



HUMAN NUTRITION

Science for Healthy Living

Third Edition

**Mc
Graw
Hill**

Tammy J. Stephenson, PhD, FAND

University of Kentucky

Megan R. Sanctuary, MS, PhD

Northern Kentucky University

Caroline W. Passerello, MS, RDN, LDN

University of Pittsburgh



HUMAN NUTRITION: SCIENCE FOR HEALTHY LIVING, THIRD EDITION

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About the Authors



©Tammy Stephenson

Tammy J. Stephenson, PhD, FAND received her BS in food science and human nutrition and PhD in nutritional sciences from the University of Kentucky.

She has taught a wide variety

of food, nutrition, and wellness courses, including introductory nutrition, to majors and nonmajors in the Department of Dietetics and Human Nutrition at the University of Kentucky for the past 20 years. Dr. Stephenson currently serves as Chair of the Department of Dietetics and Human Nutrition. She is also an active member of the Academy of Nutrition and Dietetics, having served as chair of the Nutrition Educators of Health Professionals practice group and being recognized as a Fellow of the Academy (FAND). She has published and presented on service learning, technology in teaching, student-centered learning, and other related topics. Dr. Stephenson has a passion for teaching engaging, interesting, and relevant nutrition courses and has been recognized through multiple teaching and mentoring awards at the university, state, and national levels. At the University of Kentucky, she has been recognized with both the Alumni Association's Great Teacher Award (2016) and the Provost Office's Outstanding Teacher Award (2015). Outside of the classroom, she enjoys running, doing yoga, gardening, cooking, watching her daughters play sports, and spending time with her family.

To Brian, Bailey, Kylie Mae, and Ansley

—Tammy Stephenson

Megan R. Sanctuary, MS, PhD, received her MS in molecular and integrative physiology from the University of Illinois at Urbana-Champaign and her PhD in nutritional biology from the University of California at Davis. She has

taught a wide variety of courses, including introductory nutrition, anatomy and physiology, and general biology. Dr. Sanctuary has published and presented in many areas of research, including the interactions among diet, the immune system, and the microbiota. She has a special interest in food as medicine, precision nutrition, and the effects of early nutrition on health and disease later in life. In her free time, she enjoys spending time with her family, reading, and doing yoga.



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To Maia, Maddox, and Eric

—Megan Sanctuary



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Caroline Passerrello, MS, RDN, LDN, earned her BS degrees in psychology and clinical dietetics and her MS from the School of Health and Rehabilitation Sciences at the University of Pittsburgh. Caroline has experience running a nutrition consulting company and spent 8 years working in industry,

leading a retail dietitian program.

Caroline is a registered dietitian nutritionist and a full-time faculty member at the University of Pittsburgh in the Department of Sports Medicine and Nutrition. She teaches in the accelerated graduate-level Future Education Model; courses include Experiential Practice in the Community, Entrepreneurial Skills for Nutrition Professionals, Professional Development, Principles of Nutrition Education, and Introduction to Human Nutrition.

Caroline is active in her professional organization as a national spokesperson for the Academy of Nutrition and Dietetics. She has a specialty certificate in adult weight management and focuses her media interviews on nutrition education for consumers, healthful shopping, and children's nutrition. She is pursuing her doctor of education in health and physical activity in the School of Education at the University of Pittsburgh.

In her free time, Caroline enjoys being physically active with her family and bringing stress relief to others with her therapy pet, C.C.

To Henry, Luciana, MiMi, and Pop

—Caroline Passerrello

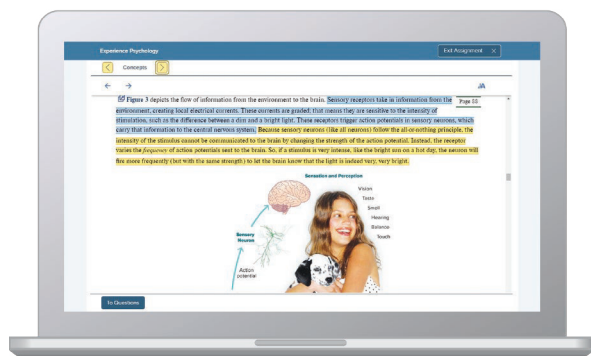
For the third edition of *Human Nutrition: Science for Healthy Living*, we welcome Megan Sanctuary and Caroline Passerrello to the authoring team! Both professors bring their areas of research expertise and professional practice to the content covered in the textbook. As well, both Dr. Sanctuary and Professor Passerrello are experienced educators who teach introductory nutrition and provide valuable insight from their own teaching with the development of the third edition of the textbook.

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- Jordan Cunningham,
Eastern Washington University



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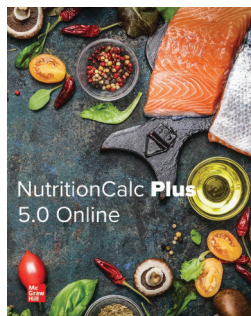
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Personalized Teaching and Learning Environment



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McGraw Hill 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, manufacturers' data, restaurant data, and data from literature sources. NutritionCalc Plus allows users to track food and activities, then analyze their choices with a robust selection of intuitive reports. The interface was updated to accommodate ADA requirements and modern mobile experience native to today's students.



Virtual Labs

VIRTUAL LABS

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

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

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

Dietary Analysis Case Studies in Connect®

One of the challenges instructors face with teaching nutrition classes is having time to grade individual dietary analysis projects. To help overcome this challenge,



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

assign auto-graded dietary analysis case studies. These tools require students to use NutritionCalc Plus to analyze dietary data, generate reports, 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.

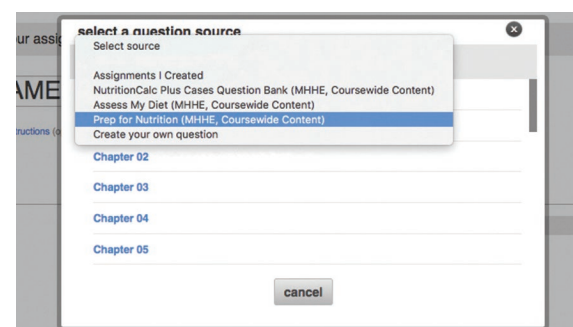


Tegrity in Connect is a tool that makes class time available 24/7 by automatically capturing every lecture. With a simple, one-click start-and-stop process, you capture all computer screens and corresponding audio in a format that is easy to search, frame by frame. Students can replay any part of any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

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

McGraw Hill Assess My Diet

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



Prep for Nutrition

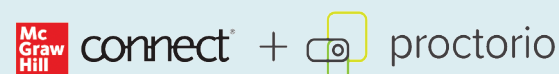
To help you level-set your classroom, we've created *Prep for Nutrition*. This question bank highlights a series of questions, including basic chemistry, biology, dietary analysis, mathematics, and student success, to give students a refresher on the skills needed to enter and be successful in their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

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

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

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

Welcome to *Human Nutrition: Science for Healthy Living*

Dear Students,

Welcome to the study of human nutrition! Before you begin your studies, it is important to understand that nutrition is a science that draws upon knowledge from other sciences, particularly biology, human anatomy and physiology, general chemistry, and biochemistry. The science of human nutrition also involves learning scientific information about foods and nutrients, as well as how this information is used to develop dietary recommendations for healthy people and nutritional therapies for those who are not healthy. By understanding the contents of this introductory nutrition textbook, you will be able to recognize the effects that people's food choices have on their health. In addition, you will appreciate the valuable role that registered dietitian nutritionists (RDNs) play as members of healthcare teams and will be well-prepared to take more advanced human nutrition courses, if you decide to become a dietitian or other professional in the medical field.

Human Nutrition: Science for Healthy Living has been developed by a team of nutrition educators who have extensive college teaching experience and a passion for teaching relevant, student-centered nutrition, biology, health, and wellness courses. Our goals with this textbook are to teach students the science of nutrition while also preparing future healthcare professionals and to make the study of introductory human nutrition enjoyable. Learning about any science can be challenging if the information is not presented in an appealing, interesting manner. We've made a distinct effort to write the content of this book in an understandable way and to provide clear descriptions of concepts that can be difficult to convey, such as the processes of digestion, absorption, and energy metabolism. To enhance your learning, numerous illustrations and photographs accompany the narrative. Such graphics enhance learning for all students, but especially for those who are "visual learners." By reviewing this Preface, you will learn about the features of this book and how to use them to facilitate your study of human nutrition.

We hope you will enjoy using this textbook!

Lammy J. Stephenson Myra Carlini Passanillo

About the Cover: The cover of this edition reflects the "farm-to-table" theme that we have used for the first and second editions of *Human Nutrition*. For this third edition of the textbook, a new "Sustainability and Your Diet" feature is included in each chapter. A sustainable food system delivers food security and nutrition for all in such a way that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised.

The image on the cover shows a sandwich made with avocado, boiled eggs, pumpkin seeds, and edible viola flowers on whole grain bread. Several species in the *Viola* genus are safe for human consumption. Like most edible flowers, not all *Viola* species are safe for intake and, therefore, check before consuming any flower. Edible viola provide vitamins A and C and are a good source of antioxidants.

Preface

The authoring team had a vision of writing an interesting, engaging, and evidence-based introductory nutrition textbook that has a wide variety of pedagogical features to promote active learning. To that end, this third edition of *Human Nutrition: Science for Healthy Living* is learner-centered, easy to read, and richly illustrated with figures and images that clearly show physiological processes. Furthermore, the author team felt students and faculty would benefit from and value a textbook that was clinically oriented and provided ample opportunities for students to practice using their nutrition knowledge and critical thinking skills. *Human Nutrition: Science for Healthy Living* is the result of a team of authors with extensive teaching experience and who currently teach introductory nutrition to diverse student populations.

The clinical emphasis of the textbook is of particular relevance to those studying nutrition, dietetics, or other health science professions, including nursing. Specific real-life examples, current statistics, and scientific evidence from professional resources are provided to support nutrition concepts. Features designed to attract students' interest, such as *Sustainability and Your Diet*, *COVID-19*, *Did You Know?* and *Fresh Tips* boxes, provide up-to-date information on current and sometimes controversial topics, as well as practical recommendations for everyday healthy living.

Human Nutrition: Science for Healthy Living provides the framework for students to *learn* how nutrition information is often interrelated and to *apply* the science of nutrition to clinical situations. Furthermore, students apply key scientific principles and knowledge that they can translate into their own lives.

Features Designed Around Student-Centered Learning

Human Nutrition: Science for Healthy Living, 3e was written by authors who have extensive experience teaching introductory nutrition classes to both majors and nonmajors. The authors recognize the diverse learning needs of today's students and how the modern learning environment in higher education—large lecture classes, online classes, and flipped/hybrid classrooms—often challenge even the most experienced nutrition educators. The textbook and its supportive interactive materials are designed to help instructors create a learner-centered teaching environment that maximizes student engagement and knowledge acquisition. This current, evidence-based

introductory textbook has a wide variety of pedagogical features to promote active learning among students.

What's New in This Edition?

Human Nutrition: Science for Healthy Living, 3e has been updated throughout to reflect the 2020–2025 *Dietary Guidelines for Americans* and associated changes to the MyPlate website and resources.

There are three new features included in the textbook: *COVID-19*, *Sustainability and Your Diet*, and *Culinary Medicine*.

The COVID-19 pandemic is addressed in relevant chapters throughout the textbook, highlighting the role of nutrition and lifestyle factors in coronavirus risk and treatment. Each *COVID-19* feature shares evidence-based and relevant content, such as the relationship between obesity and type 2 diabetes and COVID-19 risk and the role of vitamin D in preventing coronavirus. The *Sustainability and Your Diet* feature found in each chapter provides students with knowledge about sustainability and recommendations for making food and lifestyle choices to support a sustainable food system. Each chapter also includes a *Culinary Medicine* exercise that provides students with the opportunity to apply nutrition and food information to specific recommendations for preventing and treating disease. For example, how can a recipe high in sodium be modified for a person with hypertension who needs to limit sodium in her diet? Students will develop modified recipes that meet specific recommendations but also taste delicious.

For all chapters, numerous new and modern figures and photos have been added and updated to engage the reader and illustrate the content. Also, references have been updated to include the most current research and evidence-based practice recommendations. The following list provides some of the specific updates to each chapter.

- Chapter 1 has been updated based on the most current dietary recommendations. Table 1.2 has been updated for clarity. Figure 1.6 has been updated with the most current data, and the discussion of the relationship between diet and risk for chronic disease has been updated based on the most current research. A *COVID-19* feature has been added that discusses the virus being the third leading cause of death in the U.S. in 2020. Section 1.5, Factors that Influence Eating Habits, has been significantly revised and reorganized and now includes a *Sustainability and Your Diet* feature on sustainable food systems, including a new infographic on that topic.

- Chapter 2 has been reorganized to enhance the flow of the chapter. Section 2.2, Understanding the Scientific Method, has been completely revised based on student and instructor feedback. New examples are used throughout the chapter when discussing scientific studies. Section 2.3, Nutrition Information: Fact or Fiction, has been updated to reflect the fact that many consumers are now getting their information from online sources, including blogs.
- Chapter 3 has been significantly updated to reflect the 2020–2025 *Dietary Guidelines for Americans*. Three new figures have been added and all content updated to reflect the most recent release of the *Dietary Guidelines*. As well, Figure 3.8 has been revised with new tools for estimating portion sizes. Figure 3.17 provides an example of a current Nutrition Facts panel with information related to the use of that panel. Section 3.6, Cultural Influences on Meal Planning, has been completely revised with new figures to reflect the diversity of dietary choices based on ethnicity and religious practices.
- Chapter 4 includes the most up-to-date information related to the health of the gastrointestinal tract. Section 4.7, Microbes in the Digestive Tract, has been expanded with a detailed discussion of the impact of gut microbiota on health and recommendations for optimizing gut health. The chapter includes new content on fermented foods and a *Sustainability and Your Diet* feature on food waste and the benefits of composting. Section 4.8, Common Digestive Disorders, has been reorganized and updated with the most current evidence-based recommendations for preventing and treating digestive disorders.
- Chapter 5 has been updated with the most current statistics and research on diabetes mellitus. New Figure 5.16 provides guidance on the management of diabetes. Section 5.8 includes new information on the relationship between carbohydrate intake and health, including metabolic syndrome, tooth decay, and digestive health. The basic information on simple carbohydrates has been re-written and streamlined with updates to several figures and tables. The new *Sustainability and Your Diet* feature focuses on the importance of bees as pollinators and the new *COVID-19* feature summarizes the relationship between type 2 diabetes and risk for coronavirus.
- Chapter 6 provides an updated and enhanced discussion of cardiovascular disease and dietary strategies to reduce a person's risk for heart disease. The explanations of atherosclerosis and arteriosclerosis have been updated for clarity. The section on omega-3 fatty acids has been updated and includes a new *Sustainability and Your Diet* feature explaining the differences in omega-3 fatty acid content between grain-fed and grass-fed beef.
- Chapter 7 begins with a new case study for students to determine the protein needs of a healthy young adult and to make appropriate recommendations for consuming high-quality sources of protein. Table 7.3 has been updated with new food sources, and the section on protein quality has been revised significantly. Section 7.9, Food Hypersensitivity Disorders: Food Allergies, Food Intolerances, and Phenylketonuria, has been restructured with significant revisions based on the most current research available on these topics. This section now also includes the content on celiac disease, which has also been updated. Section 7.10, Plant-Based Diets, replaces the original section on “vegetarianism” to provide more broad information about the health effects of following a predominantly plant-based diet.
- Chapter 8 includes a new case study on energy drinks, exploring the role of B vitamins in energy metabolism. The chapter has been completely reorganized with major revisions to many of the figures. New Figure 8.9 provides a more clear and concise summary of the citric acid cycle. Also, the section on ketogenic diets has been updated with the most current research.
- Chapter 9 includes an update to Table 9.3, providing a summary of the fat-soluble vitamins. The chapter has been updated for clarity with a new *Did You Know?* feature on measuring skin carotenoid levels as an indicator of a person's fruit and vegetable intake. For each of the vitamins, the most current research on the relationship between vitamin status and chronic disease risk is included. Tables 9.4, 9.6, 9.7, and 9.8 have been updated with new food sources of each vitamin.
- Chapter 10 includes an update to Table 10.1 based on the most current research available on each water-soluble vitamin. Tables 10.2, 10.3, 10.4, 10.5, 10.7, 10.9, and 10.10 have all been updated with new sample foods. A new *Sustainability and Your Diet* feature on vertical farming has been added. The statistics and content provided in Section 10.12, Diet and Cancer, have been updated based on the most current research.
- Chapter 11 includes a new *Sustainability and Your Diet* feature with recommendations to reduce a person's water footprint, particularly when it comes to food production and choices. Figure 11.3 and Table 11.4 have both undergone significant revisions. All of the tables with examples of foods providing each mineral have been updated with new foods and beverages. The content in Sections 11.6 and 11.7, Sodium and Potassium respectively, have both been updated to reflect the most current (2019) Dietary Reference Intakes. New Table 11.11 provides the newest blood pressure levels and recommendations.

