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Nutrition

Concepts & Controversies



Sizer ■ Whitney

Dietary Reference Intakes (DRI)

The Dietary Reference Intakes (DRI) include two sets of values that serve as goals for nutrient intake—Recommended Dietary Allowances (RDA) and Adequate Intakes (AI). The RDA reflect the average daily amount of a nutrient considered adequate to meet the needs of most healthy people. If there is insufficient evidence to determine an RDA, an AI is set. AI are more tentative than RDA, but both may be used as goals for nutrient intakes. (Chapter 2 provides more details.)

In addition to the values that serve as goals for nutrient intakes (presented in the tables on these two pages), the DRI include a set of values called Tolerable Upper Intake Levels (UL). The UL represent the maximum amount of a nutrient that appears safe for most healthy people to consume on a regular basis. Turn the page for a listing of the UL for selected vitamins and minerals.

Estimated Energy Requirements (EER), Recommended Dietary Allowances (RDA), and Adequate Intakes (AI) for Water, Energy, and the Energy Nutrients

AGE (YR)	REFERENCE BMI (kg/m ²)	REFERENCE HEIGHT cm (in)	REFERENCE WEIGHT kg (lb)	WATER ^a AI (L/day)	ENERGY EER ^b (cal/day)	CARBOHYDRATE RDA (g/day)	TOTAL FIBER AI (g/day)	TOTAL FAT AI (g/day)	LINOLEIC ACID AI (g/day)	LINOLENIC ACID ^c AI (g/day)	PROTEIN RDA (g/day) ^d	PROTEIN RDA (g/kg/day)
MALES												
0–0.5	—	62 (24)	6 (13)	0.7 ^a	570	60	—	31	4.4	0.5	9.1	1.52
0.5–1	—	71 (28)	9 (20)	0.8 ^f	743	95	—	30	4.6	0.5	11	1.20
1–3 ^g	—	86 (34)	12 (27)	1.3	1046	130	19	—	7	0.7	13	1.05
4–8 ^g	15.3	115 (45)	20 (44)	1.7	1742	130	25	—	10	0.9	19	0.95
9–13	17.2	144 (57)	36 (79)	2.4	2279	130	31	—	12	1.2	34	0.95
14–18	20.5	174 (68)	61 (134)	3.3	3152	130	38	—	16	1.6	52	0.85
19–30	22.5	177 (70)	70 (154)	3.7	3067 ^h	130	38	—	17	1.6	56	0.80
31–50	22.5 ⁱ	177 (70) ⁱ	70 (154) ⁱ	3.7	3067 ^h	130	38	—	17	1.6	56	0.80
>50	22.5 ⁱ	177 (70) ⁱ	70 (154) ⁱ	3.7	3067 ^h	130	30	—	14	1.6	56	0.80
FEMALES												
0–0.5	—	62 (24)	6 (13)	0.7 ^a	520	60	—	31	4.4	0.5	9.1	1.52
0.5–1	—	71 (28)	9 (20)	0.8 ^f	676	95	—	30	4.6	0.5	11	1.20
1–3 ^g	—	86 (34)	12 (27)	1.3	992	130	19	—	7	0.7	13	1.05
4–8 ^g	15.3	115 (45)	20 (44)	1.7	1642	130	25	—	10	0.9	19	0.95
9–13	17.4	144 (57)	37 (81)	2.1	2071	130	26	—	10	1.0	34	0.95
14–18	20.4	163 (64)	54 (119)	2.3	2368	130	26	—	11	1.1	46	0.85
19–30	21.5	163 (64)	57 (126)	2.7	2403 ^j	130	25	—	12	1.1	46	0.80
31–50	21.5 ⁱ	163 (64) ⁱ	57 (126) ⁱ	2.7	2403 ^j	130	25	—	12	1.1	46	0.80
>50	21.5 ⁱ	163 (64) ⁱ	57 (126) ⁱ	2.7	2403 ^j	130	21	—	11	1.1	46	0.80
PREGNANCY												
1st trimester				3.0	+0	175	28	—	13	1.4	46	0.80
2nd trimester				3.0	+340	175	28	—	13	1.4	71	1.10
3rd trimester				3.0	+452	175	28	—	13	1.4	71	1.10
LACTATION												
1st 6 months				3.8	+330	210	29	—	13	1.3	71	1.30
2nd 6 months				3.8	+400	210	29	—	13	1.3	71	1.30

NOTE: For all nutrients, values for infants are AI. Dashes indicate that values have not been determined.

^aThe water AI includes drinking water, water in beverages, and water in foods; in general, drinking water and other beverages contribute about 70 to 80 percent, and foods, the remainder. Conversion factors: 1 L = 33.8 fluid oz; 1 L = 1.06 qt; 1 cup = 8 fluid oz.

^bThe Estimated Energy Requirement (EER) represents the average dietary energy intake that will maintain energy balance in a healthy person of a given gender, age, weight, height, and physical activity level. The values listed are based on an "active" person at the reference height and weight and at the midpoint ages for each group until age 19. Chapter 9 and Appendix H provide equations and tables to determine estimated energy requirements.

^cThe linolenic acid referred to in this table and text is the omega-3 fatty acid known as alpha-linolenic acid.

^dThe values listed are based on reference body weights.

^eAssumed to be from human milk.

^fAssumed to be from human milk and complementary foods and beverages. This includes approximately 0.6 L (~2½ cups) as total fluid including formula, juices, and drinking water.

^gFor energy, the age groups for young children are 1–2 years and 3–8 years.

^hFor males, subtract 10 calories per day for each year of age above 19.

