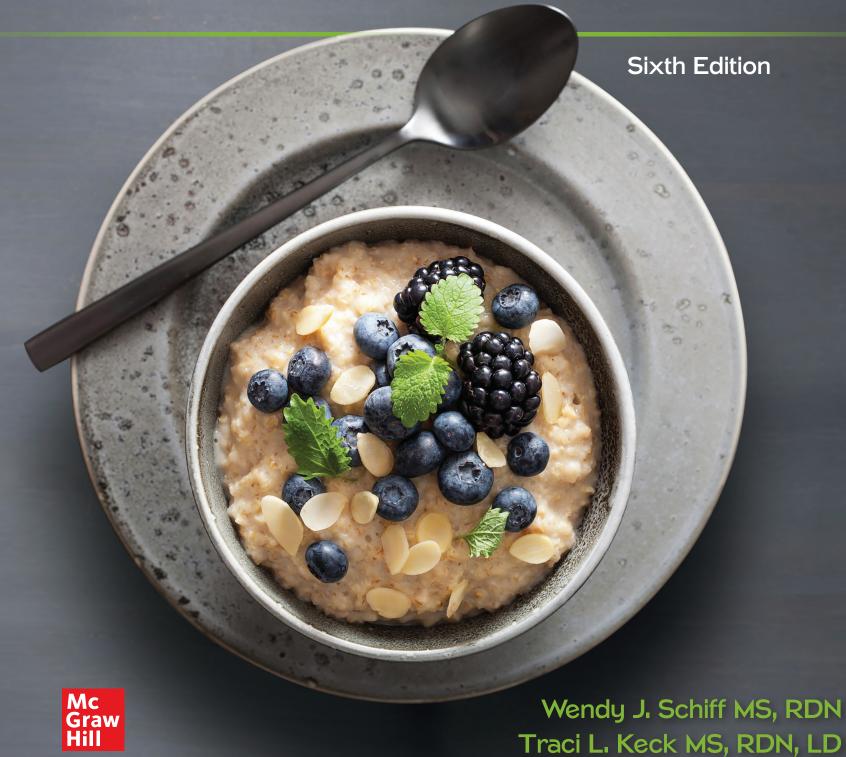


NUTRION for Healthy Living



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NUTRITION FOR HEALTHY LIVING, SIXTH EDITION

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Meet the Authors



McGraw-Hill Education/Mark Dierker, photographer

Wendy J. Schiff, MS, RDN received her BS in biological health/medical dietetics and MS in human nutrition from the Pennsylvania State University (Penn State). She has taught introductory foods and nutrition courses at the University of Missouri–Columbia, as well as nutrition, human biology, and personal health courses at St. Louis Community College–Meramec. She has worked as a public health nutritionist at the Allegheny County Health Department (Pittsburgh, Pennsylvania) and State Food and Nutrition Specialist for Missouri Extension at Lincoln University in Jefferson City, Missouri. In addition to authoring Nutrition for Healthy Living and Nutrition Essentials: A Personal Approach, Wendy has coauthored Human Nutrition: Science for Healthy Living and a college-level personal health textbook and has authored many other nutrition-related educational materials. She is a registered dietitian nutritionist and a member of the Academy of Nutrition and Dietetics.

To my late father

Traci L. Keck, MS, RDN, LD received her BS in food and nutrition with a specialization in dietetics and MS in food and nutrition from Texas Tech University. She has taught a variety of food and nutrition courses including introductory nutrition for majors and nonmajors in the Department of Public Health, as well as the Department of Nutrition and Dietetics at The University of Texas at San Antonio (UTSA). Traci has diverse professional experience as a registered dietitian nutritionist in both acute and long-term health care settings. Additionally, she has worked as a research dietitian at UTSA for studies related to childhood obesity prevention and as a consulting dietitian in the San Antonio, Texas, community. Outside the classroom, Traci enjoys gardening, hiking, volunteering on her church's media team, watching her daughter and son play sports, and spending time with her family.

To Derek, Sarah, and Kyle

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Courtesy of Derek Keck



Welcome to the Sixth Edition of Nutrition for Healthy Living

We think of ourselves as consumers when we purchase homes, cars, computers, and foods. We are also consumers of nutrition-related information. Nearly every advised and really bombarded with messages in media and from acquaintances concerning nutrition, foods, and from acquaintances concerning nutrition, foods, and health. Much of this information is unreliable, and often it is intended to promote sales of products often it is intended to promote sales of products or services. Unfortunately, many consumers lack the knowledge and skills needed to analyze such information critically and decide whether or not to apply it to their decision-making process.

Helping students become better-informed consumers, Helping students become better-informed consumers, particularly as this relates to food and nutrition, is the foundation of **Nutrition for Healthy Living**. This major theme flows throughout the textbook by providing theme flows throughout the textbook by providing students with practical information, critical thinking skills, and the scientific foundation needed to make better and the scientific foundation needed to make better informed choices about their diet and health. By reading informed choices about their diet and health. By reading learn basic principles of nutrition, they will also be able to evaluate various sources of nutrition information to evaluate various sources of nutrition practices to critically and to apply sound nutrition practices to improve their lives.

Kendy J. Scriff

Traci J. Keck



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- Jordan Cunningham, Eastern Washington University



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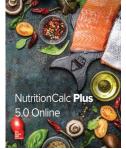
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Personalized Teaching and Learning Environment

Saves students and instructors time while improving performance.



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NutritionCalc Plus ••

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



Virtual Labs

While the sciences are hands—on disciplines, instructors are now

often being asked to deliver some of their lab components online, as full online replacements, supplements to prepare for in—person labs, or make—up labs.

These simulations help each student learn the practical and conceptual skills needed, then check for understanding and provide feedback. With adaptive pre—lab and post—lab assessment avail—able, 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



Ava Ponce 22 year old, Female, 5'6", 145 lbs Weight gain/loss: 0 lbs/week Activity level: Active

Pkchai/Shutterstock

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!



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



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

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

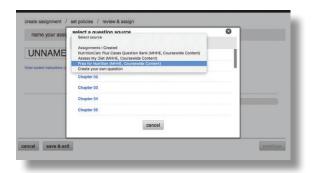






Auto-graded personalized dietary analysis.

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 evaluate their own nutrient intakes compared to current Dietary Reference Intakes and demonstrate their ability to perform calculations on their own data, such as percent of calories from saturated fat. They can compare the nutrient density of their own food selections to see which of their food choices provides the most fiber or iron. A benefit of the Assess My Diet question bank is that it offers assignable content that is personalized to the students' data, yet still auto-graded. It saves time and keeps all assignments in one place.



Prep for Nutrition

To help you level—set your classroom, we've created Prep for Nutrition. This question bank highlights a series of questions, including Basic Chemistry, Biology, Dietary Analysis, Mathematics, and Student Success, to give students a refresher on the skills needed to enter and be successful in their course! 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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Writing Assignment

Available within McGraw Hill Connect® and McGraw Hill 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.

Remote Proctoring & Browser-Locking Capabilities



New remote proctoring and browser—locking capabilities, hosted by Proctorio within Connect, provide control of the assessment environment by enabling security options and verifying the identity of the student. Seamlessly integrated within Connect, these services allow instructors to control students' assessment experience by restricting browser activity, recording students' activity, and verifying that students are doing their own work. Instant and detailed reporting gives instructors an at—a—glance view of potential academic integrity concerns, thereby avoiding personal bias and supporting evidence—based claims.





Nutrition for Healthy Living, 6th edition



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Writing an introductory college—level nutrition textbook and revising the text on a regular basis are not easy tasks. For the first five editions, Wendy Schiff relied on her experi—ence in teaching nutrition, foods, biology, and personal health classes at both the university and the community college levels to present basic information about nutrition. Her var—ied teaching experience also provided valuable insights into the diversity, as well as the needs, interests, and capabili—ties, of today's students. In addition, reviews by numerous nutrition faculty helped shape and refine the contents of this textbook.

In anticipation of preparing the 6th edition, Wendy invited Traci Keck to help revise Nutrition for Healthy Living. Traci's educational background, teaching experience, dietetics credentials, and philosophy of nutrition education support Wendy's. We are delighted to add Traci to our textbook team.

Nutrition Information for Today's Students

Nutrition for Healthy Living is intended for students who are interested in learning about nutrition for personal reasons, as well as students considering majoring in nutrition, nursing, or other health— and science—related fields. Nutrition for Healthy Living is an introductory textbook that appeals to students who represent a broad range of academic backgrounds—English majors, as well as biology and nursing majors. Using this textbook to accompany an introductory nutrition course is intended to spark students' interest in adopting healthier dietary practices and possibly even inspire some students to consider nutrition as their major.

Nutrition for Healthy Living is not only scientifically up—to—date, but also includes consumer— and clinically oriented content and features. The text is visually appealing and fun to read, engages students' interest, is well organized, and has fea—tures that contribute to the pedagogy without being distracting.



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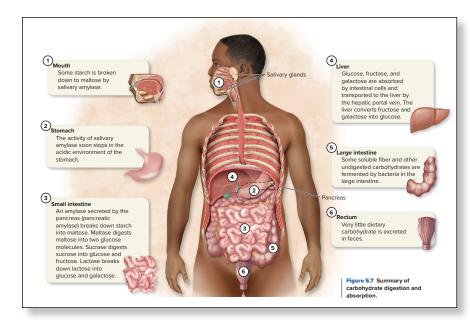


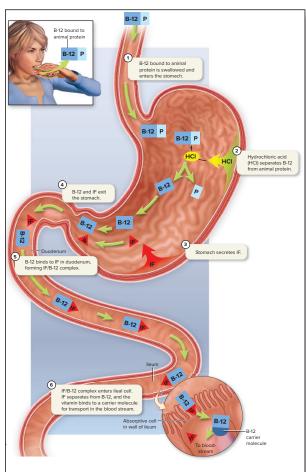
Science That Is Accessible for Students

Nutrition is an "offspring" science that requires a basic under—standing of certain chemical and physiological concepts and terms. However, students from a wide variety of academic backgrounds often enroll in introductory nutrition courses, and in many instances, they have not taken college—level science courses prior to this nutrition course.

Ignorance about chemistry and physiology contributes to food faddism and health quackery. Nutrition for Healthy Living introduces basic scientific principles that relate to the study of nutrition in a manner that every college student can understand. The textbook, for example, introduces and defines terms that relate to nutrition, foods, and dietetics, including medical terminology. Additionally, the text includes numer—ous illustrations that are designed to help students understand basic, as well as complex, physiological concepts that relate to nutrition and digestive system anatomy and physiology. By providing a solid scientific foundation, nutrition educators can more easily dispel commonly held but inaccurate beliefs, such as "When you're physically inactive, muscle turns into fat," and "Cellulite is a special type of body fat."

Students who use this textbook will be prepared to make intelligent, practical choices that may result in improved nutrition and health. Furthermore, the students will be able to take more advanced nutrition courses, should they decide to major in the field of nutrition and dietetics.











Brief Organization and Traditional Approach

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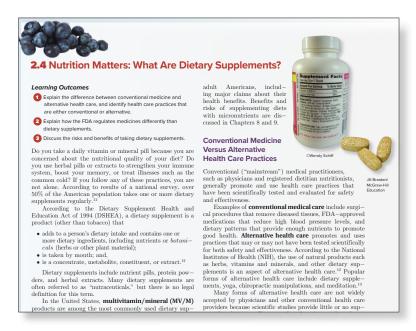
Nutrition for Healthy Living follows a more traditional approach to the study of nutrition in that the textbook's organization focuses on providing basic information about each class of nutrients rather than certain functions, tissues, or diseases. Additionally, the textbook integrates health information, particularly information about diet—related chronic diseases, within each chapter where it is appropriate, rather than relegate it to chapters near the end of the textbook. For example, the chapters that discuss nutrients provide basic information first and then present applications, including the nutrient—related health effects of certain lifestyle practices, particularly dietary choices.

Instructors often do not have the time to cover all the material in their textbooks. Nutrition for Healthy Living organizes core content into 13 chapters, which helps make teaching introductory nutrition more manageable and fits the time frame of most courses better than textbooks with 15 or more chapters. Chapter 2 is unique among nutrition textbooks in that the chapter focuses on understanding basic scientific research and evaluating the reliability of nutrition— and health-related sources and messages, especially those promoting dietary supplements. Chapters 5 through 9 provide funda mental information about the nutrients, and integrate health information, particularly diet-related chronic diseases, within each chapter where it is appropriate, rather than relegate it to a single chapter near the end of the textbook. Chapter 6, for example, discusses fats and other lipids before focusing on atherosclerosis, including risk factors for the disease. Although some nutrition—related topics were important to cover, they did not warrant using a full chapter. Thus, topics such as global nutrition concerns, alcohol and alcohol abuse, and eating disorders are presented in "Nutrition Matters," the last section of each chapter.

Chapters: Basic Descriptions

Nutrition for Healthy Living covers the basic material instructors need in a format that is logical and practical for nearly all introductory nutrition courses:

• Chapter 1 introduces students to nutrition and nutri ents, and presents 10 key nutrition concepts, such as "most naturally occurring foods are mixtures of nutrients" and "variety can help ensure the nutritional adequacy of a diet." The Nutrition Matters section of Chapter 1 discusses global nutrition concerns, including malnutrition and sustainable agriculture.



- Chapter 2 presents basic information about scientific methodology as it relates to nutrition research and provides tips for becoming a more wary consumer of nutrition— and health—related information. The Nutrition Matters sec—tion of Chapter 2 focuses on dietary supplements; how—ever, information concerning specific dietary supplements is incorporated where it is relevant throughout the book.
- Chapter 3 discusses dietary standards and guidelines, food groups and guides, and how to use information provided on food packages. This chapter's Nutrition Matters section presents information about traditional dietary practices of several cultural and ethnic groups that comprise much of the U.S. population and the possible effects of these practices on health.
- Chapter 4 presents basic principles of chemistry and human physiology as they apply to the study of nutrition but at a level that students can easily understand. The text includes numerous illustrations to help students understand basic physiological concepts that relate to nutrition and diges—tive system anatomy and physiology. Because students and courses vary in the depth of chemistry prerequisites, this chapter features some flexibility, so professors can choose to skip the chemistry section if they prefer. This chapter also provides information about intestinal microbiota, and com—mon gastrointestinal disorders and diseases, primarily in the Nutrition Matters section.









- Chapters 5, 6, 7, 8, and 9 present basic and practical information about each major class of nutrients and individual nutrients in each class. Such information includes each nutrient's major functions in the body, food sources, and roles in achieving and maintaining good health. Furthermore:
 - Chapter 5 discusses carbohydrates, including carbohy—drate digestion and absorption, and health conditions associated with carbohydrates such as diabetes mellitus and lactose intolerance. The Nutrition Matters section provides insights into the glycemic index and glycemic load.
 - Chapter 6 discusses fats and other lipids, including lipid digestion and absorption. The latter part of the chapter focuses on atherosclerosis with an empha—sis on recognizing major risk factors for the disease. Because alcohol consumption affects lipid metabolism, the Nutrition Matters section of this chapter covers alcohol.
 - Chapter 7 presents basic information about proteins, including protein digestion and amino acid absorption, and protein metabolism. The Nutrition Matters section features information about protein undernutrition.
 - **Chapter 8** covers fat— and water—soluble vitamins, including deficiency and toxicity disorders. The

- Nutrition Matters section of the chapter examines the role of certain vitamins in chronic disease prevention.
- **Chapter 9** features water, as well as essential minerals, including minerals that may be dietary essentials. Bottled water is discussed in the Nutrition Matters section of the chapter.
- Chapters 10, 11, 12, and 13 focus on applying basic nutrition information for important concerns or different age groups:
 - Chapter 10 covers body composition and weight management. The Nutrition Matters section of the chapter provides basic information about the three major eating disorders.
 - **Chapter 11** presents information relating to physical fit—ness; developing a practical program for lifelong physical fitness is the focus of this chapter's Nutrition Matters section.
 - Chapter 12 features information about food—borne ill—ness and food safety concerns. This chapter's Nutrition Matters section provides food safety information for global travelers.
 - Chapter 13 discusses nutrition during pregnancy, lactation, infancy, childhood, and the older adult years. The Nutrition Matters section of this chapter examines the role of diet in promoting longevity.







