consumed vegetable at 9 pounds per person.

Source: USDA, Economic Research Service, Loss-Adjusted Food Availability Data, 2019



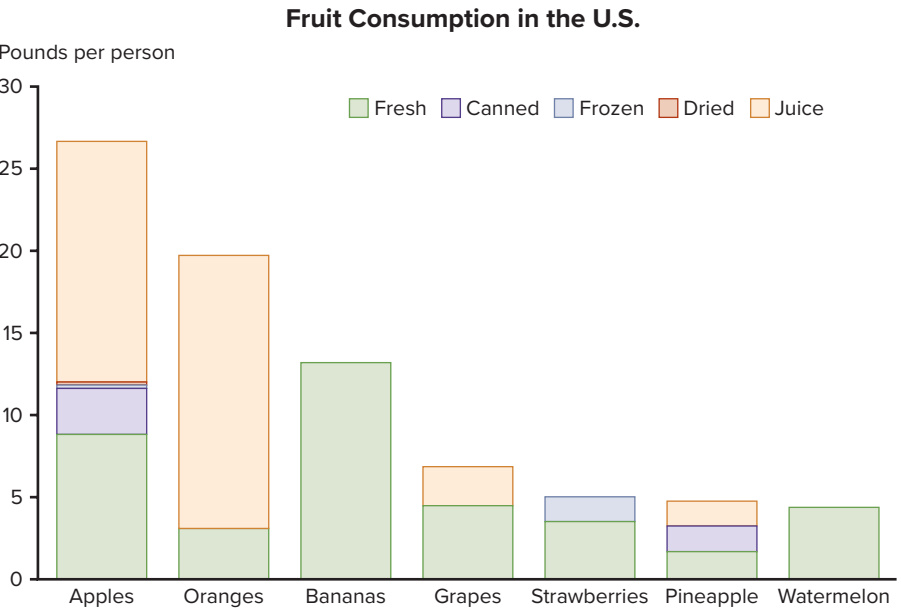
Note: Loss-adjusted food availability data are proxies for consumption.

Cost and economics play a role in our food choices. After taste, cost is the number-two reason why people choose the food they do.² While the average adult now spends less on groceries 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 also affects your 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

FIGURE 1-3 Apples held the top spot for total fruit available for consumption in 2021 with loss-adjusted apple juice availability at 14.7 pounds (1.7 gallons) per person; fresh apples at roughly 9 pounds per person; and canned, dried, and frozen apples totaling to 3.1 pounds per person. Bananas (13.2 pounds per person) topped the list of most popular fresh fruits, while orange juice (16.6 pounds or 1.9 gallons) remained the top fruit juice available for consumption in the United States.

Source: USDA, Economic Research Service, Loss-Adjusted Food Availability Data, 2021. <https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/food-availability-and-consumption/?topicId=080e8d1d-e61e-4bd8-beac-51f01d1f0fe>



Note: Loss-adjusted food availability data are adjusted for food spoilage, plate waste, and other losses to more closely approximate actual consumption.