ⁱBecause weight need not change as adults age if activity is maintained, reference weights for adults 19 through 30 years are applied to all adult age groups.

^jFor females, subtract 7 calories per day for each year of age above 19.

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Recommended Dietary Allowances (RDA) and Adequate Intakes (AI) for Vitamins

AGE (YR)	THIAMIN RDA (mg/day)	RIBOFLAVIN RDA (mg/day)	NIACIN RDA (mg/day)	BIOTIN AI (µg/day) ^a	PANTOTHENIC ACID AI (mg/day)	VITAMIN B ₆ RDA (mg/day)	FOLATE RDA (µg/day) ^b	VITAMIN B ₁₂ RDA (µg/day)	CHOLINE AI (mg/day)	VITAMIN C RDA (mg/day)	VITAMIN A RDA (µg/day) ^c	VITAMIN D RDA (IU/day) ^d	VITAMIN E RDA (mg/day) ^e	VITAMIN K AI (µg/day)
INFANTS														
0-0.5	0.2	0.3	2	5	1.7	0.1	65	0.4	125	40	400	400 (10 µg)	4	2.0
0.5-1	0.3	0.4	4	6	1.8	0.3	80	0.5	150	50	500	400 (10 µg)	5	2.5
CHILDREN														
1-3	0.5	0.5	6	8	2	0.5	150	0.9	200	15	300	600 (15 µg)	6	30
4-8	0.6	0.6	8	12	3	0.6	200	1.2	250	25	400	600 (15 µg)	7	55
MALES														
9-13	0.9	0.9	12	20	4	1.0	300	1.8	375	45	600	600 (15 µg)	11	60
14-18	1.2	1.3	16	25	5	1.3	400	2.4	550	75	900	600 (15 µg)	15	75
19-30	1.2	1.3	16	30	5	1.3	400	2.4	550	90	900	600 (15 µg)	15	120
31-50	1.2	1.3	16	30	5	1.3	400	2.4	550	90	900	600 (15 µg)	15	120
51-70	1.2	1.3	16	30	5	1.7	400	2.4	550	90	900	600 (15 µg)	15	120
>70	1.2	1.3	16	30	5	1.7	400	2.4	550	90	900	800 (20 µg)	15	120
FEMALES														
9-13	0.9	0.9	12	20	4	1.0	300	1.8	375	45	600	600 (15 µg)	11	60
14-18	1.0	1.0	14	25	5	1.2	400	2.4	400	65	700	600 (15 µg)	15	75
19-30	1.1	1.1	14	30	5	1.3	400	2.4	425	75	700	600 (15 µg)	15	90
31-50	1.1	1.1	14	30	5	1.3	400	2.4	425	75	700	600 (15 µg)	15	90
51-70	1.1	1.1	14	30	5	1.5	400	2.4	425	75	700	600 (15 µg)	15	90
>70	1.1	1.1	14	30	5	1.5	400	2.4	425	75	700	800 (20 µg)	15	90
PREGNANCY														
≤18	1.4	1.4	18	30	6	1.9	600	2.6	450	80	750	600 (15 µg)	15	75
19-30	1.4	1.4	18	30	6	1.9	600	2.6	450	85	770	600 (15 µg)	15	90
31-50	1.4	1.4	18	30	6	1.9	600	2.6	450	85	770	600 (15 µg)	15	90
LACTATION														
≤18	1.4	1.6	17	35	7	2.0	500	2.8	550	115	1200	600 (15 µg)	19	75
19-30	1.4	1.6	17	35	7	2.0	500	2.8	550	120	1300	600 (15 µg)	19	90
31-50	1.4	1.6	17	35	7	2.0	500	2.8	550	120	1300	600 (15 µg)	19	90

NOTE: For all nutrients, values for infants are AI. The table on page Y defines units of nutrient measure.

^aNiacin recommendations are expressed as niacin equivalents (NE), except for recommendations for infants younger than 6 months, which are expressed as preformed niacin.

^bFolate recommendations are expressed as dietary folate equivalents (DFE).

^cVitamin A recommendations are expressed as retinol activity equivalents (RAE).

^dVitamin D recommendations are expressed as cholecalciferol and assume an absence of adequate exposure to sunlight. Pregnant or lactating girls ages 14-18 also need 15 micrograms vitamin D per day.

^eVitamin E recommendations are expressed as α-tocopherol.