Consumer/Student Focus

Regardless of their backgrounds, students are consumers of nutrition information from a wide variety of sources, including popular magazines, friends, diet books, infomercials, and the Internet. Oftentimes these students arrive in class with many misconceptions about their diet and health. As nutrition educators, we seek to identify these beliefs and to impart sound, reliable nutrition and health information. We also strive to equip our students with the tools they need to make intelligent, informed food— and nutrition—related decisions beyond the classroom. In addition to devoting an entire chapter to evaluating nutrition—related information (Chapter 2), the consumer emphasis is integrated throughout the book.

Food & Nutrition

Tips present practical sug—gestions that apply material discussed in a section. These tips provide infor—mation students can use every day, while they are in college—and for the rest of their lives.

Food & Nutrition tips

- Cook fresh vegetables by microwaving, steaming, or stir-frying. Vegetables generally have high water content; therefore, add no water or just a small amount when microwaving vegetables.
- Do not overcook vegetables and minimize reheating because prolonged heating reduces vitamin content.
- Do not add margarine or butter to vegetables during cooking because fat-soluble vitamins
 and phytochemicals may enter the fat and be discarded when the fat is drained before
 serving. Fat in foods can enhance the body's absorption of fat-soluble vitamins; therefore,
 you can add some fat, such as olive oil or soft margarine, to vegetables after they are cooked
- Store canned foods in a cool place. Canned foods can vary in the amount of nutrients
 they contain, largely because of differences in storage times and temperatures. If the
 can has been on the shelf for an extended period of time, the food's vitamin content
 may have deteriorated, and its taste and texture may be less than desirable.

Did You Know? This margin feature notes interest—ing nutrition—related tidbits that relate to information presented in that section of the chapter. Some of these features dispel commonly held beliefs about food and nutrition that are inaccurate.

Did YOU Know?

Collagen is a major structural protein of the bones, ligaments, and skin of mammals that consists primarily of the nonessential amino acids glycine, proline, and hydroxyproline (a form of proline). Dietary sources of collagen include bone broth, nonorgan meats, fish, poultry, and egg whites.

Manufacturers use collagen to make dietary supplements that contain small peptides

called collagen hydrolysates (CHs). The small intestine digests CHs into individual amino acids that can be absorbed along with AAs that were obtained from proteins in food. Therefore, consumers cannot be certain that their bodies will use the amino acids derived from CH supplements to produce collagen or make other proteins in the body. Nevertheless, adequate dietary

protein intake from animal and plant sources of food should provide enough amino acids for the body to produce enough collagen without needing CH supplements.

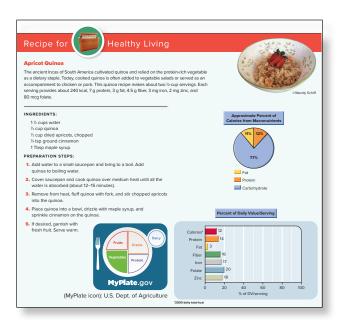
Results of some scientific studies involving human subjects indicated that taking oral collagen supplements increased skin elasticity, may help wound healing, and may be effective for relieving osteoarthritis pain but not the discomfort associated with rheumatoid arthritis. As is often the case, more research is needed to determine the usefulness of taking dietary supplements that contain CHs.



My Diverse Plate. This feature introduces students to foods and dietary practices that are ethnically and culturally diverse.



Recipe for Healthy Living is a practical application of nutrition and food information that will appeal to most college students. Each chapter features an easy—to—make, kitchen—tested recipe that helps bring the chapter's content to life (e.g., "Apricot Quinoa"). In addition to the pie graph for macronutrient content and a bar chart to illustrate % Daily Value for energy and key nutrients in a serving of the food, this feature also indicates which MyPlate food groups the major ingredients in the dish represent. By trying the recipes, students can develop basic food preparation skills and may be inspired to cook more foods from scratch.



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Real People, Real Stories feature information about "real" people, many of whom have actually recovered from or are currently living with nutrition—related conditions such as celiac disease, type 1 diabetes, and hypertension. This feature is designed to help students recognize the daily challenges people with such conditions face and the role diet and regular physical activity play in achieving and maintaining good health.

REAL PEOPLE REAL STORIES

Annie Pietsch

Annie Pietsch is a student at the University of Texas at San Antonio (UTSA) who is majoring in pre-nutrition and dietetics. When Annie is not focused on her studies, she enjoys running for exercise, spending time with her family, and shopping and eating ice cream with her friends.

While she was in high school, Annie decided she wanted to become a registered dietitian nutritionist because she wanted to help her grandmother, who had type 2 diabetes. Before she started college, Annie had no idea that her lifestyle was about to change dramatically.

Annie's health began to decline during the spring semester of her first year at UTSA. She became unusually tired when exercising as well as walking to class. According to Annie, "Walking up a flight of stairs felt like running 5 miles." She also developed an unusual craving for sugar-sweetened "soda," ice cream, and fast-food chicken. "I knew something was wrong when I was losing weight instead of gaining weight after eating this way."

At the beginning of spring break, Annie went home to visit her family. Her parents were immediately concerned with Annie's weight loss and overall

Pedagogy

Key Terms and Definitions Key terms are noted in boldface text within the narrative. Many unfamiliar terms have itali—cized pronunciations in parentheses appearing next to them. Definitions of key terms are provided in a box, generally in the margin of the page where the terms first appear in the chapter. A glossary of these key terms is at the end of the textbook.

Essential Fatty Acids

The body cannot make two PUFAs, alpha—linolenic $(al'-fah\ lin'-o-len'-ik)$ acid and linoleic (lin'-o-lay'-ik) acid. These lipids are essential fatty acids because they must be supplied by the diet. Alpha—linolenic acid is an omega—3 fatty acid. The "3" refers to the position of the first double bond that appears in the fatty acid's carbon chain, when you start counting carbons at the omega end of the molecule (see Figure 6.1c). Cells use alpha—linolenic acid to synthesize two other omega—3 fatty acids, eicosapentaenoic (eye'-koss-uh-pen'-tah-ee-no'-ik) acid (EPA) and docosahexaenoic (doe'-koss-uh-hex'-uh-ee-no'-ik) acid (DHA). However, the body's ability to make EPA and DHA from alpha—linolenic acid is limited.

alpha-linolenic acid an essential fatty acid

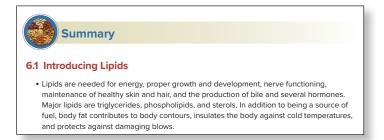
linoleic acid an essential fatty acid

essential fatty acids lipids that must be supplied
by the diet

References Nutrition for Healthy Living includes in—text citations and extensive lists of references in Appendix G. References provide readers with access to sources of information for more in—depth understanding or for topics that spark students' interest.



End—of—Chapter Summary This feature provides a brief review of the main points of each major section of the chapter.







ΧV



Assessment of Learning



One of our primary goals as nutrition educators is to ensure that our students leave the introductory nutrition course with a better understanding of the nutrition principles and concepts needed to improve their diet and health. To assess how well faculty are achieving that goal, many colleges and universities have implemented Coursewide Student Learning Outcomes as a way to measure what students have learned upon completing an introductory nutrition course. Nutrition for Healthy Living has been developed around the following student learning outcomes for nutrition courses.

Coursewide Student Learning Outcomes

- 1. Identify functions and sources of nutrients.
- 2. Demonstrate basic knowledge of digestion, absorption, and metabolism.
- 3. Apply current dietary guidelines and nutrition recommendations.
- 4. Analyze and evaluate nutrition information scientifically.
- 5. Relate roles of nutrients in good health, optimal fitness, and chronic diseases.
- Summarize basic concepts of nutrition throughout the life span.
- 7. Evaluate a personal diet record using a computer database.

Chapter Learning Outcomes

Each major section of a chapter opens with a list of section—specific learning out comes that build upon the broader coursewide outcomes. The Learning Outcomes help students prepare for reading the section and clarify major concepts they are expected to learn. These measurable outcomes are further supported by assessment methods and study aids found within the chapters and in Connect. Learning Outcomes can be used to help instructors identify specific content that requires more refined or focused teaching methods.

Quiz Yourself

This pretest, composed of five true-or-false questions, appears at the beginning of each chapter; answers to the quiz are provided at the end of the chapter. The purpose of Quiz Yourself is to stimulate interest in reading the chapter. By taking the quiz, students may be surprised to learn how little or how much they know about the chapter's contents.

Concept Checkpoint

The Concept Checkpoint feature includes review questions, many of which involve critical thinking skills, posed at the end of major section headings. Such questions enable students to test their acquisition of information presented in the section. Answers to the questions in each Concept Checkpoint are located in Appendix F.

4.3 The Digestive System

Learning Outcomes

🚺 Identify major organs of the digestive system, and describe primary functions of each organ

Identify the accessory organs of the digestive system and the roles these organs play

Oiscuss the overall processes of digestion, absorption, and transport; and waste elimination

Quiz Yourself

health? Can people obtain enough protein by eating only plant foods? What happens if you

- Animal foods such as meat and eggs a almost 100% protein. _____ T _____ f
- 2. Foods made from soybeans can be source of high-quality protein.
- 3. Americans typically consume more protein
- 4. Registered dietitian nutritionists enerally recommend that people with
- 5. People can nourish their hair by using

Concept CHECKPOINT

- 20. What is hunger? What is satiety?
- 21. Discuss the roles of leptin and ghrelin in regulating hunger
- 22. Under what conditions would having "thrifty genes" benefit a person?
- 23. What is the set-point theory?
- 24. What is the difference between hunger and appetite?
- 25. Describe how the environment influences a person's food intake and physical
- 26. Provide at least three examples of ways that physiological, psychological, and

See Appendix F for responses.

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Critical Thinking

The Critical Thinking feature involves higher—level cognitive skills, including applying, analyzing, synthesizing, and evaluating information. This assessment features a series of thought-provoking questions or activities at the end of the chapter. The questions and activities can help students develop higherlevel cognitive skills using nutrition—related content. Acquiring and/or sharpening these skills can help students become better consumers of nutrition—related information.



Critical Thinking

- Analyze your weekly physical activity habits. Does your participation in various physical activities meet the min-imum recommendations? If not, which physical activi-ties are you willing to include in your weekly routine to improve your fitness kevel?
- Calculate your target heart rate zone for moderate— intensity as well as vigorous—intensity activities.
- 3. Why do human cells rely far more on glucose and fat for energy than on protein?
- 4. What advice would you give a runner concerning fluid intake before and during a marathon?
- 5. One of your friends is a student athlete who uses gin-seng, nitrate, and caffeine to enhance his physical per-formance. What would you tell your friend concerning the pros and cons of taking these substances?
- Sunny is an athlete who weighs 143 pounds. According to the information in Section 11.4, calculate the recommended amount of protein (g) she should consume daily.

Personal Dietary Analysis

Many chapters include an end-of-chapter activity for analyzing personal eating habits. Most of these activities require the use of a dietary analysis software program, such as NutritionCalc Plus. Students can gain insight into their eating behaviors by completing this activity.



Personal Dietary Analysis

Using the DRIs

- 1. Refer to your 1- or 3-day food log from the "Personal Dietary Analysis" feature in Chapter 3.
 - a. Find the RDA values for vitamins under your life stage/sex group category in the DRI tables (see Appendix H). Write those values under the "My RDA" column in the table of this analysis activity.
 - b. Review your personal dietary assessment. Find your 3-day average intakes of vitamins A, E, C, D, folate, B-12, thiamin, riboflavin, and niacin. Write those values under the "My Average Intake" column of the table.
 - c. Calculate the percentage of the RDA you consumed for each vitamin by Calculate the percentage of the RDA you consumed for each vitamin by dividing your intake by the RDA amount and multiplying the figure you obtain by 100. For example, if your average intake of vitamin C were 100 mg/day, and your RDA for the vitamin were 75 mg/day, you would divide 100 mg by 75 mg to obtain 1.25. To multiply this figure by 100, simply move the decimal point two places to the right, and replace the decimal point with a percentage sign (125%). Thus, your average daily intake of vitamin C was 125% of the RDA. Place the percentages for each vitamin under the "% of My RDA" column.
 - **d.** Under the ">, <, or =" column, indicate whether your average daily intake was greater than (>), less than (<), or equal to (=) the RDA.
- 2. Use the information you calculated in the first part of this activity to answer the following questions
- a. Which of your average vitamin intakes equaled or exceeded the RDA value?
- b. Which of your average vitamin intakes was below the RDA value?
- e. What foods would you eat to increase your intake of the vitamins that were less than the RDA levels? (Review sources of certain vitamins in Chapter 8.)
- d. Turn in your completed table and answers to your instructor.

Practice Test

Each chapter ends with a series of 10 or more multiple-choice questions that test students' comprehension and recall of information presented in the chapter. Answers to the test questions are in Appendix F. The multiple-choice questions prepare students for classroom exams because they are similar in type and format to those in the test bank. In many instances, the test questions are correlated to the Coursewide Student Learning Outcomes and Chapter Learning Outcomes.



1. Fats in foods

- a. add taste and contribute to "mouth feel." b. are digested and absorbed in the stomach. c. carry water—soluble nutrients. d. need to be eliminated to have a healthful diet.
- 2. Solid fats generally have a high proportion of fatty acids.
- a. unsaturated
- b. saturated c. polyunsaturated d. monounsaturated
- 3. A saturated fatty acid has

- a. one double bond within the hydrocarbon chain.
 b. two double bonds within the hydrocarbon chain.
 c. no double bonds within the hydrocarbon chain.
 d. three or more double bonds within the hydrocarbon
- - a. naturally in many foods.
 b. a by—product of the hydrogenation process.
 c. essential to good health.
 d. found primarily in fatty fish.
- 6. Phospholipids
- Prosponoppas
 a. do not have fatty acids in their chemical structures.
 b. lack glycerol in their chemical structures.
 c. do not occur naturally.
 d. are partially water-soluble.
 Cholesterol is

- a. metabolized for energy.b. found only in animal foods.c. not made by the human body.d. harmful to health.
- 8. The primary site of trigly ceride digestion and absorption is the







What's New in this Edition



Jozsef Szasz-Fabian/123RF

The sixth edition of Nutrition for Healthy Living has been updated extensively. The new edition has information about the Dietary Guidelines for Americans, 2020–2025 ("2020–2025 Dietary Guidelines"); revised Daily Value charts in the Recipe for Healthy Living features; several new Practice Test questions at the end of chapters; and the recently updated DRIs in Appendix H. Furthermore, each chapter has several new photos and many of the diagrams and illustrations have been modified to make them easier to follow and understand. Such images help draw students' attention to the narrative, stimulate their interest in topics, and relate content to the "real world." It is important to note that the use of brand—name products in photos is for example representation only and does not constitute an endorsement.