- Chapter 12 has been revised to include recommendations based on the most currently available research. Table 12.1, Summary of Trace Minerals, has been revised, and the tables with examples of foods providing each trace mineral have been updated. A new *Sustainability and Your Diet* feature addressing the mineral content of soil has been added and includes recommendations for optimizing the nutrient content of soil. As well, a new *COVID-19* feature provides information about the relationship between zinc intake, the immune system, and risk for COVID-19.
- Chapter 13 has been updated with the most current statistics on the prevalence of obesity (Figure 13.1), and new Figure 13.2 summarizes the health consequences of obesity. Section 13.2, Evaluating Health Using BMI and Body Composition, has been expanded with timely content on the use of body composition and BMI in evaluating health. Section 13.4, Factors That Influence Body Weight, has been significantly revised to include the most current research on the factors contributing to the obesity epidemic in the United States. New content on strategies to improve body composition are included, with an emphasis on mindfulness and intuitive eating practices. Section 13.6, Medical Treatment of Obesity, has also been updated with the most current evidence-based recommendations, including medications and surgical options for obesity treatment, when appropriate.
- Chapter 14 has undergone significant revision, with reorganization of the content and updates to all content. New information about the role of social media in disordered eating and eating disorders has been added. The content on diabulimia has been expanded, and new tables have been added with the common signs and symptoms of anorexia nervosa, bulimia nervosa, and binge eating disorder. A *Fresh Tips* feature with recommendations for approaching a friend or family member who has an eating disorder has been added. Figure 14.4 is a new figure that provides recommendations for alternative therapies for eating disorders.
- Chapter 15 has been updated based on the second edition (2018) of the U.S. Department of Health and Human Services *Physical Activity Guidelines for Americans*. Figure 15.4 has been updated and new information on physical activity trackers included. A new *Sustainability and Your Diet* feature focuses on active commuting as an option for many to improve health while being good for the environment. Table 15.3 has been revised to include new pre-event meal options for athletes. Section 15.10, Ergogenic Aids, has been updated with the most current research on athletes' use of ergogenic aids.
- Chapter 16 includes a new case study on recommendations for a preconception diet. Section 16.3, Nutrition and Lifestyle for a Healthy Pregnancy and Delivery, has been significantly revised based on current recommendations. A section on the developmental origins of disease has also been added. Figure 16.6 has been updated, and Section 16.6, Lactation and Breastfeeding, has been reorganized and significantly revised.
- Chapter 17 begins with a new case study on complementary foods to introduce during the weaning process. The content on nutritional needs during infancy and childhood has also been updated significantly based on the most current recommendations. Section 17.4, Adolescence, provides new insight into the diet quality of adolescents in the United States, and Section 17.5, Overweight and Obesity in Children, shares specific recommendations on preventing and managing obesity in this population.
- Chapter 18 has gone through a reorganization and updated with an emphasis on healthy aging. New Figure 18.2 summarizes the lifestyle characteristics of those living in the parts of the world where people live the longest. A new *Did You Know?* feature on telomeres and the factors contributing to accelerated aging has been added. Section 18.3, Nutrient Needs of Healthy Older Adults, has been updated based on current evidence-based recommendations and now includes a discussion of the MyPlate for Older Adults. A new *Fresh Tips* feature on physical activity recommendations to build muscle mass and reduce sarcopenia is now included as part of Section 18.4, Common Health Concerns of Older Adults.
- Chapter 19 has been updated with a new chapter opener case study introducing students to food-borne illnesses and practices to protect against such an illness. Section 19.5, Preventing Food-Borne Illnesses, has been updated to provide the most up-to-date expert recommendations and the content on food additives has been expanded. As well, a new *COVID-19* feature has been added providing Food and Drug Administration (FDA) guidance on food safety during the pandemic and preventing the spread of COVID-19.
- Chapter 20's content has been updated with the most current statistics and information regarding global nutrition and food insecurity. Tables 20.1 and 20.2 have undergone significant revisions to reflect updated global data. Section 20.3, Food Insecurity in the United States, has been updated, and a new *Sustainability and Your Diet* feature on food waste has been added. A new *COVID-19* feature addressing increased rates of food insecurity during the global pandemic has been added. The biotechnology content of the chapter has also been updated based on the most current research on this topic.

Features

Case Study—Each chapter begins with a case study addressing a realistic scenario. These high-interest scenarios engage students by showing how the chapter's content is relevant to their future professions and can be seen in a practical or clinical situation. Students are encouraged to consider the case study as they review the chapter. A suggested **Case Study Response** is provided at the end of the chapter to allow students to self-assess their understanding of the chapter's material and its applications.

Quiz Yourself—This pretest, which is next to the **Case Study**, stimulates 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.

CASE STUDY RESPONSE



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Vitamin D and bone health

VITAMIN D IS NECESSARY FOR HEALTHY bones, including those of the spine. Vitamin D enhances absorption of phosphorus and calcium in the small intestine, two minerals necessary for bone growth and maintenance. When vitamin D is deficient, bones weaken, leading to osteomalacia. The weakening of the bones in the spine can lead to an abnormal curvature of the upper spine, which can be identified through monitoring changes in height over time.

Vitamin D is often called the "sunshine vitamin" because the sun can convert a substance in skin, 7-dehydrocholesterol, into active vitamin D. The amount of vitamin D made through sunlight exposure depends on a variety of factors, including where a person lives. Josette lives in northern Maine, a location with long winters. Her low blood vitamin D levels may be a result of her living north of the 33rd parallel and spending much of her day indoors.

Dairy foods are generally excellent sources of vitamin D; low-fat milk, yogurt, and cheese are good options. Salmon, tuna, catfish, herring, and sardines are also rich in vitamin D. Some ready-to-eat cereals, bread, orange juice, and margarine have added vitamin D.

9 Vitamin Overview and Fat-Soluble Vitamins

CASE STUDY

Vitamin D and bone health

SEVENTY-YEAR-OLD JOSETTE LEARNED at her last physician's appointment that she is 2 inches shorter than she was 5 years ago. Her physician noted that Josette has developed curvature of her upper spine and recommended that she have additional testing to determine the cause. Additional testing revealed that Josette has low blood levels of vitamin D.

Josette has lived in northern Maine her entire life. After spending the past 30 years working outdoors, she has retired and now spends the majority of her day indoors.

- Describe the relationship between vitamin D and developing curvature of the upper spine.
- Explain to Josette how living in northern Maine may be contributing to her low blood levels of vitamin D.
- Recommend at least five vitamin D-rich foods for Josette to include in her diet.

The suggested "Case Study Response" can be found at the end of the chapter.

QUIZ Yourself

Can vitamins give a person more energy or reduce their chances for developing chronic disease? What happens if someone consumes too little or too much of a particular vitamin? Test your knowledge of vitamins by taking the following quiz. The answers are found at the end of the chapter.

1. Vitamins are a source of "quick" energy. ☐ T ☐ F
2. A deficiency of vitamin A can lead to rickets. ☐ T ☐ F
3. Vitamin D deficiencies are rare in the United States. ☐ T ☐ F
4. Vitamin E is an antioxidant. ☐ T ☐ F
5. Vitamin K is necessary for blood clotting. ☐ T ☐ F

7.9 Food Hypersensitivity Disorders: Food Allergies, Food Intolerances, and Phenylketonuria

LEARNING OUTCOMES

- 1 Describe the incidence, causes, and treatment of food allergies.
- 2 Explain the difference between a food allergy and a food intolerance, and provide examples of each condition.
- 3 Compare and contrast celiac disease and non-celiac gluten sensitivity, including differences in cause and diagnosis.
- 4 Explain the cause of phenylketonuria (PKU) and discuss diagnosis and treatment of the disorder.

Learning Outcomes—Each major section of a chapter opens with a list of learning outcomes. The **Learning Outcomes** help students prepare for reading the section and clarify the major concepts they are expected to learn. These measurable outcomes are further supported by assessment methods and study aids found within the chapters and within McGraw Hill Education's Connect[®].

Assess Your Progress—These review questions, which appear at the end of each major section within a chapter, apply to the section's learning outcomes and often involve critical thinking skills. Such questions enable students to test their knowledge and understanding of the information provided within that section.

ASSESS YOUR PROGRESS

- 28 Identify potential health effects of untreated, frequent gastroesophageal reflux disease (GERD)
- 29 What factors contribute to the development of gastric ulcers?
- 30 Explain the differences between constipation and diarrhea and the consequences if they are untreated.
- 31 What dietary and lifestyle recommendations would you provide to a person experiencing irritable bowel syndrome (IBS)?
- 32 Describe the differences between Crohn's disease and ulcerative colitis.

Fresh Tips—These practical suggestions help students apply the chapter’s content to their current situations. The *Fresh Tips* are also valuable for future healthcare professionals who want to provide useful health, food, and nutrition advice to their clients. Such features provide tips for including more fruits and vegetables in the diet, maintaining a healthy body weight and composition, reducing intake of added sugars, and keeping foods safe to eat.

DID YOU KNOW?

Physical activity trackers, often worn on the wrist, have become widely available and utilized as a tool to monitor and promote physical activity. Fitness trackers allow users to track daily physical activity as well as, in many cases, food intake, sleep, and heart rate. According to recent research, wearable trackers can be used not only as a tool to promote physical activity but also to improve well-being through new social experiences and boosting of self-esteem.^{16,17} Fitness tracker users should keep in mind that most trackers are not 100% accurate with step counts and distance traveled but rather provide an estimate of activity level.¹⁸

Haiyin Wang/Alamy



Did You Know?—This feature presents bits of information concerning topics that support the chapter’s content and are of interest to introductory nutrition students. Some of these features dispel beliefs about food and nutrition that are commonly held but inaccurate. Many of the features are based on the most current research on a topic, presenting the science in an informative, accurate, and interesting way.

Sustainability and Your Diet—A sustainable diet is one that promotes health and is good for the planet, today and in the future. This new feature provides students with knowledge about sustainability and recommendations for making food and lifestyle choices to support a sustainable food system.

COVID-19

Early evidence suggests a link between vitamin D deficiency and COVID-19 severity.⁴⁰ Such a link can be seen both in the United States and across the world. Those countries with higher rates of vitamin D deficiency have also seen more cases of COVID-19 and more serious health consequences, including hospitalization and death, from the infection. To optimize blood levels of vitamin D, consume recommended amounts in the diet and, when possible, spend time outdoors in the sunlight. Some individuals may also benefit from taking a vitamin D supplement, but they should talk with their healthcare provider first since vitamin D may interact with other supplements and medications.⁴¹

COVID-19—The *COVID-19* feature provides the latest information on the relationship between nutrition, lifestyle factors and risk for COVID-19. As well, the impact of the pandemic on food insecurity and food safety are addressed in this timely feature.

FRESH TIPS

Dietary strategies that are often recommended to control morning sickness include:

- Eating small, frequent meals every 2 to 3 hours.
- Drinking ginger tea or nibbling on dried ginger pieces.
- Choosing healthy snacks, including those that are high in protein, such as nuts or yogurt.
- Supplementing with low doses of vitamin B-6.^{10,31}



Toltek/Stock/Getty Images



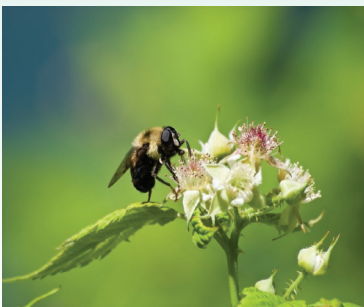
SUSTAINABILITY AND YOUR DIET

When most people think of bees, they think of honey, frequently used as a sweetener. However, in addition to producing honey, bees are also important for pollination of much of the food we eat, including vegetables, fruits, and nuts.

Experts estimate that bees help pollinate at least one-third of the plants used to produce food consumed around the world on a daily basis. According to the Food and Agriculture Organization (FAO) of the United Nations, 71 of the 100 crop species that provide 90% of the food around the world are pollinated by bees.² The accompanying image shows a honeybee getting pollen from a raspberry blossom.

Given the importance of bees in food production, keeping bees healthy is vital to a sustainable food system. Destruction of the bees’ natural habitat, pollution, climate change, and excess use of pesticides can all destroy local bee populations.³

To help keep the population healthy, the bees must have access to food and water that is contaminant free. Planting bee-friendly flowers and keeping water clean are two practices that help to sustain and grow bee colonies, important for both honey and the production of much of the food eaten around the world.



ZeroMinusOne/Stock/Getty Images

Each chapter ends with a *Case Study Response* and the following features.

Summary

SUMMARY

SECTION 13.1 Overweight and Obesity

- In the United States, overweight and obesity are widespread nutritional problems that have reached epidemic proportions. Overweight is characterized by higher than average body weight that is contributed by bone, muscle, body fat, and/or body water. Obesity is characterized by excessive and unhealthy amounts of body fat.

SECTION 13.2 Evaluating Health Using BMI and Body Composition

- Body mass index (BMI) is a health assessment tool based on the relationship between body weight and height that does not take body composition into account.

Critical Thinking—These questions involve higher-level cognition skills, including applying, analyzing, synthesizing, and evaluating information.

Critical Thinking

1. Think about what you ate yesterday. Identify at least four factors that influenced your food and beverage choices. Of these factors, which was the most important to you? Explain why.
 2. Consider your current eating habits. Does your diet have variety? Explain why your diet is or is not varied.
 3. "Everything in moderation." Explain what this statement means in terms of your diet.
 4. Consider your parents' and grandparents' health (or causes of death). Based on your family history, which chronic health conditions do you have a higher-than-average risk of developing?
- If you were at risk of developing a chronic health condition that could be prevented by changing your diet, would you make the necessary changes at this stage of your life? Explain why or why not.
5. Eric spends about \$100 each month on purchases of dietary supplements, including protein powders, vitamin pills, and herbal extracts. He thinks it is necessary to take the products to achieve optimal health and prevent chronic illnesses. Based on the information in this chapter, what would you tell Eric about his use of the supplements?