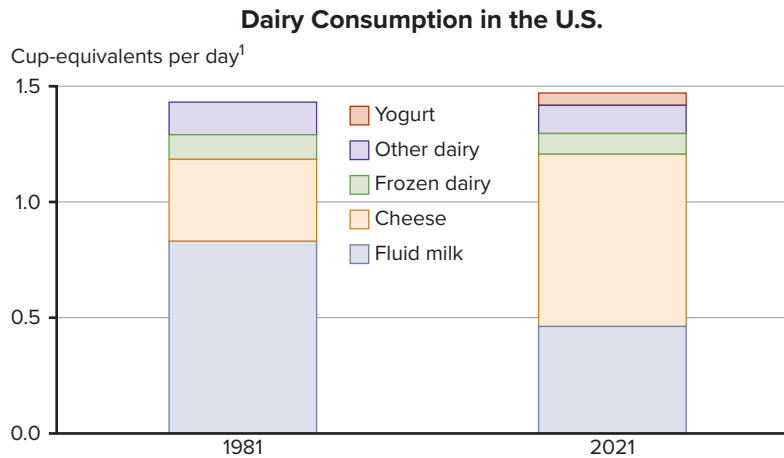


FIGURE 1-4 According to food availability data from the USDA, adults consumed a similar amount of dairy products (1.5 cup-equivalents of dairy products per person per day in 2021). This is half the recommended amount for a 2000 kcal per day diet. Although the overall quantity is slightly higher in 2021 compared to 1981, the types of dairy products consumed have changed. Milk consumption has decreased from 0.8 to 0.5 cups per person per day, while cheese consumption has doubled and yogurt consumption has increased.

Source: USDA, Economic Research Service, Loss-Adjusted Food Availability Data, 2021, <https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/food-availability-and-consumption/?topicId=080e8d1d-e61e-4bd8-beac-51f0f1df0fe>

¹Based on a 2000-calorie-per-day diet. Loss-adjusted food availability data are adjusted for food spoilage, plate waste, and other losses to approximate actual intake. "Other dairy" includes evaporated milk, condensed milk, dry milk products, cottage cheese, and half and half.

slow the rate of global warming, build strong communities, and improve our health. While the *Food & Health Survey* found that environmental sustainability was an important driver of food purchasing, most consumers continue to find it hard to know whether the food choices they make are environmentally sustainable. These consumers agreed that environmental sustainability would have a greater influence on food choices if it was easier to know which choices were in fact environmentally sustainable. For instance, when making environmentally sustainable animal protein purchases, consumers surveyed looked for labels such as "no added **hormones**," "grass-fed animals," and "locally raised."⁵

Nutrition—or what we think of as *healthy foods*—also directs our food purchases. Adults 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 survey found that a subset of consumers report they actively seek out foods or follow a dietary pattern for specific health benefits such as weight loss, energy, digestive health, and heart health.² Nutrition and health information on food package labels has also been shown to affect food choices.

WHY ARE YOU SO HUNGRY?

Both **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.

Appetite, our primarily psychological drive to eat, is affected by many of the external factors we discussed earlier, such as environmental and psychological factors and social cues and customs (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.



Jacob is majoring in nutrition and is well aware of the importance of a healthy dietary pattern. He has recently been attentive to his meals and is confused. He notices that he eats a great deal of high-fat foods, such as chicken wings, cheese, chips, ice cream, and chocolate, and few fruits, vegetables, and whole grains. He also has a 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?**

Sarah Casillas/DigitalVision/Getty Images

Sustainable Solutions

Food & Health Survey

More than half of the respondents to the *Food & Health Survey* stated the top three indicators of products being sourced in an environmentally sustainable way were: (1) recyclable packaging; (2) labeled as sustainably sourced; and (3) reusable packaging. Other indicators included being labeled as locally grown, sustainably sourced, non-GMO/non-bioengineered, and organic.

Source: International Food Information Council Foundation (IFIC). 2023 *Food & Health Survey*. <https://foodinsight.org/2023-food-and-health-survey/>

hormone A chemical messenger produced by a gland and released into the blood to travel to target tissues at distant sites throughout the body.

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.

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

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

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. Almost everyone has encountered a mouth-watering dessert and enjoyed it, 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 fuel. Appetite may not be a physical process, but it certainly can 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 management 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. Try keeping track of what triggers your eating for a few days. Is it primarily hunger or appetite?

CONCEPT CHECK 1.1

1. What are the factors that influence our food choices?
2. Which two vegetables are the most 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, our dietary patterns 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 individuals have 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?

As you learned in the *Fact Check*, 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.

WHERE DO WE FIND NUTRIENTS?