Not long after the sixth edition of Nutrition for Healthy Living entered production in early 2020, COVID—19 began to spread around the world. Because the novel and often deadly viral infection affected the lives of all Americans, the authors of this textbook decided to create a new feature that would educate college students about the virus's effects on human health and in particular, nutrition. Each chapter contains at least one COVID—19 feature that includes information relating to the chapter's contents and provides refer—ences for further reading.

The following information highlights several of the updates that are in each chapter.

COVID-19

Infection with the coronavirus that causes COVID-19 affects almost every body system, and especially, the respiratory system. Most people with the infection report having a dry cough, fever (temperature 100.4°F or higher), and fatigue. Many people with COVID-19 also experience shortness of breath, which means they cannot breathe as well as before they became sick. Symptoms of shortness of breath include having difficulty "catching one's breath" (breathlessness) and feeling chest "tightness." For more extensive information about the signs and symptoms of COVID-19, visit the websites shown in the "Sources" for this feature.

Sources: Mayo Clinic, Patient Care and Health Information: Unusual coronavirus (COVID-19) symptoms: What are they? June 2020. www.mayoclinic.org //diseases-conditions/coronavirus/expert-answers /coronavirus-unusual-symptoms/faq-20487367; Centers for Disease Control and Prevention: What to do if you are sick. May 2020. www.cdc.gov /coronavirus/2019-ncov/if-you-are-sick/steps-when -sick.html.

Chapter 1: The Basics of Nutrition

- Two COVID-19 features provide background information about the pandemic and nutrition's role in the prevention and recovery from the infectious disease.
- Information about *Healthy People 2030* is presented.
- Figures 1.6 (Energy and Nutrient Comparison), 1.8 (Comparing Nutrient Densities), and 1.9 (Energy Density) have been revised to make the information easier for students to grasp.
- A new Did You Know? features health insurance; the new Food & Nutrition Tip is about superfoods; and the new My Diverse Plate feature discusses traditional foods among people with Mexican ancestry.

Chapter 2: Evaluation Nutrition Information

- COVID-19 feature discusses a federal court's crackdown on a company promoting a fraudulent "cure" for the infection.
- A new figure for case—control studies (Figure 2.3) and information about randomized controlled trials (RCTs) are added.
- There are two new Did You Know? features, including one that provides information about career paths for registered dietitian nutritionists.
- A new My Diverse Plate discusses certain food taboos.

Chapter 3: Planning Nutritious Diets

- The 2020–2025 Dietary Guidelines and new MyPlate icon are introduced. Sections 3.3 and 3.4 have been heavily revised to reflect these updates.
- COVID-19 feature explains why sales of organic foods increased during the spring of 2020.

- The Dietary Reference Intakes (DRIs) section discusses Chronic Disease Risk Reduction Intakes (CDRRs) and Figure 3.1 (Dietary Reference Intakes) includes CDRRs.
- A new section along with a new figure (Figure 3.5) defines ultra—processed foods and explains how to identify them.

Chapter 4: Body Basics

- Two COVID-19 features present typical signs and symptoms of the disease and discuss the infection's effect on the sense of smell.
- Figure 4.5 (pH Scale) has been completely updated.
- Four new Did You Know? features about swallowing difficulties (dysphagia), bezoars, appendicitis, and "autobrewery syndrome" are presented.
- The new My Diverse Plate discusses how people consume almost every part of an animal for food.
- New content about the immune function of the intestinal tract, Crohn's disease, and ulcerative colitis is included.
- The new Real People, Real Stories feature is about a young woman with Crohn's disease.
- Nutrition Matters has a new section about colorectal cancer.

Chapter 5: Carbohydrates

- COVID-19 feature explains why people with diabetes are more likely to develop a severe case of the infection, when compared to people who do not have diabetes.
- New Figure 5.6 illustrates why humans cannot digest dietary fiber.
- Figure 5.8 (Regulating Blood Glucose) has been completely redesigned to make it easier for students to follow.
- A new Did You Know? feature discusses the monosaccharide allulose.

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• The new Real People, Real Stories feature is about a young woman with type 1 diabetes.

Chapter 6: Fats and Other Lipids

- COVID-19 feature presents information about the infection's potential to damage the heart of people with cardiovascular disease.
- Table 6.2 (Comparing Fats and Oils) has been completely revised and updated.
- Lipid digestion and absorption sections have been revised, including Figures 6.10 (Lipid Digestion) and 6.11 (Lipid Absorption), to make the content easier for students to follow and understand.
- Three new Did You Know? features that discuss long—chain and medium—chain triglycerides, essential fatty acids' role in brain development, and e—cigarettes are presented.

Chapter 7: Proteins

- COVID—19 feature explains why people with the infection can develop protein undernutrition and includes ways to meet protein needs during the illness and its recovery.
- Two new Did You Know? features that discuss oral colla gen supplements and the development of a red meat allergy from tick bites.
- A new section discusses processed meat consumption and health, and new Figure 7.14 shows American meat protein consumption patterns.
- A new section discusses protein undernutrition in acute and chronic diseases.

Chapter 8: Vitamins

- COVID-19 feature discusses the possibility of using vitamin D supplements to prevent or treat the infection.
- The new Figure 8.2 illustrates basic pathways of vitamins involved in energy metabolism.
- Two new Food and Nutrition Tips discuss blanching and ways to protect the vitamin E content of vegetable oils.
- Three new Did You Know? features discuss vitamin A-rich golden rice, the methylenetetrahydrofolate reductase (MTHFR) genetic defect in folate metabolism, and the popular health fad of IV vitamin infusions.

Chapter 9: Water and Minerals

- COVID-19 feature examines the concern that taking certain blood pressure medications may increase a patient's risk of becoming infected with the virus that causes COVID-19.
- Two new Did You Know? features discuss hangovers from excessive alcohol consumption and hypernatremia.

- New Figure 9.13 helps explain the role of parathyroid hor—mone (PTH) and vitamin D in blood calcium regulation.
- The Sodium Toxicity section has been updated to include Chronic Disease Risk Reduction (CDRR) Intake for Sodium.
- Table 9.10 (Categories for Blood Pressure in Adults) has been updated with new American Heart Association guidelines.

Chapter 10: Energy Balance and Weight Control

- COVID-19 feature explains why people who are obese have a high risk of becoming severely ill and die as a result of the infection.
- A new My Diverse Plate feature discusses the prevalence of obesity among certain ethnic groups in the United States.
- More information is provided about the roles of gut microbi ota, intestinal dysbiosis, and ultra—processed foods in obesity development.
- Three new Did You Know? features examine digital physical activity trackers, intermittent fasting, and the Federal Trade Commission lawsuit against a weight—loss program that made false, nonscientific claims.
- Bariatric surgical procedures section includes information about intragastric balloons.

Chapter 11: Nutrition for Physically Active Lifestyles

- COVID-19 feature explains why muscle pain and fatigue often occur in patients who have the infection.
- New target heart rate formulas for determining moderate and intense exercise and new physical activity recommendations are introduced.
- A new Did You Know? features oral creatine supplements.

Chapter 12: Food Safety Concerns

- COVID—19 feature discusses whether the infection is a food safety concern.
- New Table 12.9 lists foods that can undergo irradiation in the United States.
- A new Did You Know? discusses the Environmental Working Group's "Dirty Dozen" list.

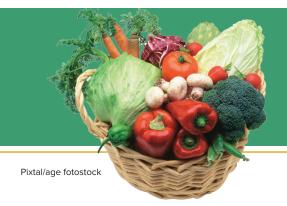
Chapter 13: Nutrition for a Lifetime

- COVID-19 feature explains why the disease is more likely to kill older adults than younger persons.
- A new section that discusses preconception health concerns is included.
- Figure 13.3 (Rate of weight gain: Healthy pregnancy) has been completely revised.
- A new My Diverse Plate feature compares snacking habits of American and Chinese children.
- A new Real People, Real Stories feature introduces a physically active 93—year—old woman.

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Handy J. Seriff Traci J. Keck





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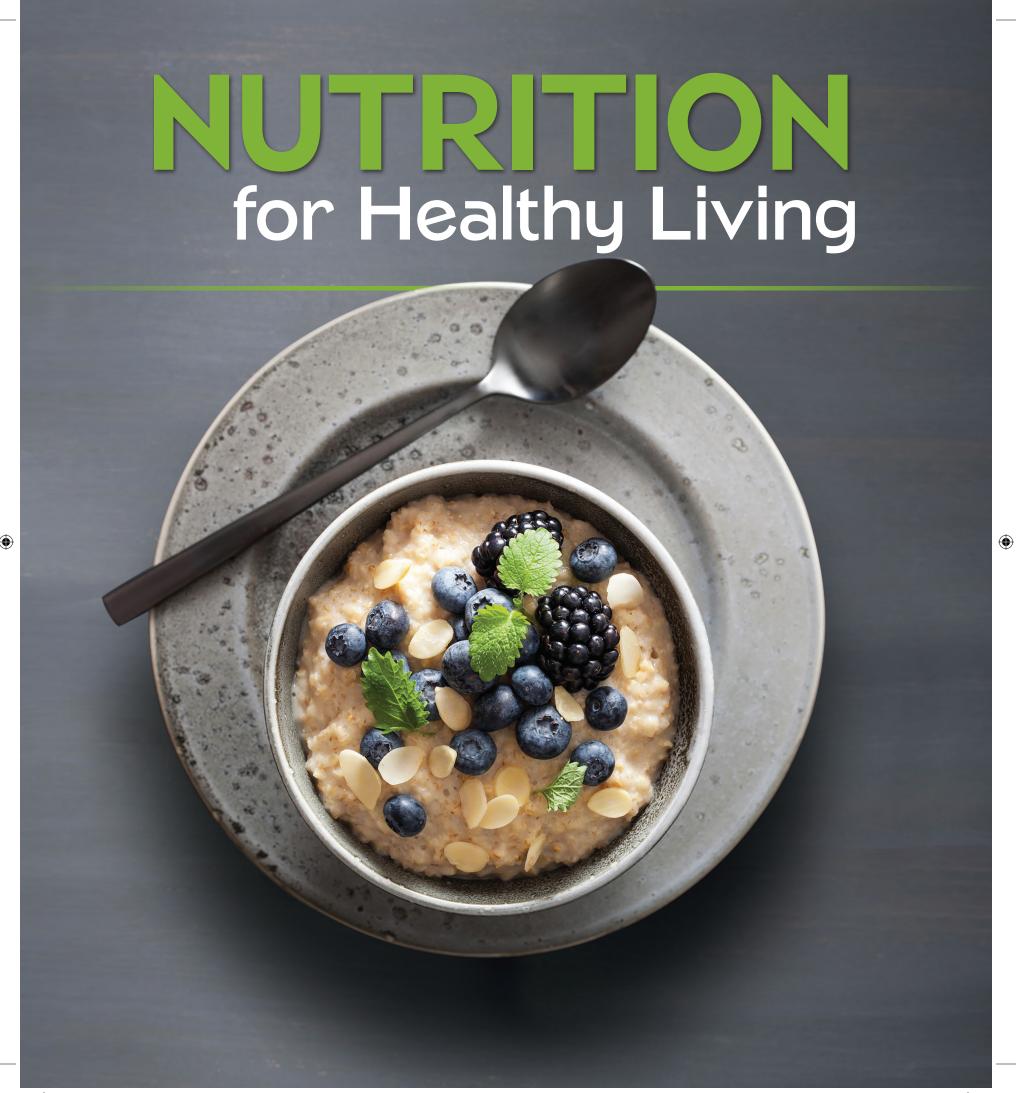
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CHAPTER

1

The Basics of Nutrition



A



1.1 Nutrition: The Basics

Learning Outcomes

- 1 Explain why it is important to learn about foods and nutrition.
- Identify factors that influence personal food choices.
- 3 Identify the leading causes of death in the United States and lifestyle factors that contribute to them.
- 4 List the six classes of nutrients, and identify a major role of each class of nutrient in the body.
- 5 Explain how to determine whether a substance is a nutrient, an essential nutrient, a nonnutrient, or a phytochemical.

When you were an infant and a young child, your parents or other adult caregivers were the "gatekeepers" of your food; they chose what you ate and prepared it, and you probably ate most of it. If you balked at eating steamed broccoli or baked salmon, they may have told you, "Eat your vegetables if you expect to get dessert" or "Finish that fish. People in Africa are starving!" As you grew older, your diet, your usual pattern of food choices, came increasingly under your control. Today, your diet is more likely to be composed of foods that you enjoy, as well as can afford and probably those you can prepare easily or obtain quickly. Your family's ethnic and cultural background may also play a role in determining what you eat regularly. For example, do you eat tamales, tripe, goat, or kimchi because you ate these foods as a child? Numerous other factors influence your food choices, including friends and food advertising, as well as your beliefs and moods (Fig. 1.1).

Food is a basic human need for survival. You become hungry and search for something to eat when your body needs **nutrients**, the life—sustaining substances in food. Nutrients are necessary for the growth, maintenance, and repair of your body's cells. Eating food supplies your body with nutri—ents and satisfies your hunger, but it also can be comforting, especially if consuming certain foods soothes your anxiety or ends your boredom. Fur—thermore, what you choose to eat may have social, economic, ceremonial, or religious significance. For example, lobster, crab legs, and prime rib steak are often associated with special occasions and people who have high incomes. Other foods, such as a frosted layer cake topped with lit candles, stuffed roasted turkey served with candied sweet potatoes, and communion wafers, are associated with birthday celebrations, seasonal holidays, and religious rites. Thus, food is more than just something to eat.

You were not born with the ability to select the appropriate mix of nutrients your body requires for proper functioning. To eat well, you need to learn about the nutritional value of foods and the effects that your diet can have on your health.

Simply having information about nutrients and foods and their effects on health may not be enough for people to change ingrained food—related behaviors; a person must be motivated to make such changes. Some people become motivated to improve their diets because they want to lose or gain weight. Others are so concerned about their health that they are motivated to change their eating hab—its in specific ways, such as by eating fewer salty or fatty foods. Many people, however, do not care if the food they eat is beneficial or harmful to their health.



COVID-19

In late December 2019, international public health experts received reports of an unusual form of viral pneumonia affecting a large number of people in China. Medical researchers were able to identify the virus that caused the pneumonia as a new and highly infectious type of coronavirus. By the end of January 2020, cases of the unusual viral pneumonia (COVID-19) were spreading so rapidly that the World Health Organization declared a *Public Health Emergency of International Concern*. By August 2020, cases of COVID-19 were identified in almost every country, and throughout the world, several hundred thousand people had died of the infection.

COVID-19 can spread when people who are infected with the new coronavirus talk loudly, or they cough or sneeze without covering their nose and mouth. Healthy people who inhale the viral-laden droplets of saliva or nasal secretions are likely to develop the infection. We will include specific information about COVID-19 and its relationship with nutritional health throughout this textbook.