Recommended Dietary Allowances (RDA) and Adequate Intakes (AI) for Minerals

AGE (YR)	SODIUM AI (mg/day)	CHLORIDE AI (mg/day)	POTASSIUM AI (mg/day)	CALCIUM RDA (mg/day)	PHOSPHORUS RDA (mg/day)	MAGNESIUM RDA (mg/day)	IRON RDA (mg/day)	ZINC RDA (mg/day)	IODINE RDA (µg/day)	SELENIUM RDA (µg/day)	COPPER RDA (µg/day)	MANGANESE AI (mg/day)	FLUORIDE AI (mg/day)	CHROMIUM AI (µg/day)	MOLYBDENUM RDA (µg/day)
INFANTS															
0-0.5	120	180	400	200	100	30	0.27	2	110	15	200	0.003	0.01	0.2	2
0.5-1	370	570	700	260	275	75	11	3	130	20	220	0.6	0.5	5.5	3
CHILDREN															
1-3	1000	1500	3000	700	460	80	7	3	90	20	340	1.2	0.7	11	17
4-8	1200	1900	3800	1000	500	130	10	5	90	30	440	1.5	1.0	15	22
MALES															
9-13	1500	2300	4500	1300	1250	240	8	8	120	40	700	1.9	2	25	34
14-18	1500	2300	4700	1300	1250	410	11	11	150	55	890	2.2	3	35	43
19-30	1500	2300	4700	1000	700	400	8	11	150	55	900	2.3	4	35	45
31-50	1500	2300	4700	1000	700	420	8	11	150	55	900	2.3	4	35	45
51-70	1300	2000	4700	1000	700	420	8	11	150	55	900	2.3	4	30	45
>70	1200	1800	4700	1200	700	420	8	11	150	55	900	2.3	4	30	45
FEMALES															
9-13	1500	2300	4500	1300	1250	240	8	8	120	40	700	1.6	2	21	34
14-18	1500	2300	4700	1300	1250	360	15	9	150	55	890	1.6	3	24	43
19-30	1500	2300	4700	1000	700	310	18	8	150	55	900	1.8	3	25	45
31-50	1500	2300	4700	1000	700	320	18	8	150	55	900	1.8	3	25	45
51-70	1300	2000	4700	1200	700	320	8	8	150	55	900	1.8	3	20	45
>70	1200	1800	4700	1200	700	320	8	8	150	55	900	1.8	3	20	45
PREGNANCY															
≤18	1500	2300	4700	1300	1250	400	27	12	220	60	1000	2.0	3	29	50
19-30	1500	2300	4700	1000	700	350	27	11	220	60	1000	2.0	3	30	50
31-50	1500	2300	4700	1000	700	360	27	11	220	60	1000	2.0	3	30	50
LACTATION															
≤18	1500	2300	5100	1300	1250	360	10	13	290	70	1300	2.6	3	44	50
19-30	1500	2300	5100	1000	700	310	9	12	290	70	1300	2.6	3	45	50
31-50	1500	2300	5100	1000	700	320	9	12	290	70	1300	2.6	3	45	50

NOTE: For all nutrients, values for infants are AI.

Tolerable Upper Intake Levels (UL) for Vitamins

AGE (YR)	NIACIN (mg/day) ^a	VITAMIN B ₆ (mg/day) ^a	FOLATE (µg/day) ^a	CHOLINE (mg/day)	VITAMIN C (mg/day)	VITAMIN A (µg/day) ^b	VITAMIN D (IU/day)	VITAMIN E (mg/day) ^c
INFANTS								
0–0.5	—	—	—	—	—	600	1000 (25 µg)	—
0.5–1	—	—	—	—	—	600	1500 (38 µg)	—
CHILDREN								
1–3	10	30	300	1000	400	600	2500 (63 µg)	200
4–8	15	40	400	1000	650	900	3000 (75 µg)	300
9–13	20	60	600	2000	1200	1700	4000 (100 µg)	600
ADOLESCENTS								
14–18	30	80	800	3000	1800	2800	4000 (100 µg)	800
ADULTS								
19–70	35	100	1000	3500	2000	3000	4000 (100 µg)	1000
>70	35	100	1000	3500	2000	3000	4000 (100 µg)	1000
PREGNANCY								
≤18	30	80	800	3000	1800	2800	4000 (100 µg)	800
19–50	35	100	1000	3500	2000	3000	4000 (100 µg)	1000
LACTATION								
≤18	30	80	800	3000	1800	2800	4000 (100 µg)	800
19–50	35	100	1000	3500	2000	3000	4000 (100 µg)	1000

^aThe UL for niacin and folate apply to synthetic forms obtained from supplements, fortified foods, or a combination of the two.

^bThe UL for vitamin A applies to the preformed vitamin only.

^cThe UL for vitamin E applies to any form of supplemental α-tocopherol, fortified foods, or a combination of the two.

Tolerable Upper Intake Levels (UL) for Minerals

AGE (YR)	SODIUM (mg/day)	CHLORIDE (mg/day)	CALCIUM (mg/day)	PHOSPHORUS (mg/day)	MAGNESIUM (mg/day) ^d	IRON (mg/day)	ZINC (mg/day)	IODINE (µg/day)	SELENIUM (µg/day)	COPPER (µg/day)	MANGANESE (mg/day)	FLUORIDE (mg/day)	MOLYBDENUM (µg/day)	BORON (mg/day)	NICKEL (mg/day)	VANADIUM (mg/day)
INFANTS																
0–0.5	—	—	1000	—	—	40	4	—	45	—	—	0.7	—	—	—	—
0.5–1	—	—	1500	—	—	40	5	—	60	—	—	0.9	—	—	—	—
CHILDREN																
1–3	1500	2300	2500	3000	65	40	7	200	90	1000	2	1.3	300	3	0.2	—
4–8	1900	2900	2500	3000	110	40	12	300	150	3000	3	2.2	600	6	0.3	—
9–13	2200	3400	3000	4000	350	40	23	600	280	5000	6	10	1100	11	0.6	—
ADOLESCENTS																
14–18	2300	3600	3000	4000	350	45	34	900	400	8000	9	10	1700	17	1.0	—
ADULTS																
19–50	2300	3600	2500	4000	350	45	40	1100	400	10,000	11	10	2000	20	1.0	1.8
51–70	2300	3600	2000	4000	350	45	40	1100	400	10,000	11	10	2000	20	1.0	1.8
>70	2300	3600	2000	3000	350	45	40	1100	400	10,000	11	10	2000	20	1.0	1.8
PREGNANCY																
≤18	2300	3600	3000	3500	350	45	34	900	400	8000	9	10	1700	17	1.0	—
19–50	2300	3600	2500	3500	350	45	40	1100	400	10,000	11	10	2000	20	1.0	—
LACTATION																
≤18	2300	3600	3000	4000	350	45	34	900	400	8000	9	10	1700	17	1.0	—
19–50	2300	3600	2500	4000	350	45	40	1100	400	10,000	11	10	2000	20	1.0	—

^dThe UL for magnesium applies to synthetic forms obtained from supplements or drugs only.