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

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.

maintenance of a healthy body throughout life. For a substance to be considered an **essential nutrient**, three characteristics are needed:

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

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. You just learned that nutrition is only one of many factors that influence our eating patterns. 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 disease** (i.e., **heart disease**), **hypertension**, **type 2 diabetes**, and some forms of **cancer**. Together, these and related disorders account for two-thirds of all deaths in the United States (Fig. 1-5). 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.

The combination of a suboptimal eating patterns and inadequate physical activity contributes to hundreds of thousands of fatal cases of cardiovascular disease, cancers, and diabetes each year. In addition, obesity is considered the second-leading cause of preventable death in North America after tobacco-related deaths. 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 has been associated with decreasing trends for heart disease, cancers, and **stroke**. Mortality from heart disease, the leading cause of death, has been declining steadily since 1980. As you gain an understanding about your lifestyle behaviors and increase your knowledge about nutrition, you will have the opportunity to significantly reduce your risk for many common health problems.

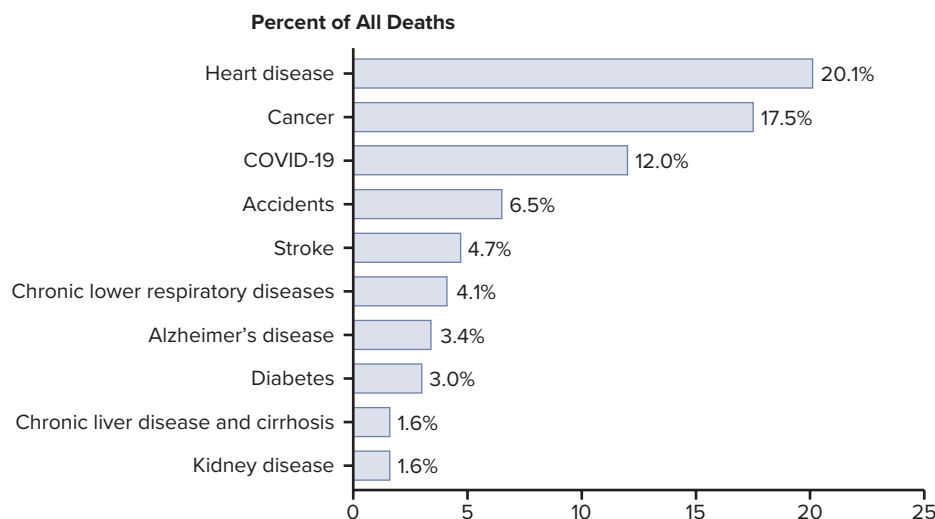


FIGURE 1-5 Ten leading causes of death in the United States.

Source: Centers for Disease Control and Prevention *National Vital Statistics Report, Deaths: Leading Causes for 2021*.

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.

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 disease The result of a combination of genetic, physiological, environmental, and behavioral factors leading to diseases of long duration. Also referred to as *noncommunicable diseases (NCDs)*.

cardiovascular 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.

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.

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*.

registered dietitian nutritionist (RDN)

A person who has completed a 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 national registration examination, and complies with continuing education requirements.

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, H₂O. The body is composed of about 60% water. Water (fluid) needs are about 9 (females) or 13 (males) cups per day; needs are greater if one exercises heavily.

ASK THE RDN Why Dietetics?

Dear RDN: Why did you become a registered dietitian nutritionist?

Growing up in the 1980s and 1990s, it seemed like the important people in my life were always “on a diet.” My family members, caregivers, and teachers latched onto every passing fad, turning away from their favorite foods in order to lose weight. Watching my role models follow various diet trends and fitness gurus, I formed a belief that calories were something to be controlled and that dieting was virtuous.

Throughout my adolescent years, my interest in nutrition and fitness grew. I immersed myself in nutrition and fitness and even experimented with many popular trends. At that point in my life, I didn't know enough to discern nutrition fact from fiction, but I certainly thought I was an expert!