Practice Test—This series of multiple-choice questions assesses students' comprehension and recall of the information presented in the chapter.

Practice Test

Select the best answer.


1. What is the AMDR for fat?
 - a. 10–35% of total kcal
 - b. 20–35% of total kcal
 - c. 30–45% of total kcal
 - d. 45–65% of total kcal
2. Which of the following statements is false?
 - a. RDAs are standards for daily intakes of certain nutrients.
 - b. RDAs meet the nutrient needs of nearly all healthy people.
 - c. RDAs contain a margin of safety.
 - d. RDAs are listed on food labels.
3. The Estimated Energy Requirement (EER)
 - a. has a margin of safety.
 - b. does not account for a person's height, weight, or physical activity level.
 - c. is based on the average daily energy needs of a healthy person.
 - d. reflects a person's actual daily energy needs.
11. Which of the following statements is false?
 - a. Each dietary pattern of the MyPlate guidelines includes a recommendation for daily fruit intake.
 - b. MyPlate can be individualized to meet a person's food preferences.
 - c. A major weakness of www.myplate.gov is the website's failure to emphasize the importance of regular physical activity.
 - d. A person can use MyPlate to evaluate his or her diet's nutritional adequacy.
12. Which of the following information is not provided by the Nutrition Facts panel (2020)?
 - a. Percentage of total calories from fat
 - b. Amount of total carbohydrate per serving
 - c. Serving size
 - d. Amount of total fat per serving
13. Daily Values are

References—Numbered references are provided at the end of each chapter.

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CULINARY MEDICINE



Foodcollection

Modifying Recipes for Healthy Living

Martin is a 16-year-old high school student who suspects that he may suffer from non-celiac gluten sensitivity (NCGS) because he experiences headaches, bloating, and “mental fog” after consuming wheat products. His diet is fairly high in gluten-containing foods; he normally eats cereal for breakfast, a sandwich at lunch, and his favorite pasta dish for dinner. Use the provided pasta recipe to answer the following questions.

1. Using diet analysis software, such as NutritionCalc Plus, enter the recipe information and evaluate the nutrition information. How many total kcal, grams of protein, grams of carbohydrate, and grams of fat are provided per serving of the pasta dish?
2. What suggestions do you have for your client to eliminate the gluten from the recipe?
3. What suggestions do you have for your client to ensure that the protein content of the recipe remains the same?
4. Develop a modified version of this recipe.
5. Use the diet analysis software to again evaluate the nutrition information. How do the total kcal, grams of protein, grams of carbohydrate, and grams of fat provided per serving of the dish compare to the original recipe?
6. OPTIONAL: Prepare both the original and the modified recipes. How does the gluten-free pasta taste, compared to wheat pasta? Have your friends see if they can figure out which dish is which!

Pesto Rigatoni

3 cups wheat linguini noodles
1/2 cup olive oil
1/4 cup pine nuts
1/4 cup parmesan cheese
1/4 cup red bell pepper
2 cups fresh basil leaves
2 cloves garlic

Makes 3 servings.

Culinary Medicine—Culinary Medicine combines knowledge of evidence-based dietary recommendations for optimizing health and preventing and treating disease with practical cooking guidance to make food tasty and appealing! This feature provides students with the opportunity to apply nutrition and food information to situations that commonly arise in clinical settings. Students modify an existing recipe to make it healthier, using information they have learned in the chapter. This feature allows students to apply their knowledge of culinary medicine to plan recipes that meet specific health guidelines, such as reducing the sodium content of a recipe for a person with high blood pressure.

PERSONAL Dietary Analysis

1. Record every food and beverage you eat over a 24-hour period. Recall how much you consumed and how it was prepared. Use the format shown in the sample (Table 3.16) to record your food and beverage intake.

TABLE 3.16 Sample Food Record

Time of Day	Foods and Beverages	Food Preparation Description (e.g., Fried, Baked, Raw)	Estimated Amount Consumed
Breakfast—7 A.M.	Whole-grain ready-to-eat cereal	—	¾ cup
Breakfast—7 A.M.	Fat-free milk	—	1 cup

2. Use NutritionCalc Plus to create a personal profile based on your age, sex, height, weight, and activity level. Then, use the “Intakes” option to enter your food and beverages.

3. Go to “Reports” and select “MyPlate Report.” Click on “View Report” to view the MyPlate analysis based on the 1-day food record.



4. Using Table 3.17, enter a minus sign (–) if your total intake is below the MyPlate recommendations and a plus sign (+) if it equals or exceeds the daily recommended amount for each food group.

TABLE 3.17 Rating Your Record

USDA Food Group	Actual Intake (from Question 3)	Recommended Intake (from Question 4)
Grains		
Vegetables		
Fruits		
Dairy		
Protein foods		

5. Evaluate the quality of your 24-hour food intake based on MyPlate guidelines.

- Did your food intake meet MyPlate guidelines for all food groups? If it did not, list the food group(s) for which your intake(s) exceeded the recommendations. List food group(s) for which your intake(s) did not meet the guidelines.
- Rate the overall quality of your general diet based on MyPlate on a scale of 1 to 5, with 1 being “poor” and 5 being “excellent.” Why did you give your diet this rating?
- If your usual intake of nutrients does not meet or exceeds daily calorie and food group recommendations on a regular basis, describe how you could modify your diet to improve your intake.



Complete the Personal Dietary Analysis activity in Connect.

Personal Dietary Analysis—Students can gain insight into their eating habits by completing this activity. Many of these activities can be completed with the use of a dietary analysis software program, such as NutritionCalc Plus.

Artwork and Photographs That Enhance Learning

Dimensional, full-color illustrations, some with numbered labels and explanatory text, help teach and/or show the progression of a complicated concept.

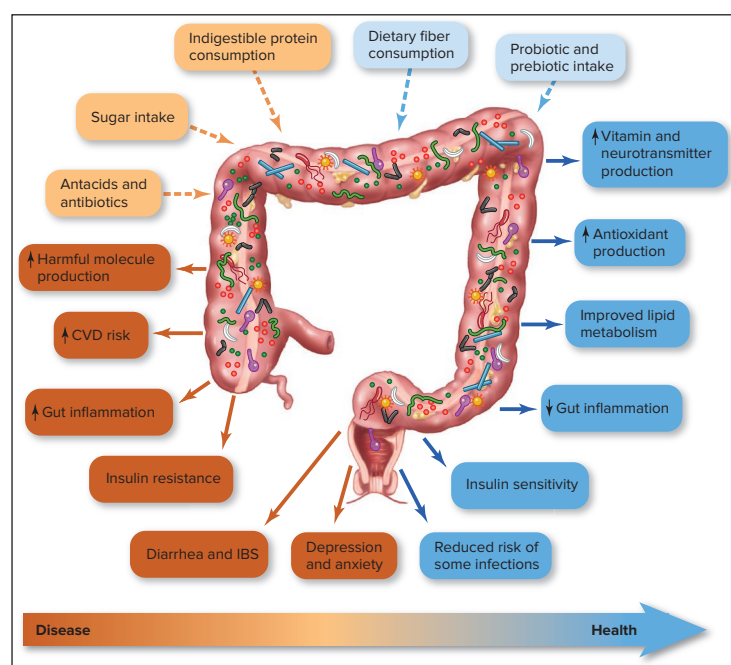


FIGURE 4.18 Gut microbiota in health and disease. Shutterstock / Netkoff

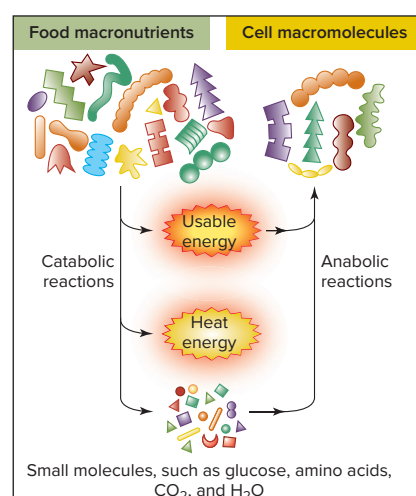


FIGURE 8.1 Metabolism. Energy released from catabolic reactions is used to fuel anabolic reactions in cells.

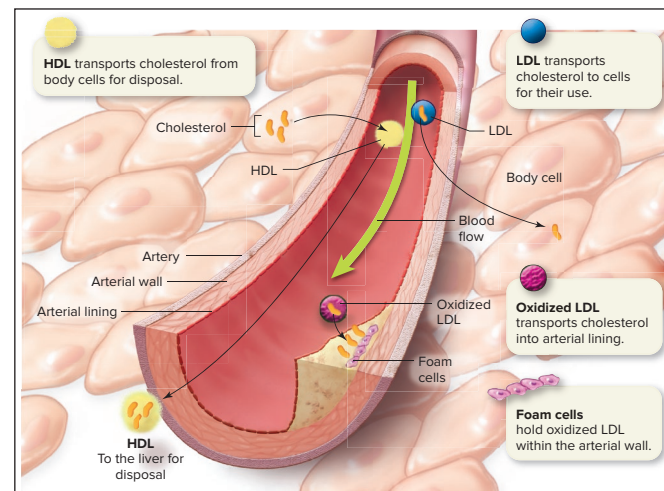


FIGURE 6.21 The role of HDL and LDL in lipid transport throughout the body. Oxidized LDL is taken up by macrophages, a type of immune system cell. Over time, the cholesterol-laden macrophages become "foam" cells that build up and contribute to atherosclerosis.

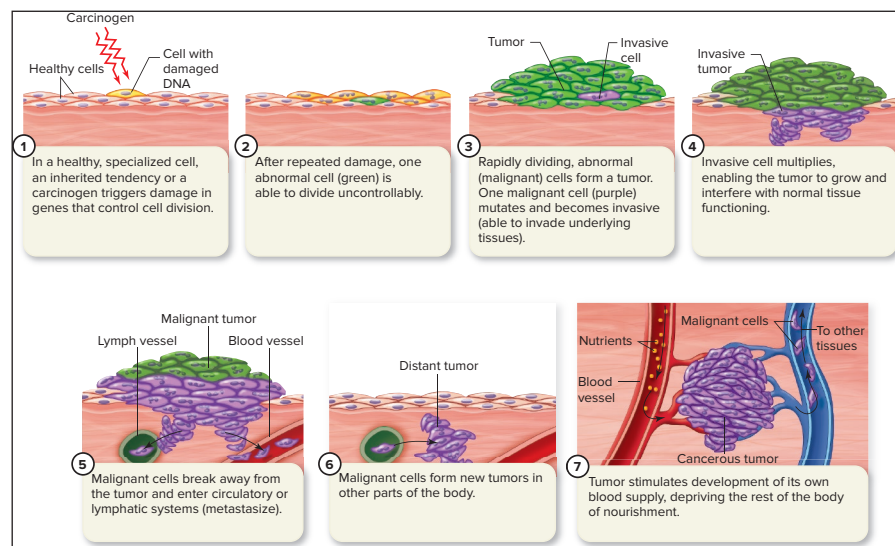


FIGURE 10.14 Cancer development and progression. Several steps are involved as a normal cell progresses into a cancer cell that multiplies out of control.

Numerous high-quality photos support the text and provide examples of nutrition-related medical conditions as well as microscopic views of clinical cases from the human body.

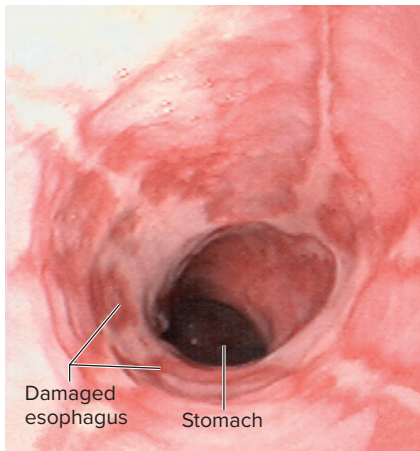


FIGURE 4.19 Acid reflux damage.
David M. Martin, M.D./Science Source

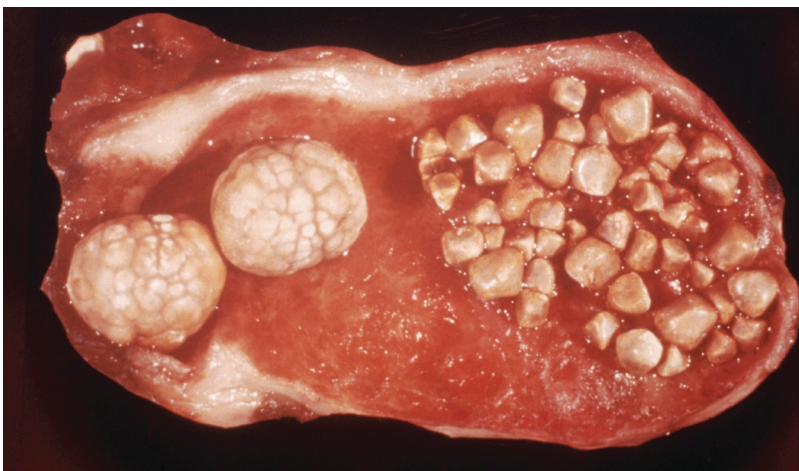


FIGURE 6.16 Gallstones.
Clinical Photography, Central Manchester University Hospitals NHS Foundation Trust, UK/Science Source



FIGURE 7.18 Skin patch testing for allergies.
©Science Photo Library/Getty Images

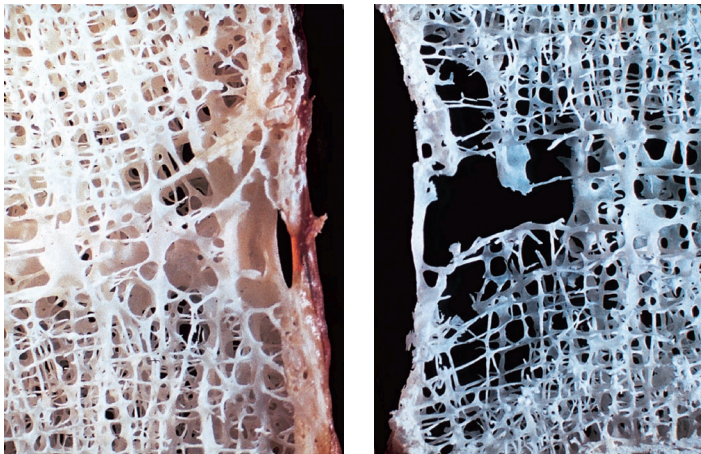


FIGURE 11.14 Bone tissue.
Michael Klein/Photolibrary/Getty Images



Shaiith/Shutterstock

Design Elements: Sustainability and Your Diet (sprout in pot): Vladvm/Shutterstock; Culinary Medicine (iPad): Andrey_Kuzmin/Shutterstock

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1 Introduction to Nutrition

CASE STUDY

Healthy eating while on campus

EACH CHAPTER IN THE TEXTBOOK is introduced with a real-life application “Case Study” that describes a person’s background, including his or her health and food choices. Begin by reviewing the case study and writing down potential responses to the case study questions. Then, after reading and studying the chapter, review your initial answers and make changes, if necessary. Compare your responses with the suggested responses to the case study that are provided at the end of each chapter.

Jorge has become concerned about his eating practices since he started college last month. He lives in a residence hall that has an all-you-can-eat dining facility in the basement and the Student Union is nearby.