NOTE: An Upper Limit was not established for vitamins and minerals not listed and for those age groups listed with a dash (—) because of a lack of data, not because these nutrients are safe to consume at any level of intake. All nutrients can have adverse effects when intakes are excessive.

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Nutrition

Concepts & Controversies



Frances Sienkiewicz Sizer



Ellie Whitney

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**Nutrition: Concepts and Controversies,
Thirteenth Edition**
Frances Sienkiewicz Sizer and Ellie Whitney

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Library of Congress Control Number: 2013930118

Student Edition:

ISBN-13: 978-1-133-60318-4

ISBN-10: 1-133-60318-1

Loose-leaf Edition:

ISBN-13: 978-1-133-61011-3

ISBN-10: 1-133-61011-0

Wadsworth
20 Davis Drive
Belmont, CA 94002-3098
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For the pirates—Nolan, Kayla, Teagan, Kevin, Mackenzie, Lauren, and David.

—Fran

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To Max, Zoey, Emily, Rebecca, Kalijah, and Duchess with love.

—Ellie



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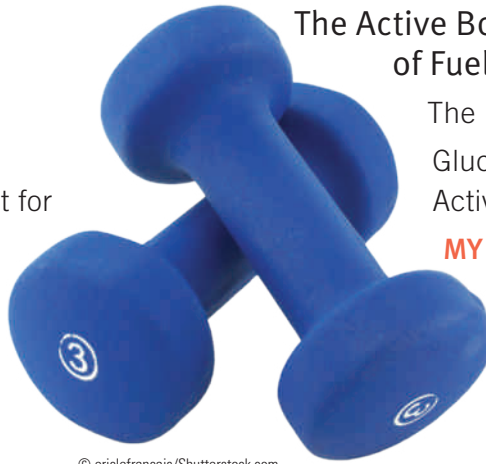
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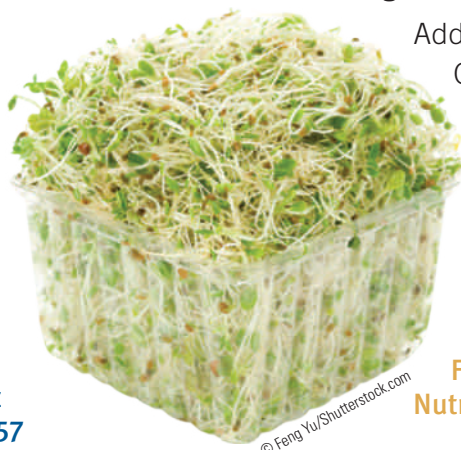
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Preface

A billboard in Louisiana reads, “Come as you are. Leave different,” meaning that once you’ve seen, smelled, tasted, and listened to Louisiana, you’ll never be the same. This book extends the same invitation to its readers: come to nutrition science as you are, with all of the knowledge and enthusiasm you possess, with all of your unanswered questions and misconceptions, and with the habits and preferences that now dictate what you eat.

But leave different. Take with you from this study a more complete understanding of nutrition science. Take a greater ability to discern between nutrition truth and fiction, to ask sophisticated questions, and to find the answers. Finally, take with you a better sense of how to feed yourself in ways that not only please you and soothe your spirit but nourish your body as well.

For well over a quarter of a century, *Nutrition: Concepts and Controversies* has been a cornerstone of nutrition classes across North America, serving the needs of students and professors in building a healthier future. In keeping with our tradition, in this, our 13th edition, we continue exploring the ever-changing frontier of nutrition science, confronting its mysteries through its scientific roots. We maintain our sense of personal connection with instructors and learners alike, writing for them in the clear, informal style that has become our trademark.

Pedagogical Features

Throughout these chapters, features tickle the reader’s interest and inform. For both verbal and visual learners, our logical presentation and our lively figures keep interest high and understanding at a peak. The photos that adorn many of our pages add pleasure to reading.

Many tried-and-true features return in this edition: Each chapter begins with “What Do You Think?” questions to pique interest and set a personal tone for the information that follows. The reader is offered another chance to reflect on these questions with “What Did You Decide?” at the chapter’s end. A list of Learning Objectives (LO) offers a sneak peek into the chapter’s major goals, and the LO reappear under section headings to make clear the main take-away messages. Streamlined margin entries now bear titles that help readers to grasp their functions at a glance. *My Turn* features invite the reader to hear stories from students in nutrition classes around the nation and to offer evidence-based solutions to real-life situations. *Think Fitness* reminders appear from time to time to alert readers to ways in which

physical activity links with nutrition to support health. The *Food Feature* sections that appear in most chapters act as bridges between theory and practice; they are practical applications of the chapter concepts that help readers to choose foods according to sound nutrition principles. The consumer sections, now entitled *A Consumer’s Guide To . . .*, have a fresh new contemporary feel. They guide readers through an often bewildering marketplace with scientific clarity, preparing them to move ahead with sound decisions regarding whole-grain foods, safe seafood choices, amino acid supplements, calorie-rich beverages, organic foods, and many others. Each section ends with review questions, new to this edition.

By popular demand, we have retained our *Snapshots* of vitamins and minerals, this time with a brand-new look. These concentrated capsules of information depict food sources of vitamins and minerals, present the DRI recommended intakes and Tolerable Upper Intake Levels, and offer the chief functions of each nutrient along with deficiency and toxicity symptoms.