In high school, I was drawn to the science linking foods to health and found my way to the field of dietetics. I was interested in helping others (and myself) use foods on a path to achieving their weight and fitness goals. Once I got to college, I began learning the *science* of nutrition and realized that nutrition is about SO MUCH MORE than calories and body weight. I was amazed to learn how the chemical compounds (i.e., nutrients) in the foods we eat become part of us: these are the building blocks of every single cell that help to form chemical messengers involved in regulating body processes and providing the fuel that powers us. Although I was still preoccupied with weight management, I slowly gained an appreciation for the role of nutrition in every aspect of physical and mental health.

What I love most about nutrition is that there is always something new to learn. The science of nutrition is only about 100 years old, and new evidence about the role of nutrition in health and disease continues to unfold. These days, the aspect of nutrition that fascinates me most is nutritional psychiatry—the connections between nutrition and mental health. This field didn't even exist when I was in school!

So, although I first chose dietetics due to an early interest in fitness and weight management, I stuck with it because I love food, science, and learning. In this text, our goal is to equip you and your classmates to separate facts from fads. Also, we want students to have a positive relationship with food and explore dietary patterns that promote and optimize your physical and mental health!

Keeping the *new* in nutrition!

Angela Collene, MS, RDN, LD

Senior Lecturer, The Ohio State University, Author of *Wardlaw's Contemporary Nutrition* and *Wardlaw's Contemporary Nutrition: A Functional Approach*



Tim Klontz

✓ 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 in the United States?

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.

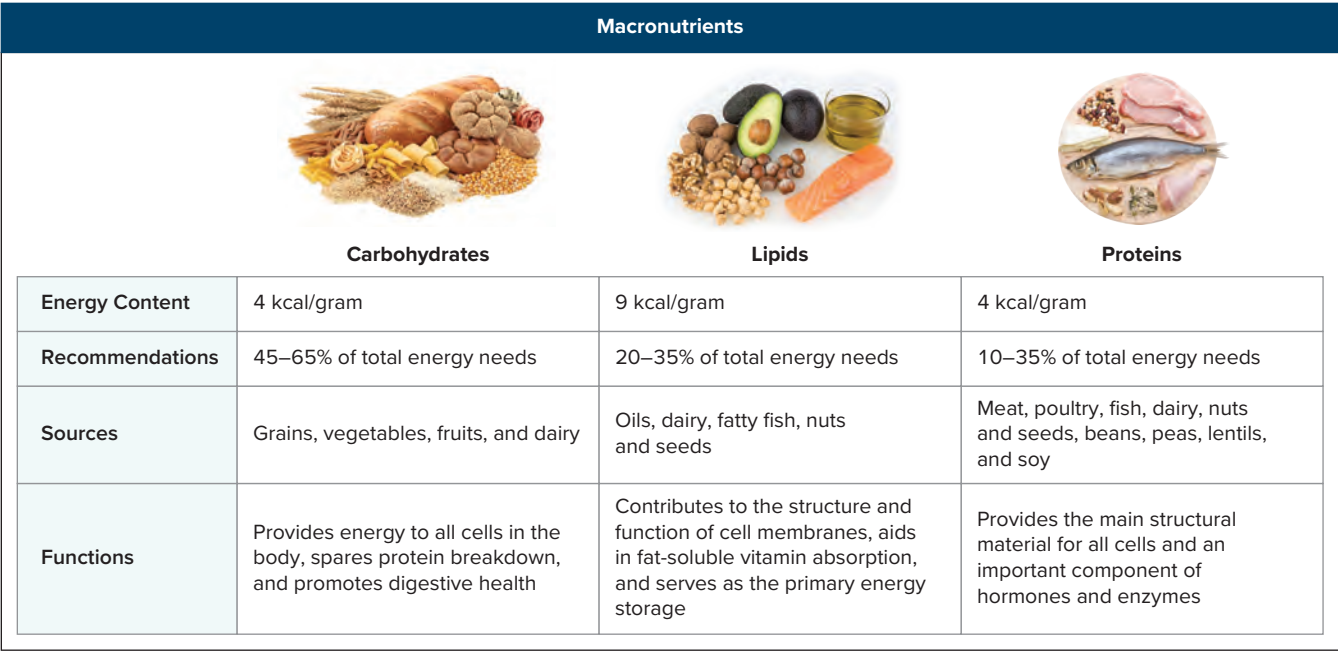


FIGURE 1-6 Comparison of macronutrients. Carbohydrates: Elena Schweitzer/Shutterstock; Lipids: tinalarsson/iStock/Getty Images; Proteins: Image Source/Glow Images