After moving in, Jorge began a daily routine of eating a fast-food breakfast sandwich, large chocolate chip muffin, and sugar-sweetened coffee at the Student Union before his 10 A.M. class. Between classes he would drink sugary soft drinks and then eat three slices of pizza or a couple of hamburgers and a large portion of French fries in the dining facility at night. He knows he should eat more nutritious foods, but he thinks he does not have enough time to eat fresh salads or fresh fruit. Jorge wants your advice concerning how he can improve his food choices.

- Consider Jorge’s current eating practices. Do his food choices reflect a nutritionally adequate pattern?
- What steps can Jorge take to improve his eating practices?

The suggested “Case Study Response” can be found at the end of the chapter.

QUIZ Yourself

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. Before reading Chapter 1, test your basic nutrition knowledge by taking the following quiz. The answers are found at the end of this chapter.

1. There are five classes of nutrients: carbohydrates, lipids, proteins, vitamins, and water. __T__F
2. Vitamins and minerals are sources of energy. __T__F
3. Heart disease is the leading cause of death in the United States. __T__F
4. Most foods are mixtures of just two nutrients. __T__F
5. The Food and Drug Administration regulates the safety and effectiveness of dietary supplements that are sold in the United States. __T__F



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1.1 The Importance of Nutrition

LEARNING OUTCOMES

- 1 Explain why it is important to study nutrition.
- 2 Describe Americans' current food-consumption practices and how they compare to dietary recommendations.

Many college students do not pay much attention to the foods they consume regularly, possibly because they are healthy now and they think poor health is unlikely to affect them until later in life. Why should you focus more on what and how much you eat? What is nutrition? In this textbook, we will provide a framework for understanding nutrition and making healthy food choices.

Why Study Nutrition?

nutrients life-sustaining substances in food

nutrition scientific study of nutrients and how the body uses them

diet a person's usual pattern of food choices

Food is a basic human need for survival: people become hungry and search for something to eat when their bodies need **nutrients**, the life-sustaining substances in food. Nutrients are necessary for the growth, maintenance, and repair of the body's cells. **Nutrition** is the scientific study of nutrients and how the body uses them.

Humans have the instinctive ability to select safe and appropriate foods. However, environmental cues and food processing can trick the body's innate sense of what is edible and healthy. To eat well, people need to learn about the nutritional value of foods and the effects that their **diet**, their usual pattern of food choices, can have on health.

Simply having information about nutrients and their importance to good health may not be enough for people to change ingrained food-related behaviors and purchase healthier foods. A person must also be motivated to make such changes. Some people strive to improve their diets because they want to lose or gain weight and/or improve their body composition. Others are so concerned about their health that they are motivated to change their eating habits in specific ways, such as by eating fewer salty foods or more fruits and vegetables.

What People Eat in America

According to average food consumption trends, Americans are consuming above the recommendations for added fats and oils, added sugars and sweeteners, high-fat protein foods, and grains and below the recommendations for vegetables, dairy products, and fruit.¹ Americans' access to ultra-processed foods continues to increase, which is in part responsible for the current problem of overweight yet undernourished individuals. 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 processing remove nutrients that were naturally in the food and/or add unhealthy amounts of sodium, sugar, and "solid" fat to foods.²

Public health experts are concerned with Americans' eating habits, because many serious diseases, including obesity and type 2 diabetes, are associated with certain dietary practices. Over the past 30 years, these health conditions have become increasingly more common, not only in North America but also among populations of other countries. People may be able to live longer, healthier lives by improving the nutritional quality of their diets.

How to Use This Textbook

Every major section of a chapter begins with a set of "Learning Outcomes" and ends with "Assess Your Progress" questions for you to evaluate your knowledge of the material. Key terms that you need to know when learning about nutrition are displayed in bold type within the narrative. The terms and their definitions are in the margins, but you can also look up the definitions in the glossary.

At the end of each chapter, you will find a summary of key points; a set of “Critical Thinking” questions; and “Practice Test,” a group of multiple-choice questions that check your understanding of the material in the chapter. Answers to the “Practice Test” questions are provided at the end of the test. A “Culinary Medicine” activity in which you modify a recipe to accommodate a client’s specific dietary needs is also included at the end of each chapter. Many chapters also include a “Personal Dietary Analysis” assignment based on your own dietary habits.

ASSESS YOUR PROGRESS

- 1 Why is it important to learn about nutrition?
- 2 Which foods do Americans tend to consume in amounts that are higher than recommended?

1.2 The Nutrients

LEARNING OUTCOMES

- 1 List the six classes of nutrients, and identify major roles of each class of nutrient in the body.
- 2 Describe the key features of an essential nutrient.
- 3 Categorize nutrients based on whether they are essential and their designation as a micronutrient or macronutrient.
- 4 Identify rich food sources of phytochemicals.

To understand nutrition, you need to learn about and use information from biology, anatomy, physiology, and chemistry. This chapter introduces the nutrients and their general functions. Chapter 4 focuses on the structures and functions of the human digestive system. Appendices B and C provide brief reviews of basic chemistry and physiology concepts that form the foundation for understanding the science of nutrition.

The Six Classes of Nutrients

There are six classes of nutrients: carbohydrates, lipids (such as fats and oils), proteins, vitamins, minerals, and water. Both food and the human body are comprised of these nutrients. Although the percentage varies with age and sex, about 50 to 70% of the body’s total weight is water. On average, healthy young men and women have similar amounts of vitamins, minerals, and carbohydrates in their bodies, but young women have less water and protein, and considerably more fat (Fig. 1.1). Bodies with high fat content tend to have less water in them than bodies with less fat since there is more water in lean tissues.

Each nutrient typically has more than one physiological role, or function, in the body (Table 1.1). In general, the body uses certain nutrients for energy, growth and development, and regulation of processes, including the repair and maintenance of cells. Cells do not need food to survive, but they need the nutrients in food to carry out their



FIGURE 1.1 Comparing body composition. This figure presents the approximate percentages of nutrients that constitute the bodies of a healthy man and woman. Note that the amount of vitamins in the human body is so small that it is not shown. Andres Rodriguez/Alamy; Pepsco Studio/Shutterstock

TABLE 1.1 Nutrients

Nutrient Class	Major Functions
Carbohydrates	<ul style="list-style-type: none">• Major source of energy (most forms)• Maintenance of normal blood glucose levels• Elimination of solid waste from gastrointestinal tract (fiber)
Lipids	<ul style="list-style-type: none">• Major source of energy• Cellular development, physical growth and development• Regulation of body processes (certain hormones, for example)• Growth and development of the brain• Absorption of fat-soluble vitamins
Proteins	<ul style="list-style-type: none">• Formation of structural components, such as muscle fibers, and functional components, such as enzymes• Cellular development, growth, and maintenance• Regulation of body processes (certain hormones, for example)• Transportation of substances within the blood• Energy (normally a minor source)
Vitamins	<ul style="list-style-type: none">• Regulation of body processes• Immune function• Production and maintenance of cells• Protection against agents that can damage cellular components
Minerals	<ul style="list-style-type: none">• Regulation of body processes, including fluid balance and energy metabolism• Formation of certain chemical messengers• Formation of structural and functional components of various substances and tissues• Cellular development, growth, and maintenance
Water	<ul style="list-style-type: none">• Maintenance of fluid balance• Regulation of body temperature• Elimination of wastes• Transportation of substances• Participation in many chemical reactions

metabolism total of all the chemical processes that occur in living cells

metabolic activities. **Metabolism** is the total of all the chemical processes that occur in living cells, including the chemical reactions involved in breaking down large molecules into smaller molecules (supplying energy), building larger molecules (such as proteins and long-chain fats) from smaller molecules, and eliminating waste products.

element substance that cannot be separated into simpler substances by ordinary chemical or physical means

Nutrients: Elements

Nutrients are sources of elements that the body needs to carry out its activities (Table 1.2). An **element** is a substance, such as carbon and oxygen, that cannot

TABLE 1.2 Elements in Nutrients

		Elements*						
Nutrient Class		Carbon	Hydrogen	Nitrogen	Oxygen	Phosphorus	Sulfur	Others
	Carbohydrates	✓	✓		✓			
	Lipids	✓	✓	X	✓	X		
	Proteins	✓	✓	✓	✓		X	
	Vitamins	✓	✓	X	✓	X	X	Cobalt
	Minerals					X	X	Sodium, magnesium, potassium, calcium, chromium, iron, copper, zinc, iodine, and others
	Water		✓		✓			

*Not every element listed may be a component of a particular nutrient in each class.
✓ All nutrients in this class contain this element.
X Some nutrients in the class, but not all, contain this element.

be separated into simpler substances by ordinary chemical or physical means. Elements are the basic substances that make up all things, including life forms such as human beings. Almost 98% of the human body (by weight) is composed of only five elements: oxygen, carbon, hydrogen, nitrogen, and calcium (Fig. 1.2).³ Several elements, such as calcium, are minerals that the body needs for a variety of functions. In Figure 1.2, the mineral elements are highlighted in green.

In chemistry, the term **organic** refers to compounds that contain carbon. Carbohydrates, lipids, proteins, and vitamins are organic nutrients because they contain carbon. **Inorganic** nutrients, such as minerals and water, are substances that do not contain carbon.

Nutrients: Essential and Conditionally Essential

All nutrients are important for health, but the body can use the “raw materials” from food to synthesize (make) many nutrients, such as cholesterol and some types of fats (lipids). The remaining nutrients, about 50 of them, 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 because the body can survive for only a few days without it.

Nutrition scientists use the following factors to help determine whether a nutrient is essential:

- If the nutrient is missing from the diet, a deficiency disease occurs as a result. A **deficiency disease** is a state of health characterized by certain abnormal physiological changes. Changes that are observable or measurable are **signs** of disease. Disease signs include rashes, failure to grow properly, and elevated blood pressure. **Symptoms** are subjective complaints of ill health that may be difficult to observe or 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.

To test an adult male human’s need for vitamin C, for example, scientists would have the subject avoid consuming foods or vitamin supplements that contain the vitamin. When the amount of vitamin C in the subject’s white blood cells (leukocytes) became too low for them to function normally, the person would develop physical signs of scurvy, the vitamin C deficiency disease. When the person brushed his teeth, his gums would bleed from the pressure of the toothbrush (Fig. 1.3). If he cut himself, the wound would heal slowly or not at all.

If the scientists began to feed foods that contain vitamin C to the subject again, the man’s deficiency signs and symptoms would disappear within a few days, because his body was recovering. Chapter 10 provides information about the physiological roles of vitamin C. One of those roles is maintaining *collagen*, the protein in the body that holds cells together, including the cells that form tiny blood vessels in skin. Collagen is also needed to produce scar tissue for wound healing. When the vitamin is lacking, the tiniest blood vessels in the gums begin to leak blood where they are compressed, and even minor cuts have difficulty healing. Thus, vitamin C meets all the required features of an essential nutrient. Table 1.3 lists nutrients that are generally considered to be essential.

Some nutrients that are normally nonessential can become essential under certain conditions, such as in metabolic disorders or serious diseases, and during prenatal (before birth) development. In these conditions, **conditionally essential nutrients** may be made by the body but in amounts that are inadequate and must

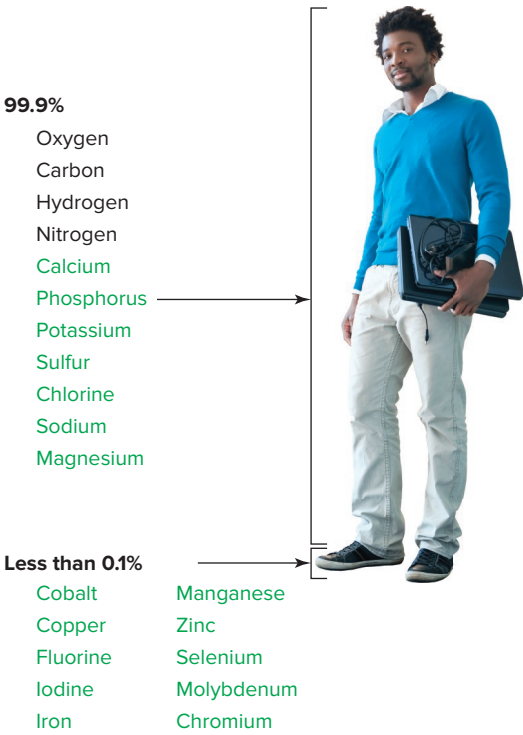


FIGURE 1.2 Nutrient-related elements in the human body. Minerals are highlighted in green; calcium is the most plentiful mineral element in the body. Eric Audras/Getty Images

organic (chemistry) refers to compounds that contain carbon

inorganic (chemistry) refers to substances that do not contain carbon

essential nutrient nutrient that must be supplied by food

deficiency disease state of health characterized by certain abnormal physiological changes that occur when the body lacks a nutrient

signs physical changes associated with a disease state that are observable or measurable

symptoms subjective complaints of ill health that may be difficult to observe or measure

conditionally essential nutrients nutrients that are normally not essential but become essential under certain conditions, such as during a serious illness



FIGURE 1.3 Sign of scurvy. Source: Centers for Disease Control

TABLE 1.3 Essential Nutrients for Humans

Carbohydrates	Proteins (Amino Acids*)	Lipids	Vitamins	Minerals	Water
Glucose [§]	The following amino acids are generally recognized as essential: Histidine Leucine Isoleucine Lysine Methionine Phenylalanine Threonine Tryptophan Valine	Fats that contain: Linoleic acid Alpha-linolenic acid	A Thiamin Riboflavin Niacin Pantothenic acid Biotin Folate B-6 B-12 C D [†] E K Choline [‡]	Major minerals: Calcium Chloride Magnesium Phosphorus Potassium Sodium Sulfur Trace minerals: Chromium Copper Iodine Iron Manganese Molybdenum Selenium Zinc	Water

*Amino acids are the basic units that make up proteins.
[†]The body makes vitamin D after exposure to sunlight, but a dietary source of the nutrient is often necessary.
[‡]The body makes choline but may not make enough to meet needs. Choline is classified as a vitamin-like compound.
[§]The body can make glucose without carbohydrates during periods of starvation.
^{||}The body can produce vitamin K and biotin from bacteria in the intestines, but a dietary source of these nutrients is often necessary.

macronutrients nutrients that the body needs in large amounts

micronutrients nutrients that the body needs in very small amounts

phytochemicals substances in plants that are not nutrients but may have healthful benefits

be supplemented by the diet. Chapter 7 discusses some amino acids that are conditionally essential. Amino acids are the nitrogen-containing compounds that make up protein molecules.

Macronutrients and Micronutrients

So far, we have organized nutrients based on their chemical composition and essentiality. A third way to classify nutrients is based on amounts that the body needs. Carbohydrates, fats, and proteins are **macronutrients** because the body requires relatively large amounts of these nutrients daily (*macro* = large). Vitamins and minerals are **micronutrients** because the body needs very small amounts of them to function properly (*micro* = small).

In general, a serving of food supplies grams (g) of carbohydrate, fat, and protein and milligram (mg) or microgram (μg) quantities of vitamins and minerals. For example, a serving of a vanilla ice cream cone (1/2 cup scoop in a sugar cone) provides about 24 g of carbohydrate, 8 g of fat, 3 g of protein, 88 mg of calcium, and 145 mg of potassium.