Sources: World Health Organization: *Timeline of WHO's response to COVID-19.* June 2020. www.who.int/news-room/detail/29-06-2020-covidtimeline; World Health Organization: *Coronavirus.* ND. www.who.int/health-topics/coronavirus#tab=tab_1.

diet usual pattern of food choices

nutrients chemicals necessary for proper body functioning



Figure 1.1 What influences your eating practices? Numerous factors influence food choices, including food advertising, peers, income, moods, and personal beliefs. ©Wendy Schiff

3

4 Chapter 1 The Basics of Nutrition



MY DIVERSE PLATE

Traditional Mexican meals typically include some form of corn, such as tortillas made from corn meal; beans; chili peppers; and rice. Meals may also feature eggs, pork, chicken, beef, and fish, as well as a wide variety of fruits and vegetables. Main dishes, dips, sauces, and snacks often incorporate fresh avocados, tomatillos, papayas, pineapples, limes, mangoes, chayote, cherimoya, jicama, tomatoes, garlic, onions, plantains, and the fruit (tuna) and young stems (nopalitos) of the prickly pear cactus that have been prepared for consumption. Cilantro; oregano; cumin; parsley; and various dried peppers, such as chile de árbol, chipotle, cascabel, and pasilla, are used to add distinctive flavors to Mexican cuisine. Because the traditional Mexican diet includes a variety of fruits and vegetables, it is high in fiber, vitamins C and A, potassium, magnesium, and beneficial phytochemicals.





Prickly pear cactus with its spiny green stems (nopales) and dark purple fruit (tuna). Nopalitos are nopales that are prepared for cooking or eating raw Cactus, nopalitos: ©Wendy Schiff

chronic refers to diseases and many other medical conditions that are long term and, often, difficult to treat

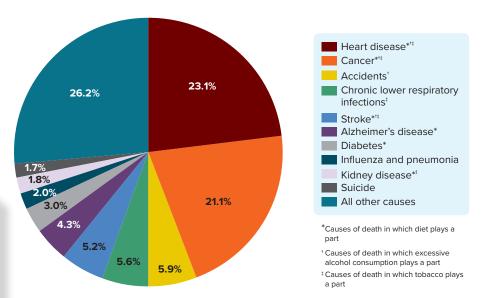


Figure 1.2 Approximate percentages of leading causes of death (U.S.), 2018. Dietary factors contribute to many of the 10 leading causes of death in the United States. As of July 2020, it is unclear how the number of COVID-19 deaths will affect this graph.

Source: www.cdc.gov/nchs/data/databriefs/db355_tables-508.pdf#2. Accessed: January 30, 2020.

Why Learn About Nutrition

Why should you care about your diet? The foods and beverages you usually select for meals and snacks contribute to your health now and in the future. In the United States, poor eating habits contribute to several leading causes of death, including heart disease, some types of cancer, stroke, and type 2 diabetes (Fig. 1.2). Such diseases and many other medical conditions are **chronic**, which means they are long term and, often, difficult to treat. Therefore, making efforts to prevent chronic health problems, especially when one is young, is crucial to a person's future physical health and emotional well—being.

People who consume a healthy diet are more likely to have proper immune responses to agents that cause infectious diseases, which include the new coronavirus that causes COVID—19.1 Recently, a team of scientists analyzed dietary information that was provided by almost 75,000 adults for 12 years. According to the results of the analysis, the people who had taken steps to consume healthier diets were less likely to die prematurely (too early) from all causes, and especially, heart disease, than the people who did not improve their diets.2 "Health—ier" diets generally supplied more whole grains and vegetables and fewer salty foods. Chapter 3 provides more information about the composition of healthy diets.

Are you concerned about the nutritional quality of your diet? The fact that you are taking this course indicates you have a strong interest in nutrition and a desire to learn more about the topic. A major objective of this textbook is to provide you with the basic information you need to better understand how your diet can influence your health. Managing your diet is your responsibility. We will not tell you what to eat to guarantee optimal health: No one can make that promise. After reading this textbook and learning about foods and the nutrients they contain, you can use the information to make informed decisions concerning the foods you eat. Furthermore, you will be able to evaluate your diet and decide if it needs to be changed.

Each chapter of this textbook begins with "Quiz Yourself," a brief true—or—false quiz to test your knowledge of the material covered in the chapter.



Each major section of a chapter ends with "Concept Checkpoints," a series of questions that can help you determine whether you understood the major concepts in the section. Answers to the "Concept Checkpoints" are given in Appendix F. At the end of each chapter, you will find the answers to the opener quiz, as well as a group of multiple—choice questions that test your understanding of the material in the chapter. The answers to those questions are provided in Appendix F. References for information cited in chapters are in Appendix G.

Introduction to Nutrition

Nutrition is the scientific study of nutrients, chemicals necessary for proper body functioning, and how the body uses them. Understanding nutrition requires learning about chemistry. Chemistry is the study of the composition and characteristics of matter, and changes that can occur to it. Matter is anything that takes up space and has mass or weight (on Earth). The air you breathe, this textbook, and even your body consist of chemicals and are forms of matter. "There are chemicals in our food!" This statement may sound frightening, but it is true. Food is matter; therefore, it contains chemicals, some of which are nutrients.

There are six classes of nutrients: carbohydrates, fats and other lipids, proteins, vitamins, minerals, and water. Your body is composed of these nutrients

(Fig. 1.3). Although an average healthy young man and woman have similar amounts of vitamins, minerals, and carbohydrates in their bodies, the young woman has less water and protein, and considerably more fat than the man.

Table 1.1 presents major roles of nutrients in your body. In general, your body uses certain nutrients for energy, growth and development, and regulation of processes, including the repair and maintenance of cells. A **cell** is the smallest living functional unit in an organism, such as a human being. There are hundreds of different types of cells in your body. Cells do not need food to survive, but they need the nutrients in food to carry out their metabolic activities. **Metabolism** is the total of all chemical processes that occur in living cells, including chemical reactions (changes) involved in generating energy, making proteins, and eliminating waste products. You will learn more about metabolism in Chapter 4 (Body Basics).

Understanding nutrition also involves learning about human *physi-ology*, the study of how the body functions. Chapter 4 prepares you for the study of nutrition by presenting basic information about chemistry and human physiology. Chapters 5 (Carbohydrates), 6 (Fats and Other Lipids), 7 (Proteins), 8 (Vitamins), and 9 (Water and Minerals) provide information about the functions of nutrients in the body.

What Is an Essential Nutrient?

The body can synthesize (make) many nutrients, such as the lipids cholesterol and fat, but about 50 nutrients are dietary essentials. An **essential nutrient** must be supplied by food because the body does not synthesize the nutrient or make enough to meet its needs. Water is the most essential nutrient.

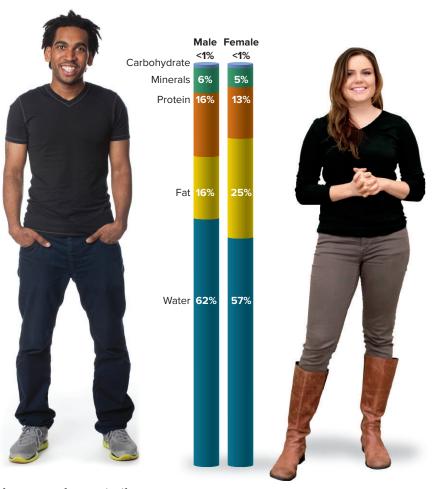


Figure 1.3 Comparing composition. These illustrations present the approximate percentages of nutrients that comprise the bodies of a healthy young man and woman. Note that the amount of vitamins in the human body is so small, it is not shown.

Many Blood/Image Source: Woman; @McGraw Hill Education/

Man: Blend/Image Source; Woman: @McGraw-Hill Education/ Aaron Roeth Photography

nutrition scientific study of nutrients and how the body uses these substances

chemistry study of the composition and characteristics of matter and changes that can occur to it

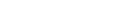
cell smallest living functional unit in an organism

metabolism total of all chemical processes that take place in living cells

essential nutrient nutrient that must be supplied by food









COVID-19

The majority of people who have COVID-19 develop mild to moderate illness and recover at home without the need for advanced medical treatment. However, malnourished individuals, older adults, and persons who have preexisting conditions, particularly chronic lung disease, heart disease, obesity, cancer, and disbetes, have a higher risk of developing severe COVID-19 that requires hospitalization. Such patients are also at risk of dying from COVID-19. It is important to note that even healthy young people are susceptible to COVID-19.

As mentioned earlier in this chapter, people who follow a healthy diet may be able to avoid infectious diseases. The body uses a variety of nutrients for maintaining its ability to prevent and fight infections (immune functioning). Additionally, having optimal nutritional status is likely to help the body recover quickly from an infectious disease, such as COVID-19.

Sources: www.un.org/coronavirus; Mehta S: Nutritional status and COVID-19: An opportunity for lasting change? *Clinical Medicine Journal* 20(3): 270, 2020.

deficiency disease state of health that occurs when a nutrient is missing from the diet

TABLE 1.1 Major Functions of Nutrients in the Body

Nutrient	Major Functions
Carbohydrates	Source of energy (most forms of carbohydrate)
Lipids	Source of energy (fat)
	Cellular development, physical growth and development
	Regulation of body processes (certain chemical messengers, for example)
	Absorption of certain vitamins
Proteins	Production of structural components, such as cell membranes, and functional components, such as enzymes
	Cellular development, growth, and maintenance
	Regulation of body processes (certain chemical messengers, for example)
	Transportation of many nutrients
	Immune function and fluid balance
	Source of energy
Vitamins	Regulation of body processes, including cell metabolism
	Maintenance of immune function, production and maintenance of tissues, and protection against agents that can damage cellular components
Minerals	Regulation of body processes, including fluid balance and metabolism; formation of certain chemical messengers; structural and functional components of various substances and tissues; physical growth, maintenance, and development
Water	Maintenance of fluid balance, regulation of body temperature, elimination of wastes, and transportation of substances
	Participant in many chemical reactions

There are three key features that help identify an essential nutrient:

- If the nutrient is missing from the diet, a **deficiency disease** occurs as a result. The deficiency disease is a state of health characterized by certain abnormal physiological changes. (*Physiological* refers to the functioning of the body.) Visible or measurable changes are referred to as *signs* of disease. Disease signs include rashes, failure to grow properly, and elevated blood pressure. *Symptoms* are subjective complaints of ill health that are difficult to observe and measure, such as dizziness, fatigue, and headache.
- When the missing nutrient is added to the diet, the abnormal physiological changes are corrected. As a result, signs and symptoms of the deficiency disorder resolve as normal functioning is restored, and the condition is cured.
- After scientists identify the nutrient's specific roles in the body, they can explain why the abnormalities occurred when the substance was missing from the diet.

If you wanted to test your body's need for vitamin C, for example, you could avoid consuming foods or vitamin supplements that contain the vitamin. When the amount of vitamin C in your cells became too low for them to function normally, you would develop physical signs of scurvy, the vitamin C deficiency disease. Early in the course of the deficiency, tiny red spots that are actually signs of bleeding under the skin (tiny bruises) would appear where the elastic bands of your clothing applied pressure. When you brushed your teeth, your gums would bleed from







the pressure of the toothbrush. If you cut yourself, the wound would heal slowly or not at all. If you started consuming vitamin C-containing foods again, the deficiency signs and symptoms would disappear within a few days as your body recovered. By reading about vitamin C in Chapter 8, you will learn that one of the physiological roles of vitamin C is maintaining a substance in your body that literally holds cells together. This substance is also needed to produce scar tissue for wound healing. Thus, vitamin C meets all the required features of an essential nutrient.

Table 1.2 lists nutrients that are generally considered to be essential. Fortunately, the human body is designed to obtain these substances from a wide variety of foods. Chapter 3 provides information about ways to plan nutritious diets.

What Are Nonnutrients? Some foods contain nonnutrients—substances that are not nutrients, yet they may have health—ful benefits. Plants make hundreds of nonnutrients called **phytochemicals** (phyto=plant). Caffeine, for example, is a phytochemical naturally made by coffee and tea plants that has a stimulating effect on the body. Many phytochemicals are antioxidants that may reduce risks of heart disease and certain cancers. An **antioxidant** protects cells and their components from being damaged or destroyed by exposure to certain harmful environmental and internal factors. Some vitamins also function as antioxidants (see Chapter 8).

Not all phytochemicals have beneficial effects on the from being used for energy body. Some phytochemicals, such as nicotine in tobacco leaves, ricin in castor beans, and oxalic acid in rhubarb leaves, are toxic or can interfere with the absorption of nutrients. Scientific research that explores the effects of phytochemicals on the body is ongoing. Table 1.3 lists several phytochemicals that are currently under scientific investigation, identifies rich food sources of these compounds, and indicates their biological effects on the body, including possible health benefits. Note that few animal foods are sources of phytochemicals.

Dietary Supplements

Many Americans take dietary supplements such as vitamin pills and herbal extracts to improve their health. The Dietary Supplement Health and Education Act of 1994 (DSHEA) allows manufacturers to classify nutrient supplements and certain herbal products as foods.³ The DSHEA defines a **dietary supplement** as a product (excluding tobacco) that contains a vitamin, a mineral, an herb or other plant product, an amino acid, or a dietary substance that supplements the diet by increasing total intake. According to scientific evidence, some dietary supplements, such as vitamins and certain herbs, can have beneficial effects on health. How—ever, results of scientific testing also indicate that many popular dietary supplements are not helpful and may even be harmful. The "Nutrition Matters" section in Chapter 2 ("What Are Dietary Supplements?") discusses dietary supplements. Information about specific dietary supplements, including those that contain phy—tochemicals, is also woven into chapters where it is appropriate.

Garlic cloves, garlic bulb, red onion: C Squared Studios/Getty Images; Kale: Stockdisc/PunchStock; Purple striped garlic bulbs: Stockdisc/Getty Images; Carrots: PhotoAlto/SuperStock

TABLE 1.2 Essential Nutrients for Humans

Water	Glucose [†]	Fats that contain
Vitamins:	Minerals:	linoleic and
А	Calcium	alpha-linolenic acids
B vitamins	Chloride	acius
Thiamin	Chromium	
Riboflavin	Copper	Components of
Niacin	lodine	proteins (amino acids):
Pantothenic acid	Iron	·
Biotin	Magnesium	Histidine
Folate	Manganese	Leucine
B-6	Molybdenum	Isoleucine
B-12	Phosphorus	Lysine
Choline*	Potassium	Methionine
С	Selenium	Phenylalanine
D**	Sodium	Threonine
Е	Sulfur	Tryptophan
K	Zinc	Valine

^{*}The body makes choline but may not make enough to meet needs. Often classified as a *vitamin-like* compound.

phytochemicals compounds made by plants that are not nutrients

antioxidant substance that protects other compounds from being damaged or destroyed by certain factors

dietary supplements nutrient preparations, certain hormones, and herbal products that are taken to increase total dietary intake





^{**}The body makes vitamin D after exposure to sunlight, but a dietary source of the nutrient is often necessary.

[†]A source of glucose is needed to supply the nervous system with energy and spare protein from being used for energy.