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. 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**. See Figure 1-6 for a summary of the energy-yielding nutrients.

CARBOHYDRATES

Chemically, carbohydrates can exist in foods as **simple sugars** and **complex carbohydrates**. Simple sugars, frequently referred to as *sugars* or *simple carbohydrates*, 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, 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 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).

Aside from enjoying their taste, we need sugars and other carbohydrates in our dietary patterns primarily to help satisfy the calorie needs of our body cells. Carbohydrates

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 dietary pattern. Also referred to as *sugars* or *simple carbohydrates*.

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*.

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*.

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.

essential fatty acids Fatty acids that must be supplied by the diet to maintain health. Currently, only linoleic acid and alpha-linolenic acid are classified as essential.

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.

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

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

fat-soluble A group of vitamins that are soluble in dietary fats and are absorbed along with fats in the small intestine. There are four fat-soluble vitamins: Vitamins A, D, E, and K.

water-soluble A group of vitamins that dissolve in water and are easily absorbed into the bloodstream. These vitamins are not stored in large amounts in the body and are excreted in the urine. There are nine water-soluble vitamins: vitamin C and eight B vitamins.



Salmon is a fatty fish that is a healthy source of essential fatty acids. **How many times per week is fatty fish recommended for most adults?** Olga Nayashkova/Shutterstock

provide a major source of calories for the body, 4 kcal per gram on average. 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, and this is 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, 9 kcal per gram on average, because of differences in their chemical composition. They are also the main form for energy (calorie) 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 our 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.

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, 4 kcal per gram on average. 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.

Protein comes from animal and plant sources. Animal products such as meat, poultry, fish, dairy, and eggs are significant sources of protein in most dietary patterns. Beans, peas, lentils, nuts, seeds, and soy products are good plant protein sources. 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, and proteins. Remember, however, that vitamins themselves contain no usable calories for the body.

The 13 vitamins are **organic compounds** that can be 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). These 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**.

MINERALS

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.

The essential minerals required in the dietary pattern 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; if more, 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

Water makes up the sixth class of nutrients. Although sometimes overlooked as a nutrient, water (H₂O) 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 adult male should consume about 3 liters (about 13 cups) of water and/or other fluids every day; adult females need closer to 2.2 liters (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**.

OTHER IMPORTANT COMPONENTS IN FOOD

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. For example, evidence from animal and laboratory studies indicates that compounds such as polyphenols in many berries prevent the growth of certain cancer cells. Research also suggests that the health benefits of phytochemicals are best obtained through the consumption of whole foods rather than dietary supplements.

Foods with high phytochemical content are sometimes called *superfoods* because of the health benefits they are thought to confer. Yet there is no legal definition for this term, and it is often overused in marketing certain foods. 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.

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

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.

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.

solvent A liquid substance in which other substances dissolve.

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

FARM to FORK Tomatoes



Adrian Burke/Photodisc/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. If you can, purchase 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 to obtain the most nutrients and the greatest amount of the phytochemical lycopene.
- Purchase smaller tomatoes for their sweetness and flavor, and enjoy the most lycopene and vitamin C.
- Buy processed tomato products, including jars or cans of tomato paste and sauce, for their highly bioavailable lycopene.

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 2 or 3 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/silroby/123RF

bioavailability The degree to which an ingested nutrient is digested and absorbed and thus is available to the body.