New or major terms are defined in the margins of chapter pages or in nearby tables, and they also appear in the Glossary at the end of the book. Definitions in *Controversy* sections are grouped together in tables and also appear in the Glossary. The reader who wishes to locate any term can quickly do so by consulting the index, which lists the page numbers of definitions in boldface type.

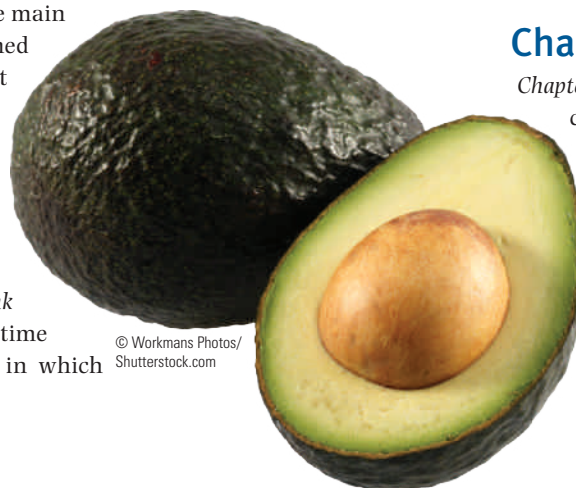
Two useful features close each chapter. First, our popular *Concepts in Action* diet and exercise tracking activities integrate chapter concepts with the Diet Analysis Plus program. The second is the indispensable *Self Check* that provides study questions, with answers in Appendix G to provide immediate feedback to the learner. New to this edition, LO numbers anchor each Self Check question to the text for easy reference.

Controversies

The *Controversies* of this book’s title invite you to explore beyond the safe boundaries of established nutrition knowledge. These optional readings, which appear at the end of each chapter, delve into current scientific topics and emerging controversies. All are up-to-date and relevant to nutrition science today.

Chapter Contents

Chapter 1 begins the text with a personal challenge to students. It asks the question so many people ask of nutrition educators—“Why should people care about nutrition?” We answer with a lesson in the ways in which nutritious foods affect diseases and present a continuum of diseases from purely genetic in origin to those almost totally preventable by



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nutrition. After presenting some beginning facts about the genes, nutrients, bioactive food components, and nature of foods, the chapter goes on to present the *Healthy People* goals for the nation. It concludes with a discussion of scientific research in nutrition to lend a perspective on the context in which study results may be rightly viewed.

Chapter 2 brings together the concepts of nutrient allowances, such as the *Dietary Reference Intakes*, and diet planning using the *Dietary Guidelines for Americans* and the USDA *MyPlate* eating patterns. *Chapter 3* presents a thorough, but brief, introduction to the workings of the human body from the genes to the organs, with major emphasis on the digestive system. *Chapters 4–6* are devoted to the energy-yielding nutrients—carbohydrates, lipids, and protein. The concept of inflammation, introduced in *Chapter 3*, is expanded in discussions of diabetes, colon health, and heart disease. Gene regulation takes its place among major functions of body proteins. *Controversy 4* has renewed its focus on theories and fables surrounding the health effects of dietary carbohydrates. In *Controversy 6* a new emphasis on using *MyPlate* in diet planning for vegetarians will assist in sound vegetarian meal planning.

Chapters 7 and 8 present the vitamins, minerals, and water. *Chapter 9* relates energy balance to body composition, obesity, and underweight and provides guidance to lifelong weight maintenance. *Chapter 10* presents the relationships between physical activity, athletic performance, and nutrition, with some guidance about products marketed to athletes. *Chapter 11* applies the essence of the first ten chapters to two broad and rapidly changing areas within nutrition: immunity and disease prevention. Readers will revisit the themes of oxidation, inflammation, and disease, introduced in earlier chapters.

Chapter 12 delivers urgently important concepts of food safety. It also addresses the usefulness and safety of food additives, including artificial sweeteners and artificial fats, formerly topics found in *Chapters 4 and 5*. *Chapters 13 and 14* emphasize the importance of nutrition through the life span and issues surrounding childhood obesity in *Controversy 13*. *Chapter 14* includes nutrition advice for feeding preschoolers, schoolchildren, teens, and the elderly, where readers will find the concluding discussion of inflammation, immunity, and chronic diseases.

Chapter 15 devotes attention to hunger and malnutrition, both in the United States and throughout the world. It touches on the vast network of problems that threaten the global food supply and links each reader to the meaningful whole through sustainable daily choices available to him or her. The *Controversy* introduces some promising new avenues of approach to providing the world's food.

New to This Edition

Every section of each chapter of this text reflects the changes in nutrition science occurring since the last edition. The changes range from subtle shifts of emphasis to entirely new sections that demand our attention. Here, we mention the most salient changes from the last edition. Readers will discover many, many others. Appendix F supplies current references; older references may be viewed in previous editions, available from the publisher.

Chapter 1

2020 Nutrition-Related Health Objectives for the Nation; selected nutrition and weight-related objectives.

Defines the term *eating pattern* (as specified in the *2010 Dietary Guidelines for Americans*).

Introduces new Academy of Nutrition and Dietetics name.

New table of professional responsibilities of dietitians.

New data on diploma mills; new guidance to identify diploma mills.

Chapter 2

2010 Dietary Guidelines for Americans included and applied throughout this edition.

New figure comparing U.S. diet to *Dietary Guidelines*.

USDA Food Guide updated to reflect the *2010 Dietary Guidelines*.

Introduces *MyPlate* icon and website.

Key nutrients of concern updated.

New figure: Dining Out Trends, United States.

New Consumer's Guide on controlling portion sizes.

New table of antioxidant capacity of selected foods from the USDA ORAC Database, Release 2, with text perspective.