Macronutrients supply energy for cells, whereas micronutrients are not sources of energy. Although the body requires large amounts of water, this nutrient does not provide energy and is not usually classified as a macronutrient.

Phytochemicals

Plants make hundreds of substances called **phytochemicals** (*phyto* = plant), which are not nutrients (nonnutrients), yet they may have health benefits. The stimulant caffeine, for example, is a phytochemical made by coffee plants. Beta-carotene is a phytochemical in many fruits and vegetables that the body can convert to vitamin A. Table 1.4 identifies rich food sources of several phytochemicals that scientists are studying. The table indicates some effects of the phytochemicals on the body, including possible health benefits.

Not all phytochemicals have beneficial effects on the 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.



Most foods are mixtures of nutrients. An ice cream cone is a rich source of carbohydrate and fat, but this dessert also contributes some protein, calcium, and potassium to diets.
M. Unal Ozmen/Shutterstock

Information about several phytochemicals that have known effects on human health is woven into the chapters of this textbook where appropriate.

TABLE 1.4 Phytochemicals of Scientific Interest

Classification and Examples	Biological Effects/Possible Health Benefits	Rich Food Sources
Carotenoids Alpha-carotene, beta-carotene, lutein, lycopene, zeaxanthin	May reduce risk of certain cancers and macular degeneration (a major cause of blindness in the United States)	Orange, red, yellow fruits and vegetables; egg yolks
Phenolics	Antioxidant activity; may inhibit cancer growth and reduce risk of heart disease	
Quercetin		Apples, tea, red wine, onions, olives, raspberries, cocoa
Catechins		Green and black tea, chocolate, plums, apples, berries, pecans
Anthocyanins		Red, blue, or purple fruits and vegetables
Resveratrol		Red wine, purple grapes and grape juice, dark chocolate, cocoa
Isoflavonoids		Soybeans and other legumes
Tannins		Tea, coffee, chocolate, blueberries, grapes, persimmons
Monterpenes		Oranges, lemons, grapefruit, cherries
Organosulfides Isothiocyanates, indoles, allylic sulfur compounds	Antioxidant effects; may improve immune system functioning and reduce the risk of heart disease	Garlic, onions, leeks, cruciferous vegetables (broccoli, cauliflower, cabbage, kale, bok choy, collard and mustard greens)
Alkaloids Caffeine	Stimulant effects	Coffee, tea, “energy drinks,” kola nuts, cocoa
Capsaicinoids Capsaicin	May provide some pain relief	Chili peppers

ASSESS YOUR PROGRESS

- 3 List the six major classes of nutrients and identify at least one physiological role for each class.
- 4 Explain the meaning of organic in the context of chemical compounds.
- 5 What are three key factors that determine whether a substance is an essential nutrient?
- 6 Distinguish between macronutrients and micronutrients, and provide examples of each.
- 7 List at least three foods that are rich sources of phytochemicals.

1.3 Food as Fuel

LEARNING OUTCOMES

- 1 Distinguish between a calorie and a kilocalorie.
- 2 Estimate the amount of energy (kcal) in a serving of food based on the grams of carbohydrate, protein, fat, and alcohol present.

Most foods are sources of biological fuels because they provide energy for cells. The human body uses energy while running, sitting, studying, and even sleeping. Every cell in the body needs energy to carry out its various activities. Therefore, people need to consume energy-containing foods to survive.

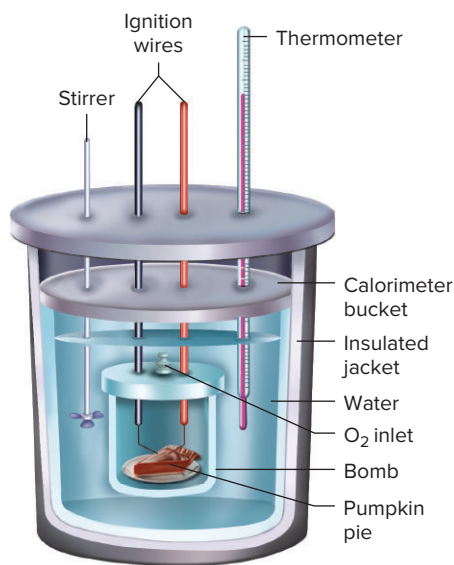


FIGURE 1.4 Bomb calorimeter.

calorie amount of heat necessary to raise the temperature of 1 g (1 ml) of water 1° Celsius (C)

kilocalorie (kcal) or **Calorie** the heat energy needed to raise the temperature of 1000 g (1 liter) of water 1° Celsius (C)

bomb calorimeter device used to measure the calories in a sample of food

A **calorie** is the amount of heat (a form of 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 that 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 (1 liter) of water 1° Celsius (C). A small apple, for example, supplies 40,000 calories, 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*. Appendix I is a food composition table that lists the energy and nutrient contents of many commonly consumed foods and beverages.

Direct Calorimetry

The calorie content of a food or beverage can be determined through direct calorimetry, which involves placing a specific amount of food in a **bomb calorimeter** (*kal-oh-rim'-eh-ter*). As shown in Figure 1.4, the “bomb” is a small chamber surrounded by a jacket of water. An electrical spark ignites the food, and under the conditions inside the bomb, the food burns completely. As the food burns, it releases energy in the form of heat, which raises the temperature of the water in the surrounding chamber. A thermometer measures the increased water temperature, and scientists use this information to determine the number of calories in the food.

Compared to the human body, a bomb calorimeter is much more efficient at using the energy-yielding nutrients in foods as fuel. Therefore, scientists must correct for this difference in efficiency when developing food composition tables, such as the one in Appendix I.

Calculating Food Energy

Consumers can calculate the number of kcal in their diets by knowing the amounts of macronutrients and the nonnutrient alcohol in their foods and beverages. A gram of carbohydrate and a gram of protein each supply about 4 kcal; a gram of fat provides about 9 kcal (Fig. 1.5). Alcohol is not a nutrient because the human body does not need the chemical to survive. Alcohol, however, is a source of energy; a gram of pure alcohol supplies 7 kcal. Chapter 8 discusses alcohol, including its metabolism and effects on health.

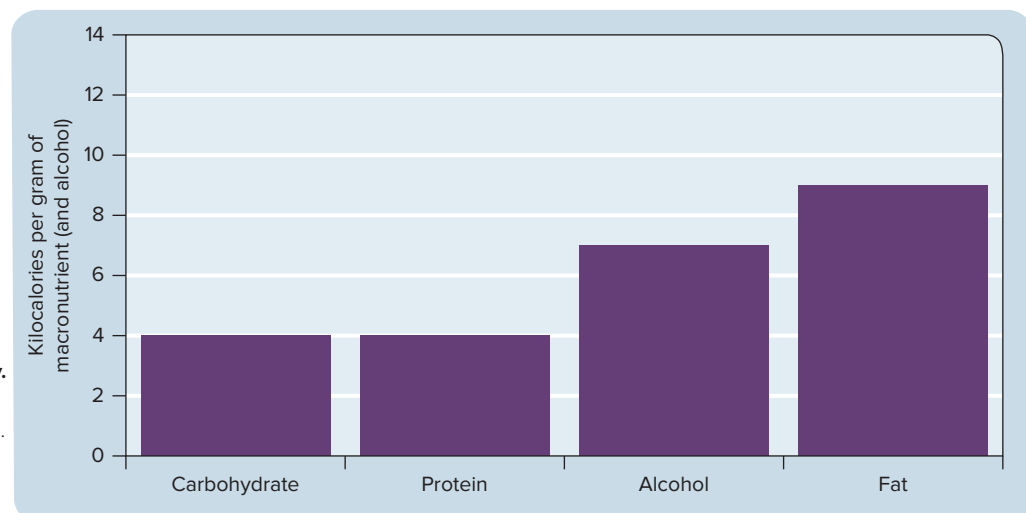


FIGURE 1.5 Energy sources for the body.

Macronutrients and alcohol supply our bodies with energy in the form of calories.

Elena Schweitzer/iStock/360/Getty Images;
D. Hurst/Alamy; Hurst Photo/Shutterstock;
Torbjorn Lagerwall/Alamy Stock Photo

Let us use the ice cream cone mentioned earlier as an example for estimating the caloric content of a food. The ice cream cone contains about 24 g of carbohydrate, 8 g of fat, and 3 g of protein. To estimate the number of kcal provided in a serving of this food,

STEP 1: Determine how many kcal are provided by each type of macronutrient.

24 g carbohydrate	×	4 kcal/g carbohydrate	=	96 kcal
8 g fat	×	9 kcal/g fat	=	72 kcal
3 g protein	×	4 kcal/g protein	=	12 kcal

STEP 2: Add the individual kcal from carbohydrate, fat, and protein together to estimate the total kcal per serving of the food.

Total kcal = 96 kcal (carbohydrate) + 72 kcal (fat) + 12 kcal (protein) = 180 kcal

This food provides approximately 180 kcal per serving.

ASSESS YOUR PROGRESS

- 8 What is the difference between a calorie and a kilocalorie?
- 9 A slice of whole-wheat bread supplies approximately 13 g of carbohydrate, 1 g of fat, 3 g of protein, and 11 g of water. Based on this information, estimate the number of kilocalories provided in a slice of the bread.
- 10 An alcoholic beverage contains 4 g of carbohydrate and 10 g of alcohol. In this drink, how many kilocalories are provided by the alcohol?

1.4 Does Diet Matter?

LEARNING OUTCOMES

- 1 List the 10 leading causes of death in the United States.
- 2 Describe lifestyle factors that contribute to many of the leading causes of death in the United States.
- 3 Explain the purpose of the Healthy People initiative.

In the beginning of this chapter, we mentioned that public health officials are concerned about the impact that poor food choices can have on the health of Americans. The graph shown in Figure 1.6 shows the 10 leading causes of deaths in the United States and the approximate percentages of deaths that were attributed to each of them in 2017. Note that heart disease was the leading cause of death and cancer was the second leading cause of death. In 2017, these two diseases accounted for almost half of all deaths.⁴ Also note that several of the leading causes of death are diet-related and responsible for the premature (early) deaths of thousands of adult Americans.

Risk Factors

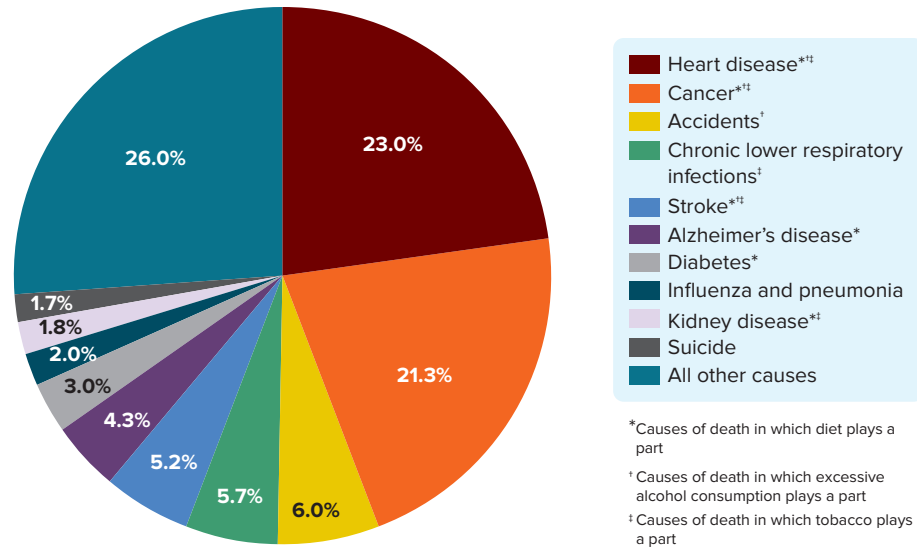
Heart disease, diabetes, and cancer are chronic diseases. **Chronic** diseases are long-term conditions that usually take many years to develop and have complex causes. A **risk factor** is an attribute, a characteristic, or an exposure that increases a person’s chances of developing a chronic disease. For example, genetic background or family history is an important risk factor for heart disease. If your grandfather had a heart attack before he was 55 years old and your mother is being treated

chronic long term

risk factor attribute, characteristic, or exposure that increases a person’s chances of developing a chronic disease

FIGURE 1.6 Approximate percentages of leading causes of death in the United States, 2017. Lifestyle factors contribute to many of the 10 leading causes of death in the United States.

Source: Kochanek, K and others: Deaths: Final Data for 2017. *National Vital Statistics Report*. 68(9): 1-77, 2019.



for having high blood pressure and high blood cholesterol levels (risk factors for heart disease), your family history indicates you have a higher-than-average risk of having a heart attack.

Lifestyle Choices

For many people, having a family history of a chronic disease does not mean that they will develop the condition. Other risk factors that contribute to ill health are unsafe environmental conditions; psychological factors, such as excess emotional stress; social determinants of health equity, such as lack of access to food and health care; advanced age; and unhealthy lifestyle. **Lifestyle** is a routine way of living, which includes one's usual dietary practices and exercise habits.

A person's lifestyle may increase or reduce his or her chances of developing many chronic diseases or delay their occurrence for years, even decades. People who choose to consume low-fat dairy products, fruits, vegetables, nuts, lean meats, and whole-grain cereals, as well as exercise regularly, may reduce their chances of developing serious diseases that contribute to premature death,

lifestyle a routine way of living

COVID-19

According to the CDC, as of November 14, 2020, COVID-19 contributed to nearly 230,000 deaths in the United States. With COVID-19 related deaths continuing to rise, the virus is expected to be one of the top three leading causes of death in the United States for 2020. For additional details and the most current statistics on deaths from COVID-19, visit <https://www.cdc.gov/nchs/nvss/vsrr/covid19/index.htm>.

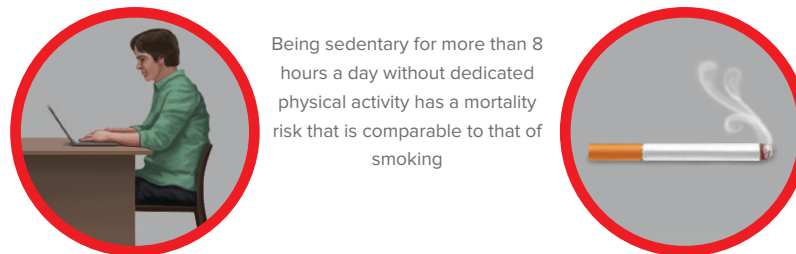
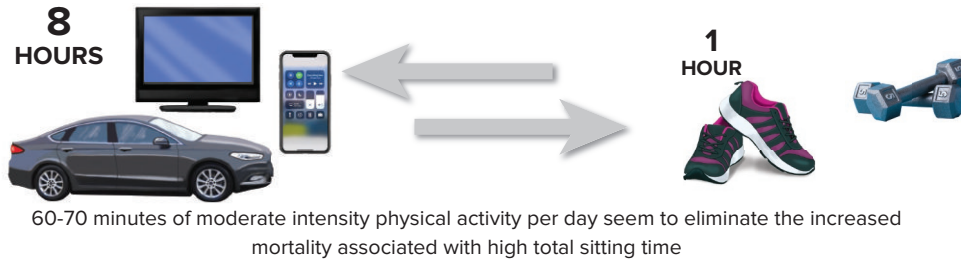
DID YOU KNOW?