8 Chapter 1 The Basics of Nutrition

TABLE 1.3 Phytochemicals of Scientific Interest

Classification and Examples	Rich Food Sources	Biological Effects/Possible Health Benefits	
Carotenoids		Antioxidant activity; may reduce risk of macular degeneration (a major cause of blindness)	
Alpha-carotene, beta-carotene, lutein, lycopene, zeaxanthin	Orange, red, yellow fruits and vegetables; egg yolks; liver		
Phenolics		Antioxidant activity; may inhibit cancer growth, may reduce risk of heart disease	
Quercetin	Apples, tea, red wine, onions, olives, raspberries, cocoa		
Catechins	Tea, chocolate, plums, apples, berries, pecans		
Anthocyanins	Red, blue, or purple fruits and vegetables		
Resveratrol	Red wine, purple grapes and grape juice, dark chocolate		
Isoflavonoids	Soybeans and other legumes		
Lignans	Flaxseed, berries, whole grains, bran, nuts		
Ellagic acid	Raspberries, strawberries, cranberries, walnuts, pomegranates		
Organosulfides		Antioxidant effects; may improve immune system functioning and reduce the risk of heart disease	
Isothiocyanates, indoles, allylic sulfur compounds	Garlic, onions, cruciferous vegetables (broccoli, cauliflower, cabbage, kale, bok choy, collard and mustard greens)		
Alkaloids		Stimulant effects	
Caffeine	Coffee, tea, kola nuts, cocoa		
Capsaicinoids		May provide some pain relief	
Capsaicin	Chili peppers		
Fructooligosaccharides		May stimulate the growth of beneficial bacteria in the human intestinal tract	
	Onions, bananas, asparagus, wheat		

Apple, strawberries; raspberries: ©Burke/Triolo Productions/Getty Images; Plums: ©Scott Bauer/ARS/U.S. Dept of Agriculture; Red grapes: Jules Frazier/Photodisc/Getty Images; Almonds: C Squared Studios/Getty Images RF; Red chili pepper: Heide Benser/Getty Images

Concept CHECKPOINT

- **1.** Identify at least two of the ten leading causes of death that are diet related.
- 2. Identify at least four factors that influence your eating habits.
- **3.** List the six major classes of nutrients.
- **4.** What are three key factors that determine whether a substance is an essential nutrient?
- **5.** Define *phytochemical* and *dietary supplement*.

See Appendix F for responses.







1.2 Factors That Influence Americans' Health

Learning Outcomes

1 Explain why people should be concerned about their lifestyle and risk factors for chronic diseases.

2 Compare Americans' current typical diet to the population's typical eating patterns in 1970.

3 Identify the main nutrition-related goal of Healthy People 2030.

As mentioned in the beginning of this chapter, poor eating habits contribute to several of the leading causes of death in the United States. As we showed in Figure 1.2, heart disease is the leading cause of death for all Americans, and cancer is the second leading cause of death. In 2018, these two diseases accounted for over 40% of all deaths.

Conditions such as heart disease and cancer are *chronic* diseases. Chronic diseases usually take many years to develop and have complex causes. A **risk factor** is a personal characteristic that increases your chances of developing a chronic disease. For example, genetic background or family history is an important risk factor for heart disease. If your father's father had a heart attack before he was 55 years old and your mother is being treated for having a high blood cholesterol level (a risk factor for heart disease), your family history indicates you have a higher—than—average risk of having a heart attack. For many people, however, having a family history of a chronic disease does not mean that they definitely will develop the condition. Other risk factors that contribute to health are age, environmental conditions, psychological factors, access to health care, and lifestyle practices.

Lifestyle is a person's usual way of living that includes dietary practices, physical activity habits, use of drugs such as tobacco and alcohol, and other typical pat terns of behavior. Your lifestyle may increase or reduce your chances of developing a chronic disease or delay its occurrence for years, even decades. Poor diet, cigarette smoking, and excess alcohol consumption, for example, are risk factors that increase the likelihood of heart disease, stroke, and many forms of cancer. Cigarette smoking is the primary cause of preventable cancer deaths, but dietary habits and physical activity patterns also contribute to the development of certain cancers.^{5,6} Additionally, poor diet and lack of physical activity can result in obesity, a condition characterized by the accumulation of too much body fat. Obesity is a risk factor for numerous health problems, including heart disease, certain cancers, type 2 diabetes, and hypertension (chronic high blood pressure).

Our Changing Eating Habits

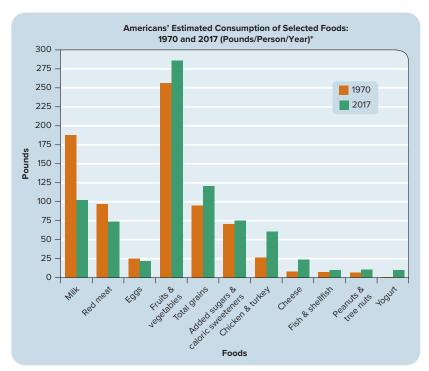
Americans' diets have changed over the past 50 years (Fig. 1.4). In general, the population now eats more peanuts and tree nuts, poultry, fish and shell—fish, yogurt, and cheese than amounts that they ate in 1970. Nevertheless, Americans have reduced their intakes of other protein—rich foods, includ—ing fluid milk, red meat (beef, veal, pork, and lamb), and eggs, since 1970. Although today's Americans consume more fruits and vegetables, they do not eat the

Did YOU Know?

Your genetic makeup influences the effects of diet on your health, as well as disease susceptibility. *Nutritional genomics* is a relatively new area of nutrition research that explores complex interactions among gene functioning, diet and other lifestyle choices, and the environment. Section 7.9 provides more information about nutritional genomics.

risk factor personal characteristic that increases a person's chances of developing a disease

lifestyle usual way of living, including dietary practices and physical activity habits



* Figures adjusted for loss.

Figure 1.4 Americans' changing eating habits, comparing 1970 to 2017.

Source: U.S. Department of Agriculture, *Economic Research Service: Food availability (per capita) data system.* 2019. www.ers.usda.gov/data-products/food-availability-per-capita-data-system/food-availability-per-capita-data-system/#Loss-Adjusted%20Food%20Availability. Accessed: July 1, 2020.





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Did YOU Know?

People who have regular professional medical care may reduce their chances of developing many of the serious chronic diseases that lead to disability, lower quality of life, and premature (early) death. However, people who lack health insurance are more likely to skip routine medical care because they cannot afford its high cost. As a result, these persons have a higher risk of becoming ill with chronic and debilitating diseases that may have been preventable. Increasing access to both health insurance and regular, high-quality medical care is crucial for improving and maintaining good health for all Americans.

In 2018, most Americans (almost 90%) who were younger than 65 years of age had health insurance (public or private plans). People with a 4–year college degree were more likely to be insured than Americans who had lower levels of education. Individuals with Asian ancestry were also more likely to have health insurance. On the other hand, members of the population who identified themselves as being an American Indian or Alaska Native were least likely to have health insurance (about 71%).

Americans who have low incomes and need regular health care often face the question of what is more important—buying nutritious food or paying for physical exams and prescription medications. The "Nutrition Matters" section of this chapter discusses some major food programs that the U.S. government sponsors for low—income populations.



Increasing access to regular, high—quality medical care is crucial for achieving and maintaining good health for all Americans.

PhotoAlto sas/Alamy Stock Photo

recommended amounts.⁷ Compared to amounts eaten in the past, Americans now consume more foods that contain too much added sugars. The population's current diet also supplies more food energy from total grains, including flour and cereal products than in 1970, but foods made from *refined* grains, such as white bread and pizza dough, make up the majority of these products.

Raw foods often undergo some form of processing, such as refining, canning, freezing, or cooking, before they are eaten. Processing can make a food more nutritious, safer to eat, and less likely to spoil. However, some forms of process—ing remove nutrients and phytochemicals that were naturally in the food. Other forms of processing add unhealthy amounts of sodium, sugar, and certain fats to foods.

In 1987–1988, adult Americans consumed an average of 1785 Calories/day (excluding calories from alcohol). By 2017–2018, adult Americans consumed an average of 2085 Calories/day (excluding calories from alcohol). Thus, adults' average food energy intake increased by almost 17% between the two time periods. ^{8,9} If a person's energy intake is more than needed, especially for physical activity, his or her body fat increases. Nationwide surveys indicate that Americans are fatter than in previous decades. Dietary practices, however, should not receive all the blame for this unhealthy finding; during the same period, we have become increasingly dependent on various labor—saving gadgets and machines that make our lives easier but also reduce the amount of energy we need to expend to avoid unwanted weight gain. Chapter 10 examines weight management in detail.

Healthy People

Since the late 1970s, health promotion and disease prevention have been the general focus of public health efforts in the United States. A primary component of such efforts is developing educational programs that can help people prevent chronic and infectious diseases, birth defects, and other serious health problems. In many instances, it is more practical and less expensive to prevent a serious health condition than to treat it.

In 2020, the U.S. Department of Health and Human Services (HHS) issued *Healthy People 2030*, a report that includes national health promotion and disease prevention objectives to be met by 2030. *Healthy People 2030* overarching goals encourage Americans to:

- attain healthy, thriving lives and well—being that are free of preventable disease, disability, injury, and premature death;
- eliminate health disparities, achieve health equity, and attain health literacy to improve the health and well—being of all;
- create social, physical, and economic environments that promote attaining the full potential for health and well—being for all;
- promote healthy development, healthy behaviors, and well—being across all life stages; and
- engage leadership, key constituents, and the public across multiple sectors to take action and design policies that improve the health and well—being of all.¹¹

The main nutrition—related goal of *Healthy People 2030* is to improve health by promoting healthy eating and making nutritious foods available. To help meet this goal, *Healthy People 2030* has several nutrition—related objectives, some of which are listed in Table 1.4. More information about these and other nutrition objectives are at the government's website (https://health.gov/healthypeople/objectives—and—data/browse—objectives/nutrition—and—healthy—eating).



TABLE 1.4 Some *Healthy People 2030* Objectives: Nutrition and Healthy Eating

Number	Objective	
03	Reduce the proportion of adults who are obese	
04	Reduce the proportion of obese children and adolescents	
06	Increase fruit intake of people who are 2 years of age and older	
07	Increase the intake of vegetables by people who are 2 years of age and older	
09	Increase whole grain intake by people who are 2 years of age and older	
10	Reduce intake of added sugars by people who are 2 years of age and older	
12	Reduce sodium intake by people who are 2 years of age and older	
13	Increase calcium intake by people who are 2 years of age and older	

Source: https://health.gov/healthypeople/objectives-and-data/browse-objectives/nutrition-and-healthy-eating

Concept CHECKPOINT

- 6. What is a risk factor?
- 7. Explain how your lifestyle can affect your health.
- 8. Discuss how Americans' food choices have changed since 1970.
- 9. Identify the main nutrition-related goal of Healthy People 2030.

See Appendix F for responses.

1.3 Metrics for Nutrition

Learning Outcomes

- 1 Identify basic units of the metric system often used in nutrition.
- Use the caloric values of macronutrients and alcohol to estimate the amount of energy (kcal) in a serving of food.
- 3 Estimate the percentage of calories that each macronutrient contributes in a serving of food.

Scientists classify specific nutrients according to their chemical composition and major functions in the body. Nutrients can also be classified based on how much of them are in food. Americans usually refer to length in terms of inches and feet, weight in pounds, and amounts of food in familiar household measures (e.g., teaspoons, tablespoons, cups). Scientists, however, generally use metric values to report length (meter), weight (gram), and volume (liter). The following section provides a basic review of the metric system. Appendix A provides common English—to—metric and metric—to—household unit conversions.

Metric Basics

The metric prefixes micro-, milli-, centi-, deci-, and kilo- indicate whether a measurement is a fraction or a multiple of a meter (m), gram (g), or liter (l or L) (Table 1.5).



TABLE 1.5 Common Metric Prefixes in Nutrition

kilo- (k) = one thousand (1000)		
$ extbf{deci-(d)} = ext{one-tenth (0.1)}$		
centi- (c) = one-hundredth (0.01)		
milli- (m) = one-thousandth (0.001)		
micro- (μ or mc) = one-millionth (0.000001)		

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A kilogram weighs about 2.2 pounds. Comstock Images/Alamy Stock Photo

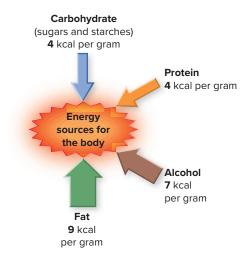


Figure 1.5 Energy sources for the body. Most forms of carbohydrate supply 4 kcal/g; protein also provides 4 kcal/g. Fat supplies 9 kcal/g, and alcohol (a nonnutrient) provides 7 kcal/q.

kilocalorie (kcal) or **Calorie** heat energy needed to raise the temperature of 1 liter of water 1° Celsius; measure of food energy

macronutrients nutrients needed in gram amounts daily and that provide energy; carbohydrates, proteins, and fats

micronutrients vitamins and minerals

There are approximately 2.54 centimeters (cm) per inch. To obtain your approximate height in centimeters, multiply your height in inches by 2.54. For example, a person who is 5'5" in height (65") measures about 165 cm (65 \times 2.54) in length. There are approximately 28 g in an ounce and 454 g in a pound. A kilogram (kilo = 1000) equals 1000 g or about 2.2 pounds. To determine your weight in kilograms (kg), divide your weight in pounds by 2.2. A person who weighs 130 pounds, for example, weighs about 59 kg.

Assume that a small raisin weighs 1 gram. If you cut this raisin into 1000 equal pieces, then each piece weighs 1 milligram (milli=1000). Thus, 1000 milligrams (mg) equal 1 gram (g). Imagine cutting a small raisin into 1 million equal pieces. Each piece of raisin would weigh 1-millionth of a gram, or a microgram (μ g or mcg). Amounts of nutrients in blood are often reported as the number of milligrams or micrograms of the substance per deciliter of blood. For example, a normal blood glucose level for a healthy fasting person is 90 milligrams/deciliter (90 mg/dl).

What Is a Calorie?

Running, sitting, studying—your body uses energy even while sleeping. Every cell in your body needs energy to carry out its various activities. As long as you are alive, you are constantly using energy. A calorie is the heat energy necessary to raise the temperature of 1 g (1 ml) of water 1° Celsius (C). A calorie is such a small unit of measurement, the amount of energy in food is reported in 1000—calorie units called kilocalories or Calories. Thus, a **kilocalorie (kcal)** or **Calorie** is the heat energy needed to raise the temperature of 1000 g (a liter) of water 1° Celsius (C). A small apple, for example, supplies 40,000 calories or 40 kcal or 40 Calories. If no number of kilocalories is specified, it is appropriate to use "calories." In this textbook, the term *calories* is interchangeable with *food energy* or simply *energy*.

A gram of carbohydrate (sugars and starches) and a gram of protein each supplies about 4 kcal; a gram of fat provides about 9 kcal (Fig. 1.5). Although alcohol is not a nutrient, it does provide energy; a gram of pure alcohol furnishes 7 kcal. If you know how many grams of carbohydrate, protein, fat, and/or alcohol are in a food, you can estimate the number of kilocalories it provides. For example, if a serving of food contains 15 g of carbohydrate, 3 g of protein, and 7 g of fat, multiply 15 g by 4 (the number of kcal each gram of carbohydrate supplies). Next, multiply 3 g by 4 (the number of kcal each gram of protein provides). Then multiply 7 g by 9 (the number of kcal each gram of fat supplies). By adding the three caloric values (60 kcal from carbohydrate, 12 kcal from protein, and 63 kcal from fat), you will determine that this food provides 135 kcal/serving.

Macronutrients and Micronutrients

Carbohydrates, fats, and proteins are referred to as **macronutrients** because the body needs relatively large amounts (grams) of these nutrients daily. Vitamins and minerals are **micronutrients** because the body needs very small amounts (milligrams or micrograms) of them to function properly. In general, a serving of food supplies grams of carbohydrate, fat, and protein, and milligram or microgram quantities of vitamins and minerals. It is important to understand that macronutrients supply energy for cells, whereas micronutrients do not. Although the body requires large amounts of water, this nutrient provides no energy and is not usually classified as a macronutrient.