Chapter 3

New organization of *Controversy* section.

New *Dietary Guidelines 2010* information.

New discussion of strength of evidence for suggested benefits of alcohol.

Binge drinking introduced as *heavy episodic drinking*.

Chapter 4

2010 Dietary Guidelines for Americans for carbohydrates in Table 4–1.

New figure of blood glucose regulation.

Enhanced digestion figure.

New Consumer's Guide on whole grains.

New table: A Sampling of Whole Grains.

Updated label information in figures.

New table of tips for reducing intakes of added sugars.

New section on HFCS and fructose.

Explores emerging links among NAFLD, diabetes, and fructose intake.

New figure: Sources of Added Sugars in the U.S. Diet.

Chapter 5

All *Dietary Guidelines for Americans* material updated throughout.

New Venn-type diagram for choosing fish.

New information on EPA/DHA.

New Consumer's Guide on balancing seafood risks and benefits.

New table of solid fat replacements.

New figure of solid fat sources in the U.S. diet.

Updated material on lipoproteins and heart disease risk.

Expanded discussion of nuts and their potential benefits.

New emphasis on total eating patterns.

Chapter 6

New section on gluten-free diets.

Defines gluten, celiac disease.
Moved world malnutrition discussion to Chapter 15.
Explains vegetarian eating pattern and CVD prevention.
New figure of vegetarian protein foods and milk products in the USDA eating patterns.
Integrates use of USDA eating patterns for lacto-ovo vegetarians and vegans, located in Appendix E.

Chapter 7

Specifies *Dietary Guidelines* vitamins of concern.
New Consumer Guide section on vitamin D sources.
Vitamin D section reflects 2011 DRI scientific background and DRI values.
Includes tocotrienols as forms of vitamin E.
New niacin/CVD information.
New folate/cancer risk information.
All vitamin Snapshots updated with current USDA nutrient data.

Chapter 8

Identifies the *Dietary Guidelines 2010* minerals of national concern.
New Consumer Guide on beverages as calorie sources.
New figure of U.S. calorie intakes from beverages.
Table of water in foods and beverages.
Calcium section reflects 2011 DRI scientific background and DRI values.
Updated figure of current U.S. sodium sources.
New table of promoters and inhibitors of iron absorption.

Chapter 9

Consolidated two figures on body fat analysis techniques.
Narrowed focus and streamlined discussions of theoretical causes of obesity.
Expanded discussions of leptin and ghrelin with new findings.
Simplified table of FDA-approved obesity drugs, including Belviq and Qsymia.
New table of environmental influences on food intake.
New table of food intake for weight gain.
New table of community strategies to combat obesity.
New Consumer's Guide on fad diets.
New table of clues to fad diets and weight-loss scams.
New table summarizing lifestyle strategies used by successful weight losers/maintainers.
Updated and simplified eating disorder diagnostic criteria.

Chapter 10

New table comparing performance-hindering effects of inadequate hydration with symptoms of heat stroke.
Updated sample balanced fitness program.
Increased emphasis on carbohydrate intakes before, during, and after physical activity.
New figure with electron micrographs depicting glycogen stores before and after exercise.
Enhanced discussions of muscle metabolism and the roles of dietary protein in muscle protein synthesis.
New figure of nutritious snacks for athletes.
New table of risk factors and symptoms of hyponatremia.

New table—summary of sports nutrition recommendations.
New fast-food pregame meal option for traveling athletes.
Updated ergogenic aids discussion.

Chapter 11

Reorganized nutrition and immunity section; included inflammation introduction.
New table of micronutrient roles in immune function.
Enhanced the figure on malnutrition and disease interactions.
Enhanced the table on malnutrition and the body's defense systems.
Updated table of recommendations for reducing cancer risks.
New table of strategies for choosing enough fruits, vegetables, and legumes.
Added a brief discussion of acrylamide to the cancer section.
Updated and shortened nutritional genomics section.

Chapter 12

Included the 2010 FDA Food Safety Modernization Act (FSMA).
Introduced the FDA's new Coordinated Outbreak Response and Evaluation Network.
Improved, condensed table of foodborne illness microorganisms.
Reframed *E. coli* O157:H7 to STEC to reflect foodborne illness trends.
Enhanced figure of safe handling and cooking of meats and poultry.
Expanded discussion of imported foods.
Added two tables of foodborne illness myths and truths.
New table weighing estimated health risks from pesticide residues on produce.
Included high-pressure processing and ultrasound technologies for microbial control.
Added luohan guo to nonnutritive sweeteners.
New graphic of increasing production of genetically modified crops.
Addressed genetic engineering advances in food fortification and microbial biofuel research.

Chapter 13

New table of risk factors for gestational diabetes.
New table of warning signs of preeclampsia.
Enhanced discussion of essential fatty acids in breast milk.
Added brief discussion of breastfeeding and reduced risk of SIDS.
New table of tips for successful breastfeeding.
New table of choking prevention.
Updated childhood obesity data and discussion.

Chapter 14

USDA Food Patterns for Young Children, 2011.
New table of tips for feeding picky eaters.
New figure of sugar-sweetened beverage intakes of adolescents.
New table of food skills and developmental milestones of preschool children.
New table of iron needs in adolescence.
Enhanced table of nutrient concerns in aging.

New roles of beverages as nutrient sources for the elderly.
Updated drug–nutrient interactions information.
Included new information on herbs and caffeine interactions.

Chapter 15

New food insecurity data, global and U.S.
Updated world hunger map.
Updated U.S. food security survey.
New section on severe acute malnutrition and chronic malnutrition, including appropriate nutrition therapy.
New table comparing severe acute malnutrition and chronic malnutrition.
New section addressing food waste.
New figure depicting U.S. food waste.
New figure of methods of food waste recovery.