A person's genetic makeup influences the effects that a person's diet may have on his or her health, as well as the individual's likelihood of developing most diseases. Nutritional genomics concentrates on the effect our genes have on our risk of disease and dysfunction that can be mitigated by nutritional intervention, as well as the impact our food, nutrition, stress, and toxins have on the expression of our genes. It is the umbrella term that includes nutrigenetics, nutrigenomics, and nutritional epigenomics.⁵ For example, your genetic makeup plays a major role in determining the levels of chemicals your body produces, including those that influence hunger and appetite control. If your body makes abnormal amounts of these chemicals, you might overeat and gain excess body fat as a result. Although you cannot change your genes, you can control or change many other factors that influence your gene expression and health. Chapter 7 provides more information about nutritional genomics.



Model of a section of DNA
Digital Vision/Getty Images

Engaging in 60 Minutes or More of Physical Activity Can Counteract 8 Hours of Sedentary Time



Be physically active when sedentary time is an unavoidable part of your day!

FIGURE 1.7 The importance of physical activity when sedentary behavior is unavoidable.

Barbells: Kristin Lee/Getty Images

particularly heart disease, type 2 diabetes, certain cancers, and excess body fat.⁶ On the other hand, people who consume a poor diet and live a sedentary lifestyle can develop numerous health problems, including obesity and high blood sugar (Fig. 1.7). Obesity is a risk factor for several chronic health problems, including heart disease and type 2 diabetes. Chapter 13 discusses obesity and its effects on health.

Healthy People 2020/2030 In the United States, public health officials monitor the state of Americans' health. A major focus of the government's public health efforts is the development of educational programs designed to prevent obesity and other serious chronic health problems. Every 10 years, the U.S. Department of Health and Human Services (DHHS) issues a report called *Healthy People*, which includes national health promotion and disease prevention goals that Americans should meet. The *Healthy People* report is a set of science-based national objectives with the goal of improving the health of all Americans. Nutrition and Weight Status is a topic area, and there are corresponding objectives and specific target goals Americans should meet. To access more information about these objectives and to see progress reports, visit the government's website: <https://www.healthypeople.gov/>.

ASSESS YOUR PROGRESS

- 11 What is lifestyle?
- 12 Identify the leading causes of death in the United States that are associated with dietary practices.
- 13 How often does the U.S. Department of Health and Human Services publish new Healthy People goals?

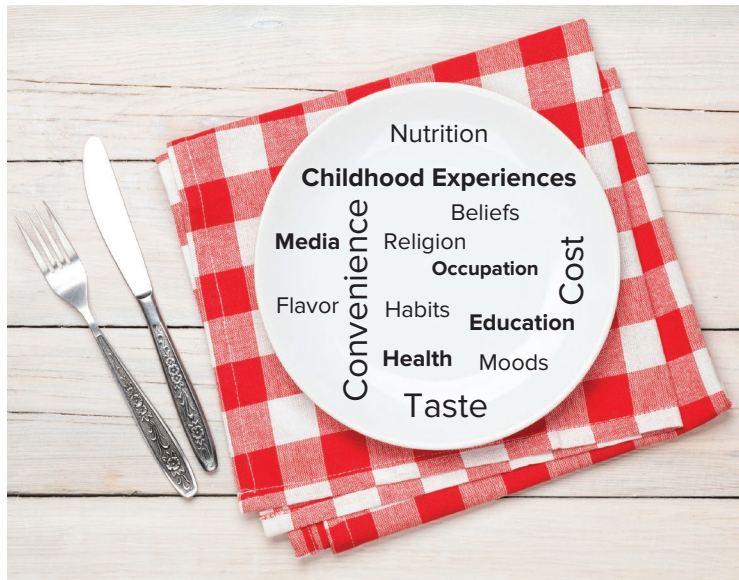


FIGURE 1.8 What influences your eating practices?
karandaev/123RF

1.5 Factors That Influence Eating Habits

LEARNING OUTCOMES

- 1 Discuss the influence that biological, physiological, cognitive, psychological, environmental, and expert advice factors can have on a person's food choices.
- 2 Explain ways that food marketing efforts can influence an individual's food selections.
- 3 Describe the role a registered dietitian nutritionist can play in an individual's selection of food.

Food is more than just a collection of nutrients and “something to eat.” Food also has personal meaning and significance, evokes feelings and sensations, and conveys status and ethnicity. Figure 1.8 displays many factors that influence a person's usual food selections. This section examines some of the biological, physiological, cognitive (involving thought processes), psychological, environmental, and expert advice factors that play important roles in determining what people consider as food and when they choose to eat it.

Biological and Physiological Factors

Biological and physiological factors that influence food selections include age; ability to perceive external sensory information, such as taste, smell, and texture of foods; and internal sensations of hunger and thirst. For example, a college athlete with a rigorous practice schedule has different nutritional needs than a student with a long commute who sits in class most of the day.

Life's Stages

One's stage of life (during childhood, pregnancy, or older adult years, for example) and health problems affect a person's nutrient requirements and resulting food selections. Age is a major factor that influences food choices. Infants and young children rely on adult caregivers (“gatekeepers”) for their food and how it is prepared. Gatekeepers choose what the children eat and prepare it. Older children, particularly teenagers, typically have more control over their diets. When young adults leave home and associate with people from diverse geographical and ethnic backgrounds, they often broaden their usual food choices. As people grow older, chronic health problems, such as high blood pressure (hypertension), swallowing difficulties, or excessive tooth loss, may require changing food choices, as well as the ways the food is prepared and how much can be eaten. Making such modifications may be necessary for an individual to improve his or her health and maintain a sense of well-being. Chapters 16, 17, and 18 provide information about nutritional recommendations during various stages of life.

Sensory Information

Would it be difficult for you to resist walking past a bakery shop without stopping to purchase some of the items? Humans rely on various types of sensory information, particularly the taste, texture, odor, and appearance of food, to develop personal food likes and dislikes. Chapter 4 includes information about the senses of taste and smell.



Senses, particularly sight, smell, and taste, contribute to the appeal of certain foods.
©Purestock/SuperStock

Cognitive and Psychological Factors

Cognitive factors that influence food choices involve learning processes. People learn which foods are acceptable to eat from past experiences, cultural practices, and religious teachings. Learning about foods and nutrition also takes place at home; in the classroom; and from media, including the Internet. Individuals can use the information to build a personal food-belief system that may encourage them to try new foods or adopt a better diet.

Although learning which foods are healthy may influence a person's dietary practices, psychological factors, especially emotional stress level and mood, also play important roles in what an individual chooses to eat. The link between food and mood is complex. A bidirectional relationship seems evident in that food affects mood and vice versa.⁷ For example, studies have shown an improvement in depressive symptoms when those with depression follow a Mediterranean diet.⁸ Chapter 3 includes more information on a Mediterranean diet.

Experiences with food can result in positive or negative associations. Children, for example, often prefer the taste of sweet foods, and caregivers may use sugary snacks or desserts as rewards for children who display good behavior. As a result, adults may reward themselves with sweets to obtain the same positive feelings. In a similar way, "comfort foods" may provide desirable feelings for adults. Eating such foods may evoke a sense of being in a safe haven, such as at home.

Some food-related experiences are negative. A 6-year-old boy, for example, who enjoys macaroni and cheese eats a bowl of the food and about an hour later becomes "sick to his stomach" and vomits. Although the macaroni and cheese did not cause the vomiting, this child may be unwilling to eat that food for several years and possibly for the rest of his life because he associates it with a stomach-related illness.

Environmental Factors

Environmental factors play a major role in what people eat. Such influences include food cost, proximity of one's home to a food store, and availability of food on campus or in the workplace. If you have access to grocery stores and a kitchen, you may prepare most of your meals with fresh ingredients and pack lunches and snacks to take to class. In contrast, if one of your favorite fast-food restaurants is near your home and the closest food store is a few bus stops away, you may find it easier to eat meals at the restaurant than to purchase food to prepare them. If you must rely primarily on your campus's dining facilities for your meals, your food choices may be limited to what is offered.

Consumers may not realize the impact of macro-level environmental factors, such as government policies, food distribution, and food marketing, on their diets. Food manufacturers generally develop food packaging intended to attract buyers, and the layout of most major supermarkets is designed to encourage consumers to purchase specific foods—in many instances, pricier items that increase the stores' profits. Attractive displays at the ends of aisles, the positioning of products on shelves, and even the flooring material are intentionally designed to stimulate the senses, direct shoppers to more profitable items, and increase sales. Food marketing efforts also include media advertising, which relies heavily on the visual sense to attract people to try food products, regardless of their nutritional value. Such factors often make it difficult for nutrition educators to help their clients make wiser, healthier food choices.

Expert Advice Factors

A registered dietitian nutritionist can help you navigate your individual factors to select foods that will fit into your budget, support your health goals, and most importantly be accessible and taste good. A **registered dietitian nutritionist (RDN)** or **registered dietitian (RD)** is a college-trained healthcare professional who has extensive knowledge of foods, nutrition, and **dietetics**, the application of

DID YOU KNOW?

A registered dietitian nutritionist (RDN or RD) is a healthcare professional who is "a food and nutrition expert." People cannot always rely on someone who refers to himself or herself as a "nutrition expert" or "nutritionalist" for reliable nutrition information because there are no standard legal definitions for these descriptors. Many states have licensure laws for someone using the title nutritionist. In other states, however, people can refer to themselves as nutritionists regardless of their education or training. Be wary if a so-called nutrition expert has "credentials" that lack credibility among members of the scientific community. Locate a nutrition expert near you by visiting <https://www.eatright.org/find-an-expert>.

registered dietitian nutritionist (RDN) or **registered dietitian (RD)** college-trained healthcare professional who has extensive knowledge of foods, nutrition, and dietetics

dietetics application of nutrition and food information to achieve and maintain optimal health and to treat many health-related conditions

nutrition and food information to achieve and maintain optimal health and to treat many health-related conditions. A person can become a RD/RDN by obtaining a degree from an accredited college (as of 2024, a master's degree is required), completing extensive supervised practice hours, passing a national exam, and completing ongoing continuing education. For more information on this career, visit <http://www.eatrightacend.org/ACEND/>.

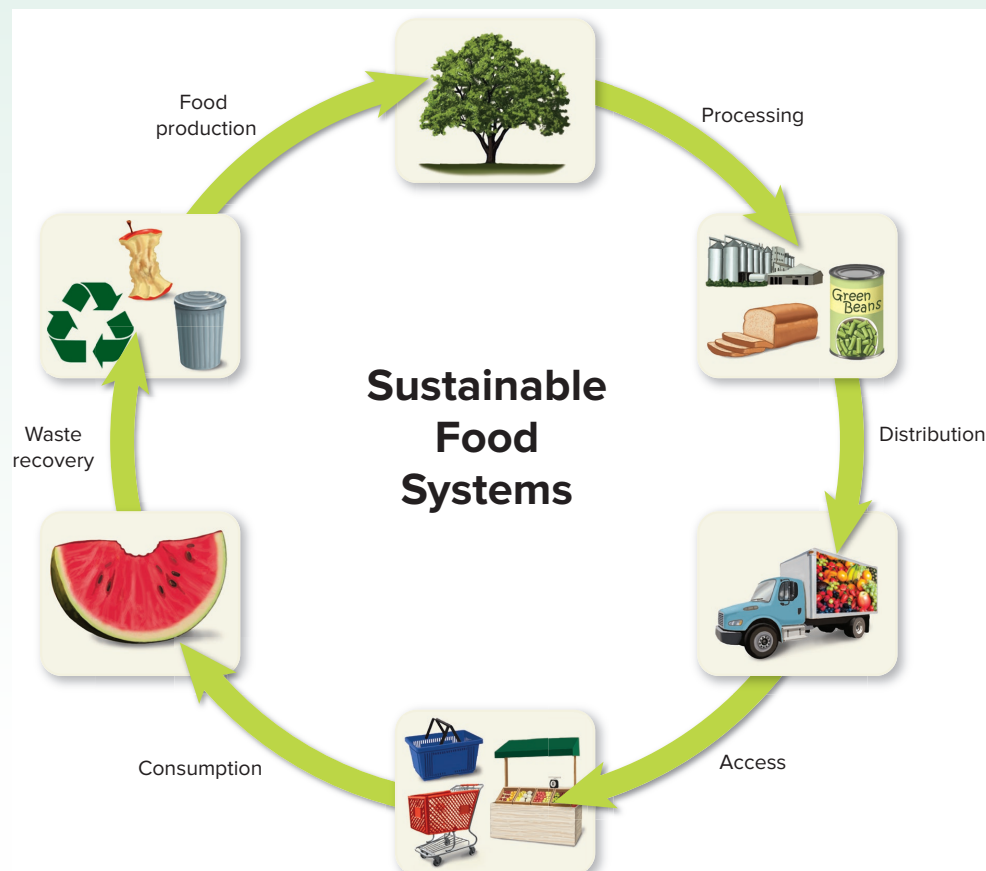


SUSTAINABILITY AND YOUR DIET

Have you ever thought about the path your food took to get to you? Have you considered the fate of your food waste? The food system includes all of the components and activities that relate to the production, processing, distribution, access, consumption, and waste recovery of food. There are global food systems and local food systems. In order to feed a healthy diet to the estimated world population of about 10 billion by 2050, the focus needs to be on an overall “sustainable food system.”

As shown in the accompanying diagram, a sustainable food system delivers food security and nutrition for all in such a way that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised.⁹ The food system is so complex and is an intersection of policy, agriculture, nutrition, and health. Therefore, many worldwide organizations are working together on specific goals to achieve a world without hunger or malnutrition in a sustainable way.

Nutrition starts with what we eat, but we also have to consider how our food is grown and processed, where we purchase our food, and what happens to our food waste. Throughout the textbook, we will introduce different topics that relate to sustainable food systems and steps you can take to support sustainability. For more information on sustainable food systems or the goals set by the United Nations, visit https://www.eatrightpro.org/practice/practice-resources/food-security-and-sustainability?rdType=url_edit&rdInfo=sustainable_food_systems.



ASSESS YOUR PROGRESS

- 14 Identify two biological or physiological factors that influence food choices.
- 15 Provide an example of a cognitive or psychological factor that can affect food choices.
- 16 Explain a specific situation when a person might want to consult with a registered dietitian nutritionist.

1.6 Key Nutrition Concepts

LEARNING OUTCOMES

- 1 Discuss the importance of the six key nutrition concepts to the study of nutrition.
- 2 Compare a food that has a lot of empty calories to a nutrient-dense food.
- 3 Explain energy density, and provide examples of energy-dense food choices.
- 4 Describe a dietary supplement according to the Dietary Supplement Health and Education Act of 1994.

As you start to study nutrition, it is important to grasp some key basic concepts related to nutrition, diet, and healthy eating (Table 1.5). This section will summarize six key nutrition concepts that will then be explored in further detail throughout the textbook.

Concept 1: Most Foods Are Mixtures of Nutrients

Most foods are mixtures of nutrients, and in many instances, water is the major nutrient in foods. For example, an 8-fluid-ounce serving of fat-free milk is about 91% water by weight, but it is an excellent source of protein and supplies carbohydrates and several vitamins and minerals. Although sugar (a carbohydrate) 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 and a few vitamins and minerals. Foods that have low nutritional value and are simply a source of calories should be consumed less frequently than other types of foods. Some foods, however, are healthier to consume more frequently than others.