More information about phytochemicals will be covered in Chapter 8. In addition, our *Farm to Fork* feature 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. Tomatoes are an important source of phytochemicals and are discussed in this chapter's *Farm to Fork* feature.

SOURCES OF NUTRIENTS

Now that you 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 (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 (about 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 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 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?

CALCULATING 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 exam, 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 percent 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 $0.06 \times 45 = 2.7$
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?	$0.15 \times 8 \text{ milligrams} = 1.2 \text{ milligrams}$

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 (Fig. 1-7).

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 contribute 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.

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. Note that 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 by 1°C . The abbreviation *kcal* is used throughout this book. Any values given on food labels in calories are actually in kilocalories. For instance, a suggested intake of 2000 calories per day on a food label is technically 2000 kcal.



FIGURE 1-7 Calorie content of energy nutrients and alcohol. The weights illustrate their relative energy potential per gram.

CALCULATING CALORIES

The calorie estimates for carbohydrate (4 kcal/g), fat (9 kcal/g), protein (4 kcal/g), and alcohol (7 kcal/g) can be used to determine the calorie content of a food.

Let's practice by calculating the calories in these items:

C Squared Studios/Photodisc/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



Burke/Triolo/Getty Images

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

You can also use the calories per gram estimates to determine what portion of total calorie 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: (290 g carb × 4 kcal/g) + (60 g fat × 9 kcal/g) + (70 g protein × 4 kcal/g) = 1980 total kcal. The percentage of your total calorie intake derived from each nutrient can then be determined:

% of kcal as carbohydrate = (290 × 4) ÷ 1980 = 0.59 (× 100 = 59%)

% of kcal as fat = (60 × 9) ÷ 1980 = 0.27 (× 100 = 27%)

% of kcal as protein = (70 × 4) ÷ 1980 = 0.14 (× 100 = 14%)

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

NUTRITION FACT LABEL CALCULATION

Use the nutrient values on the Nutrition Facts label above to determine the exact calories from one slice of this whole wheat bread:

(15 g carbohydrate × 4 kcal/g) + (1 g total fat × 9 kcal/g) + (3 g protein × 4 kcal/g) = 81 total kcal. Note the label lists 80 kcal, suggesting that the calorie value was rounded down.

Whole Wheat Bread



Fullerene/iStock/Getty Images

Nutrition Facts

19 servings per container

Serving size 1 slice (36g)

Amount per serving

Calories 80

Total Fat 1g **2%**

Saturated Fat 0g **0%**

Trans Fat less than 1g ******

Cholesterol 0mg **0%**

Sodium 200mg **8%**

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

Total Carbohydrate 15g **5%**

Dietary Fiber 2g **8%**

Total Sugars 3g

Includes 2g Added Sugars **4%**

Protein 3g

* 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.

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 (Fig. 1-8). Appendix E in this textbook lists conversions from the metric system to the English system (feet, pounds, and cups) and vice versa.