Amounts of nutrients present in different foods vary widely, and even the same food from the same source can contain different amounts of nutrients. Therefore, food composition tables and nutrient analysis software generally indicate average amounts of nutrients in foods. By using these tools, however, you can obtain approximate values for each nutrient measured and estimate your nutrient intake.



Concept CHECKPOINT

- 10. Scientists generally use which metric values to report volume, weight, and length?
- 11. A person weighs 198 pounds. How many kilograms does this person weigh?
- **12.** A slice of sunflower seed bread supplies approximately 10 g of wheat starch, 1 g of sugar, 3 g of fat, 3 g of protein, and 10 g of water. Based on this information, estimate the number of kilocalories this food provides.
- **13.** Which nutrients are classified as macronutrients? Which are classified as micronutrients? See Appendix F for responses.



Slice of sunflower seed bread ©Wendy Schiff

1.4 Key Nutrition Concepts

Learning Outcomes

- 1 Give examples of foods that contain a lot of empty calories and foods that are energydense and/or nutrient-dense.
- 2 Discuss key basic nutrition concepts, such as the importance of eating a variety of foods and why food is the best source of nutrients.

Before learning about the nutrients and their roles in health, it is important to grasp some key basic nutrition concepts (Table 1.6). The content in the chapters that follow will build upon these key concepts and can help you make more informed choices concerning your dietary practices.

Concept 1: Most Naturally Occurring Foods Are Mixtures of Nutrients

Which foods do you think of when you hear the words protein or carbohydrate? You probably identify meat, milk, and eggs as sources of protein; and potatoes, corn, and rice as sources of carbohydrate. Most naturally occurring foods, how—ever, are mixtures of nutrients. In many instances, water is the major nutrient in foods. For example, 8 fluid ounces of fat—free milk is 99% water by weight, but it is an excellent source of protein and supplies carbohydrate and several vitamins and minerals. A 6—ounce raw white potato is 79% water and only about 18% carbohydrate by weight. The potato also supplies iron and potassium (minerals) and vitamins C and niacin.

Most commercially processed foods are also mixtures of nutrients. Sweet snacks, for example, are sources of nutrients other than sugar, a carbohydrate. Although sugar comprises about 44% of the weight of a chocolate with almonds candy bar, over one—third of the sweet snack's energy is from fat. The candy bar also contains small amounts of protein, iron, calcium, vitamin A, and the B—vitamin riboflavin. Figure 1.6 compares the energy, water, protein, carbohydrate, fat, and calcium contents of a 6—ounce baked potato, a slice of whole—wheat bread, 8 fluid ounces of fat—free milk, and a chocolate—frosted, cake—type doughnut (3.5—inch diameter). You can find information about the energy and nutrient contents of foods by searching the "What's in the Foods You Eat Search Tool" that is avail—able at the U.S. Department of Agriculture's website: www.usda.gov.

Concept 2: Variety Can Help Ensure the Nutritional Adequacy of a Diet

No natural food is "perfect" in that it contains all nutrients in amounts that are needed by the body. To help ensure the nutritional adequacy of your diet, choose a

TABLE 1.6 Key Basic Nutrition Concepts

- Most naturally occurring foods are mixtures of nutrients.
- Variety can help ensure the nutritional adequacy of a diet.
- There are no "good" or "bad" foods.
- Enjoy eating all foods in moderation.
- For each nutrient, there is a range of safe intake.
- Food is the best source of nutrients and phytochemicals.
- There is no "one size fits all" approach to planning a nutritionally adequate diet.
- Foods and the nutrients they contain are not cure-alls.
- Malnutrition includes undernutrition as well as overnutrition.
- Nutrition is a dynamic science.





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14 Chapter 1 The Basics of Nutrition

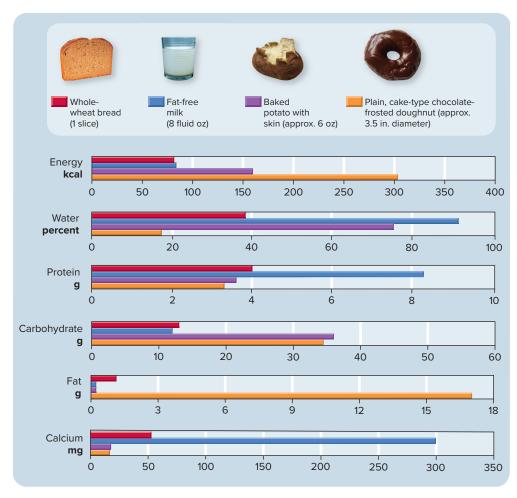


Figure 1.6 Energy and nutrient comparison. Most foods are mixtures of nutrients. A serving of whole-wheat bread, fat-free milk, baked potato, and a plain, cake-type, chocolate-frosted doughnut contribute very different amounts of energy, water, protein, carbohydrate, fat, and calcium to diets.

Bread: ©Ed Carey/Cole Group/Getty Images RF; Milk, potato: Christopher Kerrigan/McGraw-Hill Education;
Doughnut: ©Wendy Schiff

diet that contains a variety of foods from each food group that is shown in MyPlate (Fig. 1.7). Chapter 3 (Planning Nutritious Diets) provides information about the food groups and practical menu planning tools, such as MyPlate.

Concept 3: There Are No "Good" or "Bad" Foods

Are some foods "good" and others "bad" for your body? If you think there are such foods, which ones are good and which are bad? Do you sometimes feel guilty about eating "junk foods"? What is a junk food? Should pizza, chips, candy, doughnuts, and ice cream be classified as junk food?

All foods have nutritional value. For example, many people think pumpkin pie is a junk food. Pumpkin pie, however, is a good source of protein, the mineral iron, and the phytochemical beta—carotene that the body can convert to vitamin A. Although pies, doughnuts, and ice cream contain a lot of fat and added sugar, these foods may also supply small amounts of protein, vitamins, and minerals to diets. Healthy diets, however, generally contain limited amounts of such foods.

A food is bad for you if it contains toxic substances or is contaminated with bacteria, viruses, or microscopic animals that cause food—borne illness. Chapter 12 (Food Safety Concerns) focuses on food safety concerns, including major types of food—borne illnesses and ways to prevent them.

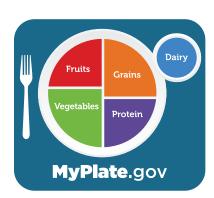


Figure 1.7 MyPlate.U.S. Department of Agriculture



Because pumpkin pie is made with eggs and milk, this holiday favorite is a good source of protein. ©Wendy Schiff



Empty Calories

Some foods and beverages, such as bacon, candy, pastries, snack chips, and sugar—sweetened drinks, provide much of their energy from unhealthy solid fats and added sugars (sometimes called "SoFAS"). Such items are described as sources of "**empty calories.**" Alcohol—containing drinks may also be considered a source of empty calories. Eating too many foods and beverages that are high in empty calories may displace more nutritious foods from the diet. Furthermore, consuming more calories than needed can result in unwanted weight gain. Therefore, people should limit their intake of foods and beverages that contain a lot of empty calories.

Nutrient Density

Certain foods are more nutritious than others. According to some nutrition experts, a **nutrient—dense** food supplies more key beneficial nutrients, such as potassium and calcium, in relation to its total calories per serving (Table 1.7). Furthermore, a nutrient—dense food has little or no solid fats, added sugars, refined starches, and sodium. Broccoli, leafy greens, fat—free milk, orange juice, lean meats, and whole—grain cereals are examples of nutrient—dense foods. Figure 1.8 compares the nutritional values of 8—fluid—ounce servings of fat—free milk (with no added nutrients) and a sugar—sweetened, cola—type soft drink. Note that milk naturally has carbohydrate but no added sugars. The milk also supplies water, protein, and certain vitamins and minerals. Although the soft drink supplies water and carbohydrate (primarily added sugars), the beverage is a poor source of protein and micronutrients. A nutritious diet contains a variety of nutrient—dense foods.

Energy Density

Energy density describes the energy value of a food in relation to the food's weight. For example, a plain, cake—type, chocolate—frosted doughnut that weighs 3 ounces provides about 400 kcal. Seven medium strawberries also weigh about 3 ounces, but they provide only 28 kcal. A person would have to eat 100 of the strawberries to obtain the same amount of food energy that is in the doughnut (Fig. 1.9). Therefore, the doughnut is an energy—dense food in comparison to the berries. In general, high—fat foods such as doughnuts are energy dense because they are concentrated sources of energy. Most fruits are not energy dense because they contain far more water than fat.

Not all energy—dense foods are high in empty calories. Nuts, for example, are high in healthy kinds of fat and, therefore, energy dense. However, nuts are also nutrient dense because they contribute protein, vitamins, minerals, and fiber to diets. Most forms of fiber are classified as carbohydrates.



3-ounce chocolate cake-type doughnut with chocolate frosting



100 medium strawberries

Figure 1.9 Energy density. A person would need to eat 100 medium strawberries to obtain the same amount of energy as in this chocolate doughnut.

Doughnut, strawberries: ©Wendy Schiff

TABLE 1.7 Nutrient Density: Key Beneficial Nutrients

Protein Fiber Vitamins: A, C, and E Minerals: Calcium, iron, potassium, and magnesium

Source: Drewnowski A, Fulgoni VL (III): Nutrient density: Principles and evaluation tools. *American Journal of Clinical Nutrition* 99(suppl):1223S, 2014.



8 fluid ounces Fat-free milk, not fortified



8 fluid ounces Sugar-sweetened soft drink

Figure 1.8 Comparing nutrient densities. Although the milk and soft drink have similar water contents, milk is a much better source of protein and certain micronutrients.

©Wendy Schiff

empty calories energy supplied by unhealthy solid fats, added sugars, and/or alcohol

nutrient dense describes a food or beverage that contains more key beneficial nutrients in relation to its total calories

energy density energy value of a food in relation to the food's weight







When a diet meets nutritional needs, including some items that contain a lot of empty calories such as these brownies adds enjoyment when such foods are consumed in moderation.

Michael Lamotte/Cole Group/Getty Images

Concept 4: Enjoy Eating All Foods in Moderation

Dietary **moderation** involves obtaining enough nutrients from food to meet one's needs and balancing calorie intake with calorie expenditure, primarily by physical activity. This can be accomplished by choosing nutrient—dense foods, limiting serving sizes of energy—dense foods, and incorporating moderate— to vigorous—intensity physical activities into your daily routine. Although moderation requires planning meals and setting aside time for physical activity daily, it can help you achieve your health and fitness goals. If, for example, you overeat during a meal or snack, you can regain dietary moderation and balance by eat—ing less energy—dense food and exercising more intensely during the next 24 hours.

Eliminating all sources of empty calories from your diet is not generally recommended or necessary. If your diet is comprised primarily of nutrient—dense foods and meets your nutritional needs, including some items that supply empty calories adds enjoyment to living when they are consumed in mod—eration. Physically active individuals, such as athletes in training programs, often find it difficult to consume enough energy from nutrient—dense foods to sustain healthy body weights, unless they include some foods that are sources of empty calories in their diets.

Concept 5: For Each Nutrient, There Is a Range of Safe Intake

By eating a variety of nutrient—dense foods, you are likely to obtain adequate and safe amounts of each nutrient. The **physiological dose** of a nutrient is the amount that is within the range of safe intake and enables the body to func—tion optimally. Consuming less than the physiological dose can result in mar—ginal nutritional status. In other words, the person's body has just enough of the nutrient to function adequately, but that amount is not sufficient to overcome the added stress of infection or injury. If a person's nutrient intake falls below the marginal level, the individual is at risk of developing the nutrient's deficiency disease. For example, recommended daily intakes of the B—vitamin niacin are 16 mg for men and 14 mg for women. People whose diets contain little or no niacin are at risk of developing *pellagra*, the vitamin's deficiency disease.

Most people require physiological amounts of micronutrients. A **megadose** is an amount of a vitamin or mineral that greatly exceeds the recommended amount of the nutrient. When taken in high amounts, many vitamins act like drugs and can produce unpleasant and even toxic side effects. For example, physicians sometimes use megadoses of the B—vitamin niacin to treat high blood cholesterol levels, but such amounts may cause painful facial flushing and liver damage. Minerals have very narrow ranges of safe intakes.

Many consumers take megadoses of vitamin and/or mineral supplements without consulting physicians because they think the micronutrients will prevent or treat ailments such as the common cold or heart disease. For most people, consuming amounts of nutrients that exceed what is necessary for good health is economically wasteful and could be harmful to the body. "More is not always better," when it relates to optimal nutrition.

In their natural states, most commonly eaten foods do not contain toxic levels of vitamins and minerals. You probably do not need to worry about consuming toxic levels of micronutrients, unless you are regularly eating large amounts of foods that are fortified with these nutrients. The diagram shown in Figure 1.10 illustrates the general concept of deficient, safe, and toxic intake ranges for nutrients such as vitamins and minerals. Chapters 8 and 9 provide more information about micronutrients, including deficiencies and toxicities.

moderation obtaining adequate amounts of nutrients while balancing calorie intake with calorie expenditure

physiological dose amount of a nutrient that is within the range of safe intake and enables the body to function optimally

megadose amount of a vitamin or mineral that greatly exceeds the recommended amount



Concept 6: Food Is the Best Source of Nutrients and Phytochemicals

The most natural, reliable, and economical way to obtain nutrients and beneficial phytochemicals is to base your diet on a variety of "whole" and minimally processed foods. Plant foods naturally contain a variety of nutrients and phytochemicals, but processing the foods often removes some of the most healthful parts. For example, a wheat kernel is stripped of its germ and outer layer (bran) during refinement into white flour (Fig. 1.11). Wheat germ is a good source of thiamin, vitamin E, iron, phosphorus, magnesium, zinc, fiber, and healthy fats. Wheat bran contains fiber and certain phytochemicals, and it is a good source of niacin, iron, copper, zinc, and selenium. The endosperm that remains is primar—ily starch (a form of carbohydrate) with some protein and very small amounts of micronutrients and fiber. By replacing refined grain products, such as white bread, with whole—grain products, you can increase the likelihood of obtaining a wide variety of nutrients and phytochemicals.

In addition to eating food, many people take nutrient supplements in the form of pills, powders, bars, wafers, or beverages. The human body, however, is designed to obtain nutrients from foods. In some instances, nutrients from food are more available, that is, more easily digested and absorbed, than those in supplements.

It is important to understand that nutrient supplements do not contain everything one needs for optimal nutrition. For example, they do not contain the wide variety of phytochemicals found in plant foods. Although dietary supplements that contain phytochemicals are available, they may not provide the same healthful benefits as consuming the plants that contain these compounds. Why? Nutrients and phytochemicals may need to be consumed together to provide the desirable effects in the body. Food naturally contains combinations of these chemicals in very small amounts and certain proportions. There is nothing "natural" about gulping down handfuls of supplements.



Figure 1.10 Intake continuum. For each nutrient, there is a range of safe intake.