Nutrient-Dense Foods

According to some nutrition experts, a **nutrient-dense** food supplies more key beneficial nutrients (protein, fiber, and certain vitamins and minerals) in relation to its total calories per serving.¹⁰ Furthermore, a nutrient-dense food has little or no solid fats, added sugars, refined starches, and sodium.¹¹ Vegetables, low-fat milk, fruits, lean meats, and whole-grain cereals are examples of nutrient-dense foods.

nutrient-dense describes a food that supplies more key beneficial nutrients and less solid fat, added sugars, refined starches, and sodium in relation to its caloric content

TABLE 1.5 Key Nutrition Concepts

Concept 1: Most foods are mixtures of nutrients.
Concept 2: Variety, moderation, and balance can help ensure a diet’s nutritional adequacy.
Concept 3: Food is the best source of nutrients.
Concept 4: Foods and the nutrients they contain are one of many components of health.
Concept 5: Malnutrition includes overnutrition as well as undernutrition.
Concept 6: Nutrition is a dynamic science.

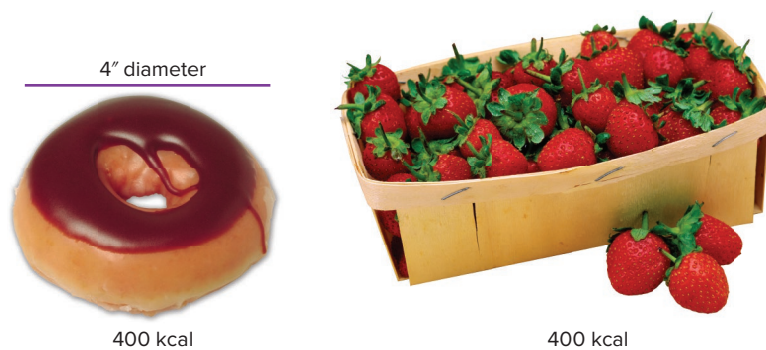


FIGURE 1.9 Energy density. A person has to eat 100 medium-size strawberries to obtain the same amount of energy that is in a chocolate glazed doughnut.
Ingram Publishing/Alamy; Pixtal/age fotostock

energy density amount of energy a food provides per given weight of the food

empty calories calories from unhealthy solid fats and added sugars

variety refers to a diet that contains foods from each food group

moderation refers to eating reasonable amounts of each food

Energy-Dense Foods

Energy density (or calorie density) is the amount of energy (kcal) a food provides per given weight (grams) of the food. Both of these values are listed on most food labels (see Fig. 3.17). According to one rule of thumb, an energy-dense food has a kilocalorie-to-weight ratio of 4.0 or higher.¹² When compared to carbohydrate, protein, and alcohol, fat supplies the most energy per gram. Thus, fatty foods tend to be more energy dense than foods with lower fat contents. Water provides no energy for the body, so watery foods, such as most fruits and vegetables, tend to be low in calories and have low energy densities.

Figure 1.9 shows amounts of two foods that supply the same number of calories. The chocolate, glazed doughnut, which weighs about 3.5 ounces (approximately 100 g) and is about 4 inches in diameter, provides almost 400 kcal. This doughnut's energy density is 4.0 (400 kcal/100 g). Eight medium strawberries also weigh about 100 g, but the fruit provides only 32 kcal. The strawberries' energy density is 0.32 (32 kcal/100 g). A person would have to eat 100 strawberries to obtain the same amount of food energy that is in the chocolate glazed doughnut. Therefore, the doughnut is an energy-dense food in comparison to the berries.

It is important to note that there are many energy-dense foods that are healthy. Nuts, for example, are high in fat and, therefore, energy dense. However, nuts are also nutrient dense because they contribute protein, vitamins, minerals, and fiber to diets.

Empty Calories

Some foods and beverages, such as candy, snack chips, and sugar-sweetened drinks, are rich sources of unhealthy solid fats and added sugars (SoFAS), which are often referred to as **empty calories**.¹³ Alcohol-containing beverages may also be considered sources of empty calories. In general, foods that contain a lot of empty calories are not good sources of vitamins and most minerals. Eating too many foods that contain a lot of empty calories may displace more nutritious foods from the diet. Thus, excess consumption of empty calories can contribute to an unhealthy diet. Chapter 3 has more information about empty calories.

Concept 2: Variety, Moderation, and Balance Can Help Ensure a Diet's Nutritional Adequacy

The human body is designed to obtain the nutrients it needs from a wide **variety** of foods. No naturally occurring food is “perfect” in that it contains all nutrients in amounts that are required by the body. To help ensure the nutritional adequacy of their diets, people should eat several different kinds of foods from each food group shown in Figure 1.10. People should also consume foods in **moderation**, or in reasonable amounts. Dietary moderation involves obtaining enough nutrients from food to meet one's needs while avoiding excessive amounts. Chapter 3 provides more information about food groups, including recommendations for serving sizes.

Figure 1.11 compares amounts of energy and certain nutrients provided by 8-ounce servings of fat-free milk and a cola-type, sugar-sweetened (“regular”) soft drink. Although the drinks supply similar amounts of calories, the milk provides more protein, calcium, phosphorus, riboflavin, and vitamin A. A nutritionally balanced diet contains a variety of nutrient-dense foods and limits empty calories. If a diet is comprised primarily of nutrient-dense foods and meets a healthy individual's nutritional needs, then occasionally including some sources of empty calories can add enjoyment to living—when the foods and beverages are consumed in moderation.

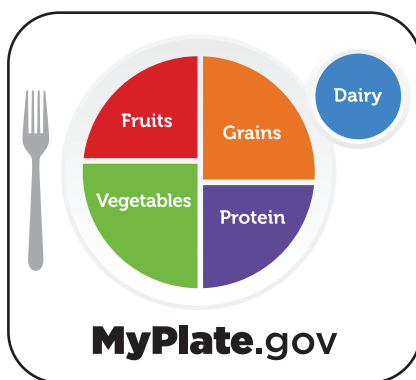


FIGURE 1.10 MyPlate food groups. Chapter 3 provides more information about MyPlate.
Source: www.myplate.gov

Concept 3: Food Is the Best Source of Nutrients

The most reliable and economical way for people to obtain nutrients and beneficial phytochemicals is to base their diets on a variety of “whole” and minimally processed foods. Plants, for example, often contain a variety of nutrients and phytochemicals, but processing (especially refining) may remove some healthful parts.

Some individuals, however, need higher amounts of vitamins and other nutrients than those found in food. A few people, for example, have inherited defects that increase their needs for nutrients, particularly vitamins. Older adults, pregnant women, people who take certain medications, and people who have digestive disorders that interfere with nutrient absorption may also require supplemental nutrients.

Dietary Supplements

A **dietary supplement** is a product 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.¹⁴ The **Dietary Supplement Health and Education Act of 1994 (DSHEA)** allows manufacturers to classify nutrient supplements and herbal products as foods.¹⁵ As a result of this legislation, dietary supplements do not undergo the rigorous testing of safety and effectiveness that medications must undergo before being marketed.

According to the results of one study, 75% of American adults reported taking a dietary supplement in 2018, which is a 10% increase over the past decade. The most commonly used dietary supplements continue to be multivitamin/mineral (MV/M) products. In general, taking a MV/M supplement that does not supply more than 100% of the recommended amounts of the micronutrients daily is unlikely to pose any risks to your health.¹⁶ However, healthy adults should consider taking such supplements as an “insurance policy” and not as a substitute for eating a variety of nutrient-dense foods.

In 2019, some of the most popular nonvitamin, nonmineral dietary supplements taken by American adults were fish oil or omega-3 fatty acids; protein powders, drinks, and bars; green tea, and probiotics.¹⁷ Results of scientific research indicate that some dietary supplements, such as vitamins and certain herbs, can have beneficial effects on health. Results of other studies, however, provide evidence that many popular dietary supplements are not helpful and may even be harmful. Information about specific dietary supplements is included in various chapters where appropriate.

At present, the Food and Drug Administration (FDA) does not regulate dietary supplements as strictly as prescription medications. The FDA is working to develop new enforcement strategies to ensure the safety of dietary supplements, but until the FDA determines that a particular supplement presents a significant or unreasonable risk of harm, the agency alerts consumers about the risk and seeks to recall the product; that is, the FDA initiates efforts to have it removed from the market. In most instances, the manufacturer voluntarily recalls the product after determining there is a problem with it or being notified by the FDA about the problem.¹⁸ In some cases, however, the FDA requests a recall.

Dietary supplements do not contain everything one needs for optimal nutrition. Although supplements that contain phytochemicals are available, they may not provide the same healthful benefits as consuming the plants that naturally have these compounds. Why not? People may need to consume nutrients and phytochemicals together to provide desirable effects in the body. Minimally processed food often contains combinations of these chemicals in very small amounts and certain proportions that the body can use safely. There is nothing “natural” about gulping down handfuls of dietary supplements.

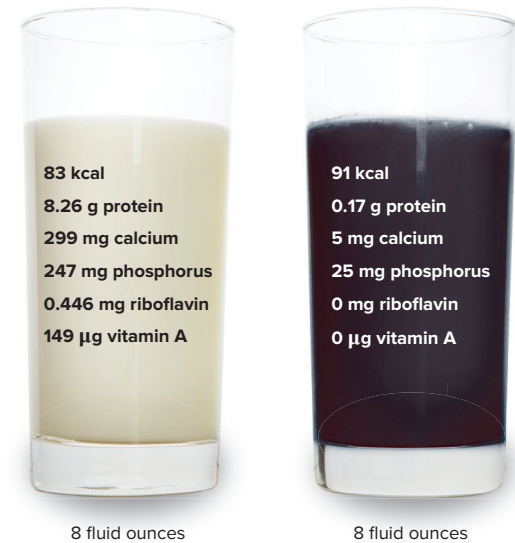


FIGURE 1.11 Beverage comparison. Although equivalent amounts of fat-free milk and a sugar-sweetened soft drink have similar calorie contents, the milk contains considerably more protein, riboflavin, vitamin A, and the minerals calcium and phosphorus.

DID YOU KNOW?

The FDA has standards for manufacturers to follow that help ensure the identity, purity, strength, and composition of dietary supplements.¹³ The agency, however, does not test dietary supplements to determine whether they meet such quality standards. Manufacturers can have certain nongovernmental laboratories, including U.S. Pharmacopeia and ConsumerLab.com, test product quality. Products that pass such testing are permitted to display seals of approval on the label to assure consumers that the products were properly manufactured and do not contain dangerous amounts of contaminants. It is important to note that products bearing such seals of approval are not guaranteed to be safe or effective.

dietary supplement product 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

Dietary Supplement Health and Education Act of 1994 (DSHEA) federal legislation that allows manufacturers to classify nutrient supplements and herbal products as foods

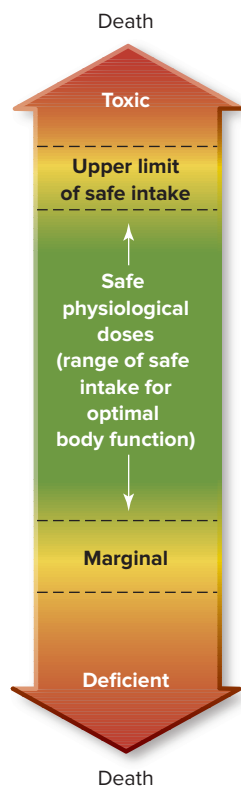


FIGURE 1.12 Nutrient intake continuum. For each nutrient, there is a range of safe intake.

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 of the nutrient and most commonly results from supplement consumption.

For Each Nutrient, There Is a Range of Safe Intake

More is not always better when it relates to optimal nutrition. The **physiological dose** of a nutrient is the amount that is within the range of safe intake and enables the body to function optimally. Consuming less than the physiological dose can result in marginal 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 disease 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. The diagram shown in Figure 1.12 illustrates the general concept of deficient, safe, and toxic intake ranges for nutrients such as vitamins and minerals. Chapter 3 discusses nutrient needs and the *Dietary Reference Intakes*, which include standards for safe intakes of nutrients. Chapters 9 through 12 provide more information about micronutrients, including deficiencies and toxicities.

Most commonly eaten foods do not contain toxic levels of vitamins and minerals. A **megadose** is an amount of a vitamin or mineral that greatly exceeds the recommended amount of the nutrient and most commonly results from supplement consumption. When taken in high amounts, many vitamins behave like drugs and can produce unpleasant and even toxic side effects. Some healthcare providers prescribe megadoses of the B-vitamin niacin to treat high blood cholesterol levels, but such amounts can cause serious side effects, including liver damage. Compared to vitamins, minerals generally have very narrow ranges of safe intakes.

FRESH TIPS

Consider these guidelines to help you make informed choices about the use of dietary supplements:

- Determine whether the supplement is necessary. Discuss your need for the supplement with your physician or a registered dietitian nutritionist before you purchase or use the product, especially if you are pregnant, are breastfeeding, or have a chronic condition such as diabetes or heart disease.
- If you are experiencing symptoms of a serious illness, consult a physician. Using supplements to treat health problems instead of seeking conventional medical care can be a risky practice. Delaying or forgoing medical evaluation and treatment may result in an illness becoming worse or even life-threatening.
- The following government websites provide reliable information about dietary supplements:
 - U.S. National Library of Medicine (https://medlineplus.gov/druginfo/herb_All.html)
 - U.S. Food and Drug Administration (<http://www.fda.gov/Food/DietarySupplements/default.htm>)
 - Office of the Dietary Supplements (<https://ods.od.nih.gov/>)
- If you experience negative side effects after using a particular dietary supplement, consult a physician immediately. Furthermore, you and your healthcare provider should report the problem to the FDA's MedWatch program by calling (800) FDA-1088 or visiting the agency's website: <http://www.fda.gov/Safety/MedWatch/HowToReport/default.htm>.

Concept 4: Foods and the Nutrients They Contain Are One of Many Components of Health

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 that influences a person's 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.

Each year, food manufacturers introduce new products into the marketplace that are designed to attract health-conscious consumers. Many of these foods are referred to as “functional foods” because they contain nutrient and/or phytochemical ingredients that may provide health benefits. Functional foods are often manufactured to boost nutrient intakes or help manage specific health problems. For example, consumers who want to increase their calcium intake to promote bone health can purchase orange juice that has the mineral added to it. Various chapters present information about functional foods and their roles in health.

What About Special Diets?

Registered dietitian nutritionists often plan modified (“special”) diets (**medical nutrition therapies**) for people with chronic health conditions, such as diabetes, cardiovascular disease, food allergies, or celiac disease. Dietitians must consider many factors regarding a patient’s situation, including his or her current health status, occupation, food likes and dislikes, budget, family and peer support systems, and ability to access and prepare foods. Information about special diets is included in the chapters where appropriate.

medical nutrition therapies nutritionally modified diets for people with chronic health conditions

Concept 5: Malnutrition Includes Overnutrition as Well as Undernutrition

Malnutrition (*mal* = bad) is a state of health that occurs when the body is improperly nourished. Although many people associate malnutrition with undernutrition and starvation, overnutrition, which is long-term excess consumption of energy or nutrient intake, is also a form of malnutrition. Chronic overnutrition characterized by excessive energy intake results in obesity. Chapter 13 provides information about obesity; Chapters 7 and 20 include discussions about undernutrition.

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

Some people select nutritionally inadequate diets because they lack knowledge about nutritious foods or the importance of nutrition to health. Individuals with low incomes and older adults living on fixed incomes are often at risk for malnutrition because they have limited financial resources for making healthy food purchases. Other people who are at risk for malnutrition include those who have severe eating disorders, are addicted to drugs such as alcohol, or have serious medical problems that interfere with their body’s ability to absorb or use nutrients.