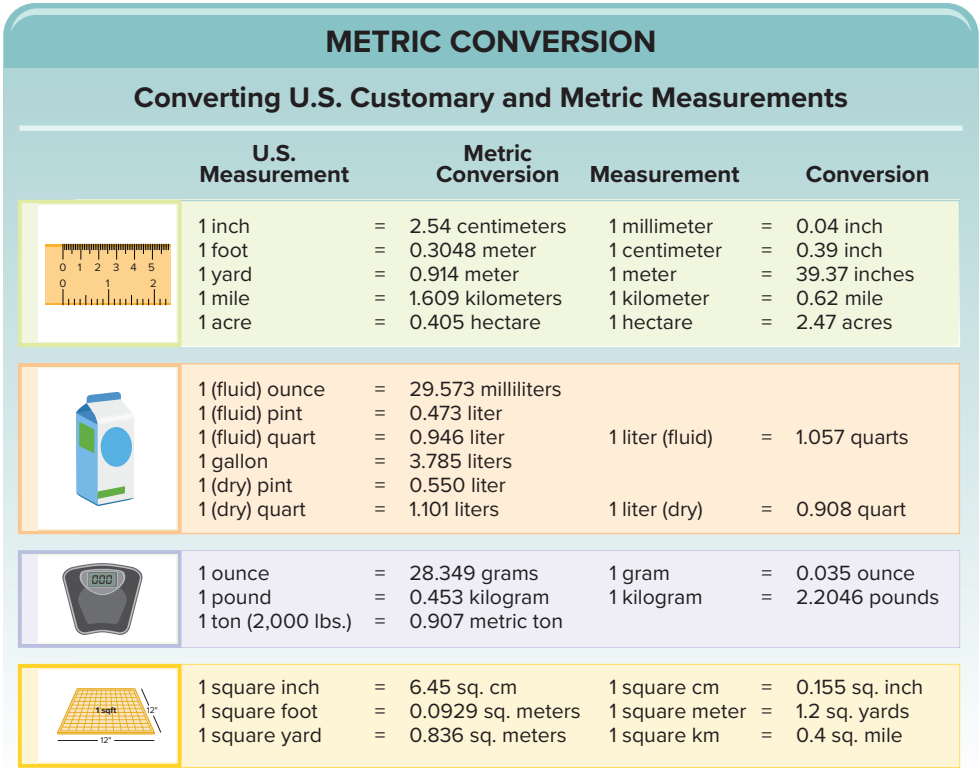


FIGURE 1-8 Metric conversion reference chart.

Let's Practice!

The label of a 5.3-ounce container of Greek yogurt contains 15 grams of sugar. How many teaspoons of sugar does this equal?

1 teaspoon = 5 grams of sugar

15 grams ÷ 5 grams/teaspoon = 3 teaspoons of sugar

How many ounces are in 8 cups of water?

8 cups of water = 64 ounces (or 2 quarts)

Your water bottle holds 500 milliliters. How many milliliters or liters should you drink to equal 8 cups?

8 cups × 240 millileters/cup = 1920 millileters = 1.92 liters (almost four 500 millileter bottles)

- In the field of nutrition, it is important to remember:
- 1 kilogram = 2.2 pounds
 - 1 ounce weighs 28 grams
 - 2.54 centimeters = 1 inch
 - 1 liter almost equals 1 quart
 - micro = 1/1,000,000
 - milli = 1/1000
 - centi = 1/100
 - kilo = 1000

✓ CONCEPT CHECK 1.4

1. What are the energy (calorie) values for each of the *energy nutrients*?
2. Convert 154 pounds of body weight into kilograms.

1.5 How Do We Know What We Know About Nutrition?



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

THE SCIENTIFIC METHOD

The first step of the scientific method is the observation of a natural phenomenon (Fig. 1-9). 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**.