Food & Nutrition



Advertisers may use the term "superfood" to describe a dietary supplement or particular food for marketing purposes. The Food and Drug Administration (FDA), however, does not have a legal definition for this term. No dietary supplement contains every substance needed for good health. Furthermore, no naturally occurring food is perfect (a so-called superfood) in that it contains all of the nutrients required for human survival. Certain foods, however, can add more key beneficial nutrients and other healthful substances, including phytochemicals, to diets than others. Such foods include:

- · berries;
- · seafood;
- legumes (soybeans and split peas, for example);
- yogurt;
- whole-grains; and
- tree nuts.15

To improve your diet, consider eating these foods in meals or as snacks regularly.





micronutrients. People who have chronic illnesses, digestive disorders that interfere with nutrient absorption, and certain inherited disorders may require supplemental nutrients. Additionally, many older adults may need higher amounts of vitamins and other nutrients than those found in food. Because it is often difficult to plan and eat nutritious menus each day, taking a dietary supplement that contains a variety of vitamins may be advisable, especially for older adults. In general, there appears to be little danger in taking a supplement that provides 100% of recommended amounts of the micronutrients daily. 14 However, healthy adults should consider taking such supplements as a dietary "insurance policy" and not a substitute for eating a variety of nutrientdense foods.

Some individuals have increased needs for certain nutrients, particularly

Concept 7: There Is No "One Size Fits All" Approach to **Planning a Nutritionally Adequate Diet**

By using food guides presented in Chapter 3, you can individualize your diet so that it is nutritionally adequate and suits your food likes and dislikes, budget, and lifestyle. Individualizing a diet does not mean only eating foods that "match" your blood type, hair color, personality, or shoe size. If someone promotes a diet based on such personal traits, steer clear of the diet and the promoter. Consider this: Human beings would not have survived as a species for thousands of years if their diets had to be matched to physical character istics or personalities.

Physicians often prescribe special diets, sometimes referred to as medical nutrition therapies, for people with chronic health conditions such as diabetes. Even the nutritional needs of healthy people vary during different stages of their lives. Chapter 13 (Nutrition for a Lifetime) provides information about the importance of diet during pregnancy, childhood, and other stages of the life cycle.



This product is a functional food because it was manufactured with oils that may reduce the risk of heart disease ©Wendy Schiff

Concept 8: Foods and the Nutrients They Contain Are Not Cure-Alls

Although specific nutrient deficiency diseases, such as scurvy, can be cured by eating foods that contain the nutrient that is missing or in short supply, nutrients do not "cure" other ailments. Diet is only one aspect of a person that influences his or her health. By making certain dietary changes, however, a person may be able to prevent or forestall the development of certain diseases, or possibly lessen their severity if they occur.

Although there is no legal definition for "functional foods," such products may have health benefits beyond simply helping to meet basic nutritional needs. 16 Functional foods are often manufactured to boost nutrient intakes, reduce the risk of disease, or help manage specific health problems. For example, consumers who want to increase their calcium intake can purchase orange juice that has the mineral added to it. Beverages that are formulated to contain a variety of nutrients may be a convenient way to supplement a person's diet. Certain peanut butter substitutes contain oils that may lower the risk of heart disease. Although some functional foods can help Americans improve their health, such products should not replace whole and minimally processed foods and beverages from healthy people's diets.



Concept 9: Malnutrition Includes *Under*nutrition as Well as *Over*nutrition

Malnutrition is a state of health that occurs when the body is improperly nour—ished. Everyone must consume food and water to stay alive, yet despite the abundance and variety of nutritious foods, many Americans consume nutri—tionally poor diets and suffer from malnutrition as a result. Some people select nutritionally inadequate diets because they lack knowledge about nutritious foods or the importance of nutrition to health. Low—income people, however, are at risk for malnutrition because they have limited financial resources for making wise food purchases. Other people who are at risk of malnutrition include those who are addicted to drugs such as alcohol, are hospitalized or in long—term care facilities, or have chronic medical conditions that reduce the body's ability to absorb or use nutrients (Fig. 1.12). This chapter's "Nutrition Matters" section discusses the international problem of undernutrition.

Although many people associate malnutrition with undernutrition and starvation, overnutrition, the long—term excess of energy or nutrient intake, is also a form of malnutrition. Overnutrition is often characterized by obesity (having an excessive and unhealthy amount of body fat). People who are obese may also be undernourished if they consume diets that lack adequate amounts of essen—tial nutrients, especially micronutrients. Taking megadoses of micronutrients can also cause overnutrition, especially in people who have no physiological need for the extra nutrients.

You may be surprised to learn that overnutrition is associated with more deaths throughout the world than undernutrition. Obesity is widespread in countries where most people have the financial means to buy plenty of food, have an ample supply of energy—dense foods, and obtain little exercise. Chapter 10 provides information about obesity.

Concept 10: Nutrition Is a Dynamic Science

As researchers continue to explore the complex relationships between diets and health, nutrition information constantly evolves. As a result, dietary practices and recommendations undergo revision as new scientific evidence becomes avail—able and is reviewed and accepted by nutrition experts. Unfortunately such changes can be confusing to the general public, who expect medical researchers to provide definite answers to their nutrition—related questions and rigid advice concerning optimal dietary practices.

Even nutrition educators find it difficult to keep up with the vast number of research articles published in scientific journals. Chapter 2 explains how nutrition research is conducted using scientific methods. Furthermore, Chapter 2 provides information to help you become a better consumer of nutrition and health information that appears in popular sources such as magazines, infomer—cials, and the Internet.

Concept CHECKPOINT

- **14.** Identify at least five of the key nutrition-related concepts presented in this section.
- **15.** What is the difference between a food that supplies a lot of empty calories and a nutrient-dense food?
- **16.** What is the difference between a physiological dose and a megadose of a nutrient?
- 17. Explain why a person who has too much body fat could be undernourished.

See Appendix F for responses.



Figure 1.12 Malnutrition and long-term care. People who are in long-term care facilities are at risk of undernutrition.

Photodisc Collection/Getty Images

malnutrition state of health that occurs when the body is improperly nourished







1.5 Nutrition Matters: Undernutrition—A Worldwide Concern

Learning Outcomes

- 1 Discuss factors that contribute to undernutrition, and identify regions of the world where people are most likely to be undernourished.
- Describe how undernutrition during pregnancy can affect the woman's health and the health of her newborn offspring.
- 3 Discuss how undernutrition during infancy and childhood can affect the health and development of children.
- Discuss undernutrition in the United States.
- 5 Identify major federal food assistance programs in the United States and the populations served by each program.
- 6 Define biotechnology as it relates to food production.
- 7 Discuss how sustainable agriculture can improve the environment.

Over 7.7 billion people inhabit the Earth.¹⁸ An estimated 800 million of these persons are chronically undernourished.¹⁹ Chronic undernutrition is a condition that occurs when a person's long—term energy and nutrient intakes are insuf—ficient to meet his or her needs. Chronically undernourished people are underweight and often hungry.

Many factors contribute to chronic undernutrition (Fig. 1.13). Poverty, civil unrest, wars, and lack of access to nutritious food are major contributors, particularly in Africa and certain regions of South America and Asia. In Africa, the AIDS epidemic has left millions of people impoverished and living in uncertainty. Furthermore, unfavorable weather conditions and crop failures can cause regional food shortages.

According to the World Health Organization (WHO), at least 2 billion people use drinking water that may be contaminated with feces.²⁰ Such water is unsafe to drink

because it can contain bacteria and viruses that cause diarrhea and serious infectious diseases that include cholera, typhoid, dysentery, and polio. Every year, an estimated 485,000 people die as a result of developing diarrhea after consuming unclean water (Fig. 1.14).²⁰

Figure 1.14 Unsafe water source. In developing countries, lack of clean cooking and drinking water contributes to the spread of potentially deadly infectious diseases. Stockbyte/Getty Images

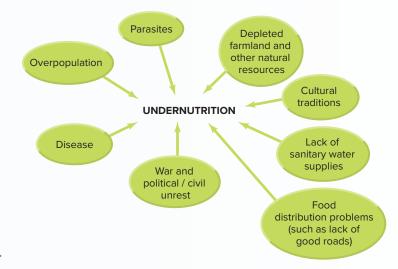


Figure 1.13 Factors that contribute to chronic undernutrition. Many factors, including war, disease, and overpopulation, contribute to undernutrition in developing countries.

Undernutrition During Periods of Growth

When undernutrition occurs during periods of rapid growth, such as pregnancy, infancy, and childhood, the long—term effects can be devastating. In 2018, an estimated 149 million children who were under 5 years of age were stunted.²¹ The height of a child with stunting is much lower than nor—mal when compared to children who are the same age but adequately nourished. Additionally, an estimated 49 mil—lion children in this age group were severely underweight (wasted). There are no clear estimates of how many young children suffer from both stunting and wasting.²¹ Through—out the world, undernutrition contributes to 45% of deaths of children under 5 years of age.²²

Undernutrition During Pregnancy

Women who are undernourished during pregnancy (maternal undernutrition) are more likely to experience difficult labor, have excessive bleeding after delivering their infants, and die as a result of pregnancy.²³ Maternal undernutrition can also result in the birth of premature babies (infants born too early in pregnancy) and



low-birth-weight (LBW) newborns. These babies often suffer from serious health problems that increase their risk of dying during their first year of life. Each year, an estimated 20 million LBW infants are born in the world.²⁴ The vast majority of LBW babies are born in developing countries. Chapter 13 provides more information about the importance of adequate nutrition during pregnancy.

Undernutrition During Infancy

As explained in Chapter 13, breast milk is the best food for infants because it is sanitary and nutritionally adequate, and provides babies with immunity to some infectious diseases. Globally, only 41% of babies consume only breast—milk during their first 6 months of life. The Undernourished mothers who breastfeed their babies may produce less breast milk than breastfeeding women who are properly nourished. Furthermore, the milk of poorly nourished breastfeeding mothers may contain amounts of vitamin A, B vitamins, and essential fatty acids that are too low to meet the nutritional needs of their infants. ²³

Although infant formulas are nutritious substitutes for breast milk, they do not provide immunity to diseases, and they are generally expensive. To increase the volume of infant formula that they can afford to give their children, poor parents in developing countries often add excessive amounts of water. This practice dilutes the nutritional value of the formula and increases the likelihood of contaminating it with disease—causing microbes. Infants who drink formula that has been mixed with unsanitary water can develop diarrhea that causes loss of body water (dehydration) and death.

Ideally, babies should be exclusively breastfed for their first 6 months and then consume breast milk in addition to solid foods well into their second year. According to the WHO, at least 820,000 children under the age of 5 years die each year because they did not consume adequate amounts of breast milk during their first 2 years of life.²⁵

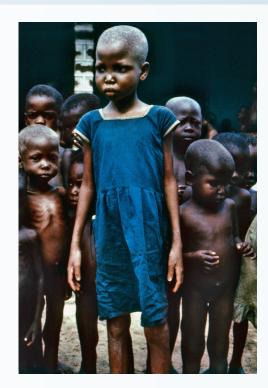
Undernutrition During the Preschool Years

In undernourished preschool children, nutrient deficiencies are responsible for delayed physical growth and development, blindness, impaired intellectual development, wasting, and premature death. Many chronically undernourished young children are stunted. Such children may not achieve their full potential height by the time they reach maturity (Fig. 1.15).

The body needs vitamin A for proper vision, growth, and immune system function, especially protection against infectious diseases. In developing countries, vitamin A deficiency causes as many as 500,000 cases of blindness among young children annually.²⁶ Half of these children die from infectious diseases within a year of becoming blind.

In the United States and other developed countries, children are usually well nourished and vaccinated against

Figure 1.15 Chronic undernutrition. This photograph shows a group of young children who have signs of stunted growth and wasting. The children are outside a Nigerian orphanage during the late 1960s. Source: Centers for Disease Control and Prevention/Dr. Lyle Conrad



common childhood diseases, such as measles. In poorer nations, however, many children are malnourished and not protected against infectious agents, including the virus that causes measles. Measles can be a life—threatening illness in undernourished children because their immune systems do not function normally.

Undernutrition in the United States

Undernutrition also occurs in wealthy, developed nations such as the United States. In some instances, undernutrition is not due to poverty in these countries. For example, people suffering from anorexia nervosa (an eating disorder) and chronic alcoholism are undernourished despite often having enough money to purchase food. Nevertheless, Americans with low incomes have a higher risk of malnutrition than members of the population who are in higher income categories. In 2019, 10.5% of the population were living at or below the U.S. Department of Health and Human Services poverty guideline.²⁷ In 2020, the poverty guideline was \$26,200 for a family of four.²⁸

Most American households are *food secure*, which means the people in those households have access to and can purchase sufficient food to lead healthy, active lives. In 2019, **food insecurity** was reported in an estimated 10.5% of all households in the United States.²⁹ Food insecurity

food insecurity situation in which individuals or families are concerned about running out of food or not having enough money to buy more food

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describes individuals or families who are concerned about running out of food or not having enough money to buy more food. People who are unemployed, work in low—paying jobs, have excessive medical and housing expenses, or are home—less often experience food insecurity. Food insecurity may also affect older adult Americans who live on fixed incomes, especially if they are forced to choose between purchasing nutritious food and buying life—extending medications.

Charities and churches in many cities operate food pantries and "soup kitchens" to feed food—insecure people (Fig. 1.16). In addition to the help provided by the private sector, low—income individuals can obtain food aid from federal food assistance programs. Table 1.8 summarizes information about some of the major federally subsidized food programs in the United States. Although not every eligible food—insecure adult has access to or takes advan—tage of the aid, federal food assistance programs can protect most American children from hunger and undernutri—tion. For more information about the federal government's various food assistance—programs, visit www.nutrition.gov/subject/food—assistance—programs.

World Food Crisis: Finding Solutions

Reducing hunger through food aid programs is a major goal of the United Nations. The World Food Program (WFP) and United Nations Children's Fund (UNICEF) are agencies within the United Nations that provide nutrient—dense food for undernourished populations. UNICEF also supports the



Figure 1.16 Feeding the hungry. In many cities, charities and churches operate food pantries and "soup kitchens" to feed food-insecure people. Image Source/Getty Images

development and distribution of ready—to—use therapeutic food (RUTF) to treat severe undernutrition among young children in developing countries. Plumpy'Nut, for example, is an energy— and nutrient—dense paste made from a mixture of peanuts, powdered milk, oil, sugar, vitamins, and miner—als. During processing, the paste is placed in foil packets to keep the food clean and make it easy to transport to remote places without refrigeration. In 2019, UNICEF acquired over 49,000 tons of RUTFs to feed starving children in developing nations.³⁰

TABLE 1.8 Some Major Federally Subsidized Food Programs in the United States

Program	General Eligibility Requirements	Description
Supplemental Nutrition Assistance Program (SNAP)	Low-income individuals and families	Participants use an electronic benefit transfer (debit) card to purchase allowable food items.
Commodity Distribution Program	Certain low-income groups, including pregnant women, preschool-age children, and the elderly	In some states, state agencies distribute U.S. Department of Agriculture (USDA) surplus foods to eligible people.
Women, Infants, and Children (WIC)	Low-income pregnant or breastfeeding women, new mothers who are not breast- feeding, infants, and children under 5 years of age who are at nutritional risk	Participants receive checks or vouchers to purchase a variety of nutritious foods, such as milk, cheese, fruits and vegetables, certain cereals, and infant formula, at grocery stores. Nutrition education and support for breastfeeding mothers are also provided.
Child Nutrition Programs School Breakfast Program, National School Lunch Program, Summer Food Service Program, Child and Adult Care Food Program, Special Milk Program	Low-income children of school age Low-income adults (Child and Adult Care Food Program)	Certain schools and child-care facilities receive subsidies from the government to provide free or reduced-price nutritionally balanced meals and snacks.
Nutrition Program	Age 60 or older (no income guidelines)	Provides grants for sites to provide nutritious congregate and home-delivered meals
Food Distribution Program on Indian Reservations	Low-income American Indian or non-Indian households on reservations; members of federally recognized Native American tribes	Distribution of monthly food packages. This program is an alternative to SNAP and provides grants for a nutrition education component.