Concept 6: Nutrition Is a Dynamic Science

As researchers continue to explore the complex relationships between diet and health, therefore, nutrition information and dietary recommendations constantly change. The public may expect medical researchers to provide definite answers to their nutrition-related questions and rigid advice concerning optimal dietary practices. However, nutrition is not an exact science, especially when the research involves human subjects. As a result, dietary practices and recommendations undergo revision as new scientific evidence becomes available and the information is reviewed and accepted by nutrition experts. Chapter 2 discusses how nutrition scientists collect information and report their findings.



It is possible to be both overweight as well as undernourished.

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ASSESS YOUR PROGRESS

- 17 Discuss the importance of variety, moderation, and balance in terms of a person’s diet.
- 18 Provide at least three examples of foods or beverages that contain empty calories and three examples of foods or beverages that are nutrient-dense.
- 19 Explain why an herbal product that contains echinacea is a dietary supplement according to the Dietary Supplement Health and Education Act of 1994.

SUMMARY

SECTION 1.1 The Importance of Nutrition

- The human body needs nutrients for the growth, maintenance, and repair of cells. Nutrition is the scientific study of nutrients and how the body uses them.
- Public health experts are concerned with Americans' eating habits because rates of many serious chronic diseases are associated with certain dietary practices. People may be able to live longer, healthier lives by improving the nutritional quality of their diets.

SECTION 1.2 The Nutrients

- The six classes of nutrients are carbohydrates, lipids, proteins, vitamins, minerals, and water. The human body can synthesize many nutrients, but about 50 nutrients are essential nutrients that must be supplied by food or supplements.
- Carbohydrates, lipids, proteins, and vitamins are organic nutrients; minerals and water are inorganic nutrients. Carbohydrates, fats, and proteins are macronutrients; vitamins and minerals are micronutrients.
- Plant foods contain a variety of phytochemicals. Many phytochemicals are beneficial antioxidants, but some phytochemicals are toxic.

SECTION 1.3 Food as Fuel

- A Calorie is the heat energy needed to raise the temperature of 1 liter of water 1° Celsius (C).
- A gram of carbohydrate and a gram of protein each supply about 4 kcal; a gram of fat provides about 9 kcal. Although alcohol is not a nutrient, a gram of pure alcohol provides 7 kcal.

SECTION 1.4 Does Diet Matter?

- Heart disease and cancer are the two leading causes of death for all Americans. Such chronic diseases are complex conditions that have multiple risk factors.
- People may live longer and healthier by modifying their lifestyles, including their diets.
- Nutrition and Weight Status is one of several topic areas of the *Healthy People* report, which is updated every 10 years.

SECTION 1.5 Factors That Influence Eating Habits

- Biological, physiological, cognitive, psychological, environmental, and expert advice factors influence a person's food choices.
- A registered dietitian nutritionist (RDN) or registered dietitian (RD) is a food and nutrition expert who has graduated from an accredited degree program in nutrition and dietetics, completed a supervised practice program, and passed a comprehensive national exam.

SECTION 1.6 Key Nutrition Concepts

- Most foods are mixtures of nutrients.
- Variety, moderation, and balance can help ensure a diet's nutritional adequacy.
- Food is the best source of nutrients.
- Foods and the nutrients they contain are one of many components of health.
- Malnutrition includes overnutrition as well as undernutrition.
- Nutrition is a dynamic science.

CASE STUDY RESPONSE

Healthy eating while on campus



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JORGE'S EATING PRACTICES do not reflect a nutritionally adequate pattern. His diet is nutritionally imbalanced because it lacks fruits, vegetables, and dairy products. As well, his food choices do not include a variety of more nutrient-dense foods. Furthermore, his diet lacks moderation in that he chooses large portion sizes, particularly of foods that contain a lot of empty calories. Jorge can

- Consider choosing more nutrient-dense foods. On busy class days, for example, he can carry light snacks with him, such as a bag of almonds or walnuts, carrot sticks, fresh fruit, or peanut butter spread on whole-grain crackers.
- Be more careful when choosing which foods to eat in his dorm's dining hall. He can learn to broaden his food likes to include a greater variety of foods, especially fruits and vegetables.
- Practice moderation by reducing his food portions, especially of the many energy-dense options that are available at the dining hall. Jorge can choose smaller portions and not return to the buffet for "seconds," unless it is to serve himself more nutrient-dense food choices such as fruits and vegetables.

CULINARY MEDICINE



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Modifying Recipes for Healthy Living

Culinary medicine combines knowledge of evidence-based dietary recommendations for optimizing health and preventing and treating disease. It also includes practical cooking guidance to make food tasty and appealing. Each chapter includes a "Culinary Medicine" activity that is related to the content of that chapter. You will typically be provided with a basic recipe and instructed to modify the recipe to make it healthier to meet certain dietary recommendations. Table 1.6 provides suggestions for common ingredient substitutions and indicates how the changes improve the nutritional quality of the products. For example, modifying the type and amount of sweetener in a cookie recipe can significantly decrease the sugar content of the cookies. As you modify recipes, keep the following tips in mind:

- Do not change every ingredient. Make one or two minor changes each time you try the recipe. For example, if you are making a cake for the first time, do not eliminate all the sugar and fat. These are ingredients that add flavor, color, texture, and moisture to the cake. A cake with no sugar or fat would be dry and almost tasteless.
- Recipes can often be made healthier simply by making minor changes, such as replacing solid fat with canola oil, eliminating salt, or reducing the amount of sugar by 25%. You probably will not notice a significant difference in taste or quality if you use $\frac{3}{4}$ cup of sugar instead of 1 cup or $\frac{1}{2}$ teaspoon of salt instead of 1 teaspoon. Appendix A provides information about household measures, such as cups and teaspoons.

Culinary medicine is a growing field of study with medical programs now incorporating food preparation and cooking skills as part of the program curriculum. Visit <https://culinarymedicine.org/> for more information about the Certified Culinary Medicine Specialist credential and associated resources.



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TABLE 1.6 Recipe Substitutions for Better Nutrition

Recipe Calls For	Modification or Substitution	Nutritional Effects of the Change
All-purpose (white) flour or bread flour	Use ½ whole-wheat flour and ½ all-purpose flour for each cup of all-purpose or bread flour. Use 1 cup black bean puree in place of 1 cup flour in brownies.	Adds fiber Eliminates wheat and adds protein and fiber
Butter or margarine (in baking)	Replace each quantity of butter or margarine with an equivalent amount of applesauce. Use ½ cup mashed, cooked carrots, sweet potato, pumpkin, or squash for each 1 cup butter or margarine in baked goods.	Reduces calories and solid fat (“unhealthy fat”); adds some fiber and vitamins Reduces calories and solid fat; adds some fiber, vitamins, and phytochemicals
Cream	Use whole milk or half-and-half.	Reduces calories and solid fat
Cream cheese, regular	Use low-fat or reduced-fat (“Neufchatel”) cream cheese.	Reduces calories and solid fat
Cheese, regular	Use low-fat or nonfat cheese. <i>NOTE: Do not use nonfat cheese in cooked foods because it will not melt properly.</i>	Reduces calories and solid fat
Enriched pasta or rice	Use whole-grain pasta or brown rice. Mix ½ whole-grain pasta with ½ regular pasta.	Adds fiber
Eggs	Use 2 egg whites or ¼ cup egg substitute for each whole egg. Mix 1 Tbsp ground flax seeds with 3 Tbsp warm water and let sit for 5 minutes to replace 1 egg in baked goods.	Reduces calories and cholesterol Adds fiber and eliminates the egg in case of an allergy
Evaporated milk	Use low-fat evaporated milk.	Reduces calories and solid fat
Condensed milk	Use low-fat evaporated milk. <i>NOTE: Products will not be as sweet.</i>	Reduces calories from solid fat and added sugar
Fruit canned in heavy sugar syrup	Use fresh or frozen fruit. Use fruit canned in “own juice” or light syrup, or rinse sugar syrup from fruit before using.	Reduces calories and sugar; adds vitamins and phytochemicals Reduces calories and added sugar
Herbs with added salt (e.g., “garlic salt”)	Use salt-free ground herbs and spices or fresh herbs and spices such as basil, cilantro, dill, oregano, or paprika.	Reduces sodium
Salt	Do not add to water before cooking vegetables or pasta. Do not add salt to foods before serving them.	Reduces sodium
Sour cream, regular	Use fat-free or low-fat sour cream. Use plain fat-free Greek yogurt.	Reduces calories and solid fat Increases protein
Sugar, white or brown	Reduce the amount of sugar by 25–50%. Use a sugar substitute that is appropriate for preparing baked products.	Reduces calories and added sugar
Vegetable oil	Reduce amount by 25%. Use ¾ cup mashed, cooked carrots, sweet potato, pumpkin, or squash for 1 cup oil in baked goods.	Reduces calories Reduces calories and fat and adds fiber, vitamins, and phytochemicals
Whole milk, 2% milk	Use fat-free or low-fat milk.	Reduces calories and solid fat

PERSONAL Dietary Analysis

1. For 1 week, track your food purchases from grocery and/or convenience stores.
 - a. How much money did you spend on foods purchased at these markets? ____
 - b. Which foods were the most expensive items purchased? ____
 - c. How much money did you spend on foods and beverages that contain too many empty calories, such as cookies, salty snacks, soft drinks, and candy? ____
 - d. What percentage of your food dollars was spent on foods that contain too many empty calories? ____
 (Divide the amount of money spent on such foods by the total cost of food for the week. Move the decimal point over two places to the right and place a percent sign after the number.)
 - e. How much money did you spend on nutrient-dense foods, such as whole-grain products, fruits, and vegetables? ____
 - f. What percentage of your food dollars was spent on nutrient-dense foods? ____
 (Divide the amount of money spent on nutrient-dense foods by the total cost of food for the week. Move the decimal point over two places to the right and place a percent sign after the number.)
2. For 1 week, keep a detailed log of your usual vending machine purchases, including the item(s) purchased and amount of money spent for each purchase.
 - a. What types of foods and beverages did you buy from the machines? ____
 - b. How many soft drinks did you consume each day? ____
 - c. How much money did you spend on vending machine foods and beverages? ____
 - d. Based on this week's vending machine expenditures, estimate how much money you spend on such purchases in a year. ____
3. For 1 week, keep a detailed log of your usual fast-food consumption practices, including food and beverage purchases at convenience stores, restaurants, and coffee shops. List the types of food and beverages you purchased and amount of money you spent.
 - a. According to your weekly record, how often did you buy food from fast-food places and convenience stores? ____
 - b. What types of foods did you usually buy? ____
 - c. How much money did you spend on fast foods? ____
 - d. Based on this week's expenditures, estimate how much money you spend on fast-food purchases in a year. ____
4. If you take dietary supplements, estimate the amount of money you spend on such products each month. ____



connect[®]

Complete the Personal Dietary Analysis activity in Connect.

Critical Thinking

1. Think about what you ate yesterday. Identify at least four factors that influenced your food and beverage choices. Of these factors, which was the most important to you? Explain why.
2. Consider your current eating habits. Does your diet have variety? Explain why your diet is or is not varied.
3. “Everything in moderation.” Explain what this statement means in terms of your diet.
4. Consider your parents’ and grandparents’ health (or causes of death). Based on your family history, which chronic health conditions do you have a higher-than-average risk of developing?

If you were at risk of developing a chronic health condition that could be prevented by changing your diet, would you make the necessary changes at this stage of your life? Explain why or why not.

5. Eric spends about \$100 each month on purchases of dietary supplements, including protein powders, vitamin pills, and herbal extracts. He thinks it is necessary to take the products to achieve optimal health and prevent chronic illnesses. Based on the information in this chapter, what would you tell Eric about his use of the supplements?

Practice Test

Select the best answer.

1. Diet is a
 - a. practice of restricting energy intake.
 - b. usual pattern of food choices.
 - c. method of reducing portion sizes.
 - d. technique to reduce carbohydrate intake.
2. Which of the following conditions is one of the 10 leading causes of death in the United States in which diet plays a role in its development?
 - a. Tuberculosis
 - b. Cancer
 - c. Hepatitis
 - d. Influenza
3. The nutrients that provide energy are
 - a. proteins, fats, and carbohydrates.
 - b. lipids, proteins, and minerals.
 - c. vitamins, minerals, and proteins.
 - d. carbohydrates, vitamins, and lipids.
4. Which of the following is not considered an organic nutrient?
 - a. Lipids
 - b. Proteins
 - c. Vitamins
 - d. Minerals
5. Which of the following substances is an essential nutrient?
 - a. Cholesterol
 - b. Alanine
 - c. Calcium
 - d. Beta-carotene
6. Which of the following foods is considered nutrient dense?
 - a. Unsalted butter
 - b. Sugar-sweetened soft drink
 - c. Low-fat milk
 - d. Iceberg lettuce
7. Which of the following foods is a rich source of phytochemicals?
 - a. Hamburger
 - b. Fish
 - c. Peaches
 - d. Chicken
8. Which of the following conditions is a chronic disease?
 - a. Heart disease
 - b. Common cold
 - c. Scurvy
 - d. Influenza
9. How many minutes of moderate intensity physical activity per day are needed to counteract 8 hours of sedentary time?
 - a. 90–100 minutes per day
 - b. 60–70 minutes per day
 - c. 30–50 minutes per day
 - d. 10–20 minutes per day
10. According to recent studies, most Americans consume more ____ than recommended.
 - a. sugary foods
 - b. dairy foods
 - c. fruits and vegetables
 - d. whole grains
11. A serving of food contains 15 g carbohydrate, 3 g protein, and 7 g fat. Based on this information, a serving of this food supplies
 - a. 100 kcal.
 - b. 135 kcal.
 - c. 190 kcal.
 - d. 225 kcal.
12. A serving of food supplies 20 g carbohydrate, 4 g protein, 10 g fat, 50 g water, 2 mg iron, and 50 mg vitamin C. Which of the following statements is true about a serving of the food?
 - a. Protein provides the most food energy.
 - b. Carbohydrate provides the most food energy.
 - c. Water and vitamin C provide the most food energy.
 - d. Fat provides almost 50% of total calories.



fahrwasser/123RF

13. Which of the following foods is the most energy dense per 100 grams?
- French fries
 - Romaine lettuce
 - Raw apple
 - Red pepper
14. Which of the following statements is false?
- A megadose of vitamins provides no calories.
 - Megadoses of nutrients may behave like drugs in the body.
 - In general, megadoses of nutrients are safe to consume.
 - A physiological dose of a vitamin is less than a megadose of the vitamin.
15. Which of the following substances is classified as a dietary supplement according to the DSHEA of 1994?
- Fish oil
 - Nonfat milk
 - Red wine
 - Chewing tobacco

1- b; 2- b; 3- a; 4- d; 5- c; 6- c; 7- c; 8- a; 9- b; 10- a; 11- b; 12- d; 13- a; 14- c; 15- a
ANSWERS TO THE PRACTICE TEST

ANSWERS TO CHAPTER 1 QUIZ Yourself

- There are five classes of nutrients: carbohydrates, lipids, proteins, vitamins, and water. **False** (Section 1.2)
- Vitamins and minerals are sources of energy. **False** (Section 1.2)
- Heart disease is the leading cause of death in the United States. **True** (Section 1.4)
- Most foods are mixtures of just two nutrients. **False** (Section 1.6)
- The Food and Drug Administration regulates the safety and effectiveness of dietary supplements that are sold in the United States. **False** (Section 1.6)

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