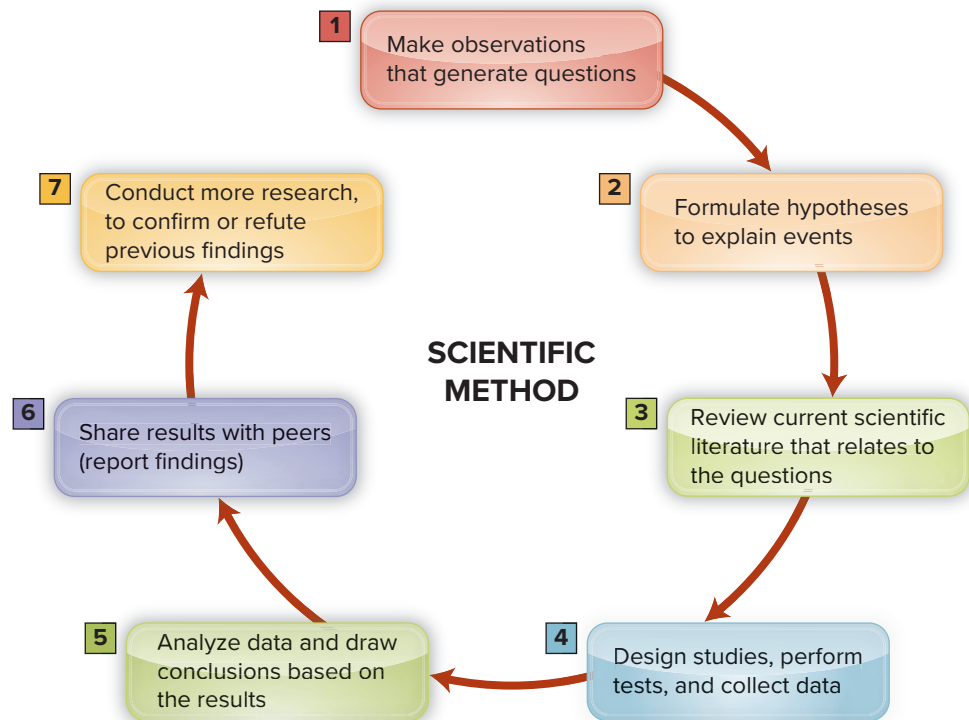
Thus, hypotheses about the role of the dietary pattern in various health problems can be suggested by historical and epidemiological findings. *Proving* the role of particular dietary components, however, requires controlled experiments. The data gathered from experiments may either support or refute each hypothesis. If the

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.

FIGURE 1-9 The scientific method. Scientists consistently follow these steps when testing hypotheses. Scientists do not accept a nutrition or other scientific hypothesis until it has been thoroughly tested using the scientific method.



results of many experiments support a hypothesis, scientists accept the hypothesis as a **theory**.

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 1-9.

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

When answering questions about nutrition needs, we look for the best available evidence. The hierarchy of evidence (Fig. 1-10) 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 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 (called the experimental group) follows a specific protocol (e.g., consuming a certain food or nutrient),

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.

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

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 that 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.

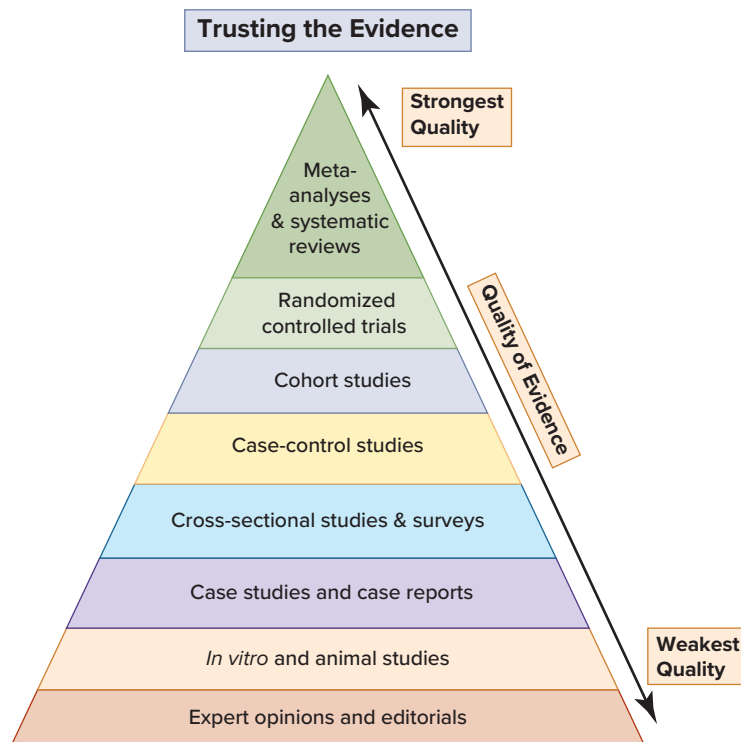


FIGURE 1-10 Hierarchy of scientific evidence with the strongest types of evidence at the top progressing to the weakest types of evidence at the bottom. Source: thelogicofscience.com.