The Promise of Biotechnology

Biotechnology involves the use of living things—plants, animals, microbes—to manufacture new products. Bio—technology in agriculture has led to the development of crops that have more beneficial characteristics than conventional crops. Biotechnology offers a variety of ways to help alleviate the world food crisis.

Bioengineering techniques involve scientific methods that change an animal or plant's hereditary mate—rial (genes or DNA). For example, genes that produce a desirable trait, such as disease resistance, are transferred from one organism into the DNA of a second organism, favorably altering its genes.

Cotton, corn, and soybeans are the most common bioengineered (BE) crops grown in the United States.³¹ These crops may have been genetically altered to improve their flavor, resist pests, increase yields, and improve their immunity to plant diseases. Bioengineering of food crops can also provide the opportunity to enhance the plants' nutritional qualities. The ability to grow more nutrient—rich crops is very important in parts of the world where people's diets lack critical nutrients, such as vitamin A and protein.

Bioengineering has also been used to improve ani—mals that are eaten by humans. In 2019, the U.S. Food and Drug Administration (FDA) approved the sale of foods made with AquAdvantage Salmon, a bioengineered form of Atlantic salmon. Additionally, the eggs of the salmon can be imported into the United States and raised in FDA—approved facilities. AquAdvantage Salmon grow faster than their non—bioengineered counterparts (Atlantic salmon).³²

In the United States, the National Bioengineered Food Disclosure Law requires a national standard for identifying foods that are bioengineered. The U.S. Department of Agriculture (USDA) released the standard in 2018.³³ According to the standard, a **bioengineered food** (BE food) contains genetic material that has been modified by certain scientific



Some bioengineered barley contains a gene that may help the plants avoid being infected by a particular virus.

Photo by Scott Bauer/USDA



Figure 1.17 Approved label icon for BE foods. Source: U.S. Department of Agriculture (USDA)

methods. Furthermore, a BE food is not found in nature or is not the result of conventional breeding techniques. A BE food may be commonly referred to as a $genetically\ modified\ organism\ (GMO)$ or having ingredients from GMOs. The USDA, however, does not recognize the term "genetically modified organism" for labeling purposes.

By 2022, food manufacturers must use an approved method to identify a BE food or a food that contains BE ingredients. One such method is having the package logo shown in Figure 1.17. For a list of BE foods, visit the USDA's Agricultural Marketing Service website (www.ams.usda.gov) and search for "list of bioengineered foods."

The FDA regulates the safety of bioengineered foods. According to a report published by the National Academy of Sciences in 2016, there is no scientific evidence that indicates genetically modified crops are unsafe for humans to consume or harmful to the environment.³⁴

Feeding the World, Protecting Natural Resources

Our current system of food production relies primarily on conventional agricultural methods. In general, conventional farming requires considerable amounts of water and pesticides that can harm the environment. Irrigation systems often remove fresh water from rivers and other natural sources at a faster rate than it is restored. This activity reduces water flow to many communities. The water that runs off conventional farms can carry with it precious topsoil and potentially harm—ful pesticides that pollute waterways. Such farming methods also release greenhouse gases, especially carbon dioxide and methane, which contribute to global warming. Furthermore, the need for new farmland often requires cutting down trees so that forests can be converted to croplands. The loss of forests eliminates native animal and plant habitats. About 40%

biotechnology using living things to manufacture new products **bioengineering** scientific techniques that alter an organism's hereditary material

bioengineered food food that contains genetic material that has been modified by certain scientific methods





of the Earth's land (excluding Greenland and Antarctica) is used for food production; very little suitable land remains to be farmed.³⁵ What can be done to feed the world's population without destroying the Earth's natural resources?

What Is Sustainable Agriculture? Sustainable agriculture involves farming methods that meet the demand for more food without depleting natural resources and harming the environment. The challenge is finding ways for farmers and ranchers to make the conversion from primarily conventional farming techniques to sustainable agriculture. Farming needs to be profitable for farmers and ranchers, so any switch from conventional to sustainable agricultural methods must not reduce their profit margins.

To solve the problems created by conventional agricultural methods, an international team developed the following points for establishing a universal policy:³⁵

- Stop expanding agricultural activity, especially into tropical forests and grasslands.
- Find ways to improve crop yields on existing farms. Biotechnology in agriculture has led to the development of crops that supply higher yields, resist pests, or are tolerant of drought conditions. By increasing food production or modifying the nutritional content of foods, biotechnologi—cal advances can help reduce the number of undernour—ished people in the world.
- Rely more on nonchemical methods of pest management (see Chapter 12).
- Eat less meat. Sixty percent of the world's crops (primarily grains) are grown for human consumption. Most of the remaining crops are used to feed cattle and other farm animals. It takes about 30 pounds of grains to produce 1 pound of hamburger. By reducing the consumption of meat, especially beef, more grains could be produced to feed people. Raising grass—fed beef also spares grains for human consumption because grass is not eaten by people.
- Reduce food waste—about 30% of food is wasted. In many instances, the food spoils before it is eaten or it is thrown out as garbage. Smaller portion sizes and better menu planning can reduce the amount of food that people waste each day.
- Find ways to use natural resources and pesticides more efficiently. Use irrigation systems, such as drip irrigation, that apply water directly to a plant's base instead of spraying it into the air, where much of the water evaporates.

Taking Action

Poverty and hunger have always plagued humankind; the causes of poverty and hunger are complex and, therefore, difficult to eliminate. Nevertheless, certain social, political, economic, and agricultural changes can reduce the number of people who are chronically hungry. In the short run, wealthy countries can provide food aid to keep impoverished people from starving to death. Families and small farmers in underdeveloped nations need to learn new and more efficient



This row of young citrus trees is obtaining water via a drip irrigation system. Drip irrigation helps conserve water because it delivers small amounts of water close to the trees' roots over a long period and reduces the amount of irrigation water that is lost by evaporation.

Source: Photo by Tim McCabe, USDA Natural Resources Conservation Service

methods of growing, processing, preserving, and distributing nutritious regionally produced foods. Additionally, govern—ments can support programs that encourage breastfeeding and fortify locally grown or commonly consumed foods with vitamins and minerals that are often deficient in local diets.

In the long run, population control is critical for preserving the Earth's resources for future generations. Impoverished parents in poor countries often have many children because they expect only a few to survive to adulthood. When people are financially secure, adequately nourished, and well educated, they tend to have fewer, healthier children. Thus, long—term ways to slow population growth include providing well—paying jobs, improving public education, and increasing access to health care services.

sustainable agriculture farming methods that do not deplete natural resources or harm the environment while meeting the demand for food

Concept CHECKPOINT

- **18.** How do unfavorable environmental and political factors in developing countries affect the health status of people living in those nations?
- **19.** What effects can undernutrition have on the health of pregnant women and young children?
- 20. What is the "WIC program"?
- **21.** Explain the difference between conventional and sustainable agricultural methods.
- 22. What is a bioengineered food?

See Appendix F for responses.





See Appendix G.



1.1 Nutrition: The Basics

- Lifestyle choices, including poor eating habits and lack of physical activity, contribute to the development of many of the leading causes of premature deaths for American adults, including heart disease, cancer, stroke, and diabetes. However, you may be able to extend your years of healthy life and improve your quality of life by applying what you learn about nutrition and the role that a nutritious diet plays in achieving and maintaining good health.
- There are six classes of nutrients: carbohydrates, lipids, proteins, vitamins, minerals, and water. The body needs certain nutrients for energy, growth and development, and regulation of processes, including the repair and maintenance of cells. The human body can synthesize many nutrients, but about 50 nutrients are dietary essentials that must be supplied by food.
- Nonnutrients, which include phytochemicals, are substances in food that may have healthful benefits. Many phytochemicals are antioxidants that protect cells from being damaged or destroyed by exposure to certain environmental factors. However, some phytochemicals are toxic. The Dietary Supplement Health and Education Act of 1994 (DSHEA) allows manufacturers to classify herbal products and nutrient supplements as dietary supplements.

1.2 Factors That Influence Americans' Health

Heart disease is the leading cause of death for all Americans. Chronic diseases, such
as heart disease, are complex conditions that have multiple risk factors. A risk factor is a
personal characteristic that increases a person's chances of developing diseases. In many
instances, people can live longer and healthier by modifying their diets, increasing their
physical activity, and altering other aspects of their lifestyles. Objectives to improve the
status of Americans' health, including nutrition—related programs, are an important focus
of Healthy People.









1.3 Metrics for Nutrition

- Scientists generally use metric values when measuring volume, weight, and length. The
 metric prefixes micro-, milli-, deci-, centi-, and kilo- indicate whether a measurement is a
 fraction or a multiple of a meter, gram, or liter. Approximately 28 grams are in an ounce
 and 454 grams are in a pound; a kilogram equals 1000 grams or about 2.2 pounds. Each
 gram equals 1000 milligrams or 1 million micrograms.
- Every cell needs energy. A Calorie is the heat energy needed to raise the temperature of 1 liter of water 1° Celsius (C). Calories or kilocalories (kcal) are used to indicate the energy value in food. If no number of kilocalories is specified, it is appropriate to use "calories." A gram of carbohydrate and a gram of protein each supplies about 4 kcal; a gram of fat provides about 9 kcal. Although alcohol is not a nutrient, a gram of pure alcohol furnishes 7 kcal.
- Carbohydrates, fats, and proteins are referred to as macronutrients because the body needs relatively large amounts of these nutrients daily. Vitamins and minerals are micronutrients because the body needs very small amounts. Although the body requires large amounts of water, this nutrient provides no energy and is not usually classified as a macronutrient.

1.4 Key Nutrition Concepts

• There are several key points to understanding nutrition. Most naturally occurring foods are mixtures of nutrients, but no food contains all the nutrients needed for optimal health. Thus, nutritionally adequate diets include a variety of foods from all food groups. Instead of classifying foods as "good" or "bad," people can focus on eating all foods in moderation and limiting empty calories. For each nutrient, there is a range of safe intake. Healthy people should rely on eating a variety of whole and minimally processed foods to meet their nutrient needs instead of taking dietary supplements. Foods and the nutrients they contain are not cure-alls. There is no "one size fits all" approach to planning a nutritionally adequate diet. Malnutrition includes overnutrition, as well as undernutrition. Finally, nutrition is a dynamic science; new scientific information about nutrients and their roles in health is constantly emerging. Therefore, ways the science of nutrition is applied, such as dietary recommendations, also change.

1.5 Nutrition Matters: Undernutrition—A Worldwide Concern

• Poverty and undernutrition are commonplace in many developing countries. Impoverished people must often cope with infectious diseases and polluted water supplies. In developing countries, poor sanitation practices and lack of clean cooking and drinking water contribute to diseases and deaths. When undernutrition occurs during periods of rapid growth, such as pregnancy, infancy, and childhood, the long-term effects can be devastating. In undernourished children, nutrient deficiencies are responsible for stunted physical growth, delayed physical development, blindness, impaired intellectual









development, and premature death. Chronic undernutrition depresses the body's immune functioning, increasing the risk of death from infectious diseases, such as measles, especially in childhood. The vast majority of childhood deaths associated with undernutrition occur among poor populations in developing countries, particularly in Africa and regions of South America and Asia.

Reducing hunger through food aid programs is a major goal of the United Nations.
 Biotechnological advances in agriculture have led to the development of improved food crops and animals. Conventional farming methods can cause soil loss and add pesticides to water supplies. Sustainable agriculture refers to farming methods that do not deplete natural resources or harm the environment while meeting the demand for food.

Recipe for



Healthy Living

Food Preparation Basics (Yes, You Can Cook!)

By learning how to prepare dishes, experiment with recipe ingredients, and use a variety of spices and herbs as seasonings, you can make home-cooked meals that are more tasty, more appealing, and lower in unhealthy types of fat, sugar, salt, and calories than the usual choices at fast-food restaurants. Additionally, you can save money by making your meals and snacks instead of purchasing them from restaurants and convenience stores.

At the end of each chapter, you will find the "Recipe for Healthy Living," a nutritious, easy-to-prepare recipe. Each recipe includes a list of ingredients, instructions, and some information concerning the energy and selected nutrient contents in a serving of the product. The "MyPlate" icon indicates which of the USDA's food groups are primarily represented in the recipe (see Figure 1.7). The circle graph shows approximate percentages of total calories for each macronutrient in the food. The bar graph indicates approximate percentages of Daily Values (DVs) for energy and some key nutrients. Daily Values are a set of nutrient standards used for food labeling purposes (see Chapter 3).

Even if you've had little or no cooking experience, you can learn the basics of preparing foods. Some cooks don't measure ingredients; they know from experience how to estimate amounts of foods and seasonings to add when preparing dishes. Until you feel confident with your food preparation skills, it is best to follow recipes and measure ingredients carefully.

You'll need some basic food preparation equipment to get started. You don't have to spend a lot of money, but buy well-made stainless steel (rustproof) cooking utensils and mixing bowls that will last for decades. Baking pans should also be stainless steel. A square or rectangular tempered-glass baking dish can be used for a variety of cooking needs, including heating foods in a toaster oven or microwave oven.

Understanding how to use household measurements is a good place to begin when learning how to cook. Purchase a set of

stainless steel measuring spoons that includes $\frac{1}{8}$ teaspoon (tsp), $\frac{1}{4}$ tsp, $\frac{1}{2}$ tsp, 1 tsp, and 1 tablespoon (Tbsp) measures. You'll also need a set of measuring cups that includes the following measures: $\frac{1}{4}$ cup, $\frac{1}{2}$ cup, and 1 cup. These cups are used to measure dry ingredients such as flour or sugar. Finally, purchase a two-cup glass or clear plastic measuring pitcher that is marked to indicate fluid ounces. This pitcher is used for measuring liquid ingredients such as water, milk, and oil.

To measure dry ingredients, fill the appropriate measuring cup or spoon to the top, and skim off the excess with the straight edge of a knife. To measure liquid ingredients, use a liquid measuring pitcher. Fill the pitcher to the desired amount, and place it on a level surface. Crouch down so you are at eye level with the fluid's level, and then carefully add more or remove some fluid as needed.

HOUSEHOLD UNITS

Common household units often used for measuring food ingredients and their commonly used abbreviations are listed below. Ounces (oz) are a measure of weight; *fluid* ounces are a measure of volume. Appendix A provides information about English-to-metric and metric-to-household unit conversions.

COMMON HOUSEHOLD UNITS FOR MEASURING FOOD INGREDIENTS

3 tsp = 1 Tbsp 1 cup = 8 fluid ounces (oz)

4 Tbsp = $\frac{1}{2}$ cup 1 cup = $\frac{1}{2}$ pint 5 Tbsp + 1 tsp = $\frac{1}{2}$ cup 2 cups = 1 pint

8 Tbsp = $\frac{1}{2}$ cup 4 cups or 2 pints = 1 quart

16 Tbsp = 1 cup 4 quarts = 1 gallon