Ancillary Materials

Students and instructors alike will appreciate the innovative teaching and learning materials that accompany this text.

- **MindTap:** A personalized, fully online digital learning platform of authoritative content, assignments, and services that engages your students with interactivity while also offering you choice in the configuration of coursework and enhancement of the curriculum via web-apps known as MindApps. MindApps range from ReadSpeaker (which reads the text out loud to students), to Kaltura (allowing you to insert inline video and audio into your curriculum). MindTap is well beyond an eBook, a homework solution or digital supplement, a resource center website, a course delivery platform, or a Learning Management System. It is the first in a new category—the Personal Learning Experience.
- **Diet Analysis Plus™:** Diet Analysis Plus enables you to track and assess your diet and physical activity online. You can create a personal profile based on height, weight, age, sex, and activity level and use this tool to easily analyze the nutritional value of the food you eat, adjust your diet to meet your personal health goals, and gain a better understanding of how nutrition relates to your life. Diet Analysis Plus includes a 35,000+ food database, 10 reports for analysis, a food recipe feature, the latest Dietary References, and goals and actual percentages of essential nutrients, vitamins, and minerals. Diet Analysis Plus is a valuable tool that you can use in your nutrition course and then continue to use after the course is over.
- **Study Guide:** Provides key-concepts-focused review exercises in a variety of formats, such as practice tests, fill-ins, matching sets, and short-answer questions.
- **Instructor's Manual:** Features ready-to-use assignment materials, including critical thinking questions, food label and diet planning worksheets, and new crossword puzzles. Class preparation tools include ideas for in-class activities—such as quick meal comparisons, new to this edition—lecture presentation outlines, chapter summaries, and text-specific handouts.

- **Test Bank:** Offers a rich assortment of multiple-choice and essay questions, including new food label–based application items.
- **PowerLecture DVD-ROM:** Combines PowerPoint lectures and images, videos, JoinIn quizzes, **ExamView** testing software preloaded with the test bank questions, the instructor's manual, and the test bank into a single resource.

Our Message to You

Our purpose in writing this text, as always, is to enhance our readers' understanding of nutrition science. We also hope the information on this book's pages will reach beyond the classroom into our readers' lives. Take the information you find inside this book home with you. Use it in your life: nourish yourself, educate your loved ones, and nurture others to be healthy. Stay up with the news, too. For despite all the conflicting messages, inflated claims, and even quackery that abound in the marketplace, true nutrition knowledge progresses with a genuine scientific spirit, and important new truths are constantly unfolding.

Acknowledgments

Thank you, Philip, for making everything possible. Our thanks also to our partners Linda Kelly DeBruyne and Sharon Rolfes for 35 years of immeasurable support. Linda, thank you especially, for your TLC in updating Chapter 11 and Chapter 13. To Shannon Gower-Winter, MS, RD, many thanks for your careful and thorough updates of Controversy 13 and Chapter 14. Thank you, Spencer Webb, RD, CSCS, for your design of our unique fitness program and your other assistance in Chapter 10 (and for getting us into shape, too). Rebecca Skinner, thank you for your skilled attention to the form and content of the Consumer's Guide sections and Controversy 15. Thank you to Carole Sloan for contributing the Critical Thinking questions at the end of each Controversy. To our assistant, Chelsea MacKenzie, many heartfelt thanks for your cheerful, consistent, and careful work.

Our special thanks to our publishing team—Yolanda Cosio, Peggy Williams, Nedah Rose, and Carol Samet—for their dedication to excellence. Thank you to our marketing manager, Tom Ziolkowski, for getting the word out about our new edition.

We would also like to thank the authors of the student and instructor ancillaries for the 13th edition: Alana Cline, who revised and expanded the test bank; Mary Ellen Clark, who contributed materials to the instructor's manual; Jana R. Kicklighter, who authored the study guide; and Jeanne Freeman, who provided content for the PowerLecture and student website.

Reviewers of Recent Editions

As always, we are grateful for the instructors who took the time to comment on this revision. Your suggestions were invaluable in strengthening the book and suggesting new lines of thought. We hope you will continue to provide your comments and suggestions.

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1

Food Choices and Human Health

what do you think?

Can your diet make a real difference between getting sick or staying healthy?

Are supplements more powerful than food for ensuring good nutrition?

What makes your favorite foods your favorites?

Are news and media nutrition reports confusing?

Learning Objectives

After reading this chapter, you should be able to accomplish the following:

- LO 1.1** Discuss how daily food choices can help or harm the body's health over time.
- LO 1.2** Describe the national *Healthy People* objective for the nation, and identify some nutrition-related objectives.
- LO 1.3** Define the term *nutrient* and be able to list the six major nutrients.
- LO 1.4** Summarize the five characteristics of a healthy diet and describe cultural or other influences on human food choices.
- LO 1.5** Describe the major types of research studies and give reasons why national nutrition research is important for the health of the population.
- LO 1.6** List the major steps in behavior change and devise a plan for making successful long-term changes in the diet.
- LO 1.7** Define *nutrient density* and explain the advantages of choosing nutrient-dense foods.
- LO 1.8** Identify misleading nutrition information in infomercials, advertorials, and other sources in the popular media.



Brand X Pictures/Jupiterimages/Getty Images

When you choose foods with nutrition in mind, you can enhance your own well-being.

If you care about your body, and if you have strong feelings about **food**, then you have much to gain from learning about **nutrition**—the science of how food nourishes the body. Nutrition is a fascinating, much talked about subject. Each day, newspapers, radio, and television present stories of new findings on nutrition and heart health or nutrition and cancer prevention, and at the same time advertisements and commercials bombard us with multicolored pictures of tempting foods—pizza, burgers, cakes, and chips. If you are like most people, when you eat you sometimes wonder, “Is this food good for me?” or you berate yourself, “I probably shouldn’t be eating this.”

When you study nutrition, you learn which foods serve you best, and you can work out ways of choosing foods, planning meals, and designing your **diet** wisely. Knowing the facts can enhance your health and your enjoyment of eating while relieving your feelings of guilt or worry that you aren’t eating well.

This chapter addresses these “why,” “what,” and “how” questions about nutrition:

- *Why* care about nutrition? Why be concerned about the **nutrients** in your foods? Why not just take supplements?
- *What* are the nutrients in foods, and what roles do they play in the body? What are the differences between vitamins and minerals?
- *What* constitutes a nutritious diet? How can you choose foods wisely, for nutrition’s sake? And what motivates your choices?
- *How* do we know what we know about nutrition? How does nutrition science work, and how can a person keep up with changing information?

Controversy 1 concludes the chapter by offering ways to distinguish between trustworthy sources of nutrition information and those that are less reliable.

A Lifetime of Nourishment

- LO 1.1** Discuss how daily food choices can help or harm the body’s health over time.

If you live for 65 years or longer, you will have consumed more than 70,000 meals, and your remarkable body will have disposed of 50 tons of food. The foods you choose have cumulative effects on your body. As you age, you will see and feel those effects— if you know what to look for.

Your body renews its structures continuously, and each day it builds a little muscle, bone, skin, and blood, replacing old tissues with new. It may also add a little fat if you consume excess food energy (calories) or subtract a little if you consume less than you require. Some of the food you eat today becomes part of “you” tomorrow.

The best food for you, then, is the kind that supports the growth and maintenance of strong muscles, sound bones, healthy skin, and sufficient blood to cleanse and nourish all parts of your body. This means you need food that provides not only the right amount of energy but also sufficient nutrients, that is, enough water, carbohydrates, fats, protein, vitamins, and minerals. If the foods you eat provide too little or too much of any nutrient today, your health may suffer just a little today. If the foods you eat provide too little or too much of one or more nutrients every day for years, then in later life you may suffer severe disease effects.

A well-chosen array of foods supplies enough energy and enough of each nutrient to prevent **malnutrition**. Malnutrition includes deficiencies, imbalances, and excesses of nutrients, alone or in combination, any of which can take a toll on health over time.

KEY POINTS

- The nutrients in food support growth, maintenance, and repair of the body.
- Deficiencies, excesses, and imbalances of energy and nutrients bring on the diseases of malnutrition.

The Diet and Health Connection

Your choice of diet profoundly affects your health, both today and in the future. Only two common lifestyle habits are more influential: smoking and using other forms of tobacco and drinking alcohol in excess. Of the leading causes of death listed in Table 1–1, four are directly related to nutrition, and another—motor vehicle and other accidents—is related to drinking alcohol.

Table 1–1

Leading Causes of Death in the United States

Blue shading indicates that a cause of death is related to nutrition; the light yellow indicates that it is related to alcohol.

	Percentage of Total Deaths
1. Heart disease	24.6%
2. Cancers	23.3%
3. Chronic lung disease	5.6%
4. Strokes	5.3%
5. Accidents	4.8%
6. Alzheimer’s disease	3.2%
7. Diabetes mellitus	2.8%
8. Pneumonia and influenza	2.2%
9. Kidney disease	2.0%
10. Suicide	1.5%

Source: *Deaths: Preliminary data for 2009*, National Vital Statistics Reports, March 16, 2011, Centers for Disease Control and Prevention, www.cdc.gov/nchs.

food medically, any substance that the body can take in and assimilate that will enable it to stay alive and to grow; the carrier of nourishment; socially, a more limited number of such substances defined as acceptable by each culture.

nutrition the study of the nutrients in foods and in the body; sometimes also the study of human behaviors related to food.

diet the foods (including beverages) a person usually eats and drinks.

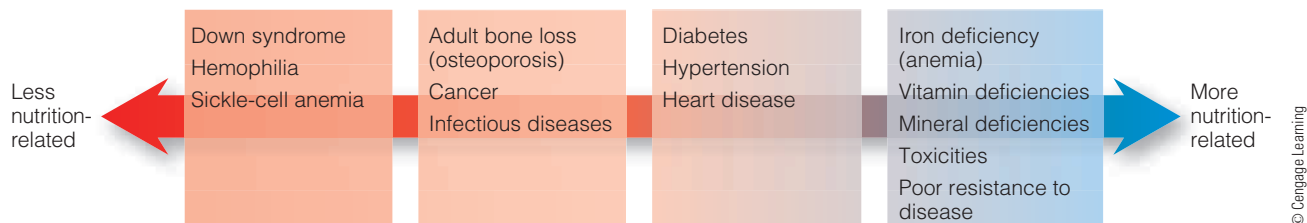
nutrients components of food that are indispensable to the body’s functioning. They provide energy, serve as building material, help maintain or repair body parts, and support growth. The nutrients include water, carbohydrate, fat, protein, vitamins, and minerals.

malnutrition any condition caused by excess or deficient food energy or nutrient intake or by an imbalance of nutrients. Nutrient or energy deficiencies are forms of undernutrition; nutrient or energy excesses are forms of overnutrition.

Figure 1–1

Nutrition and Disease

Not all diseases are equally influenced by diet. Some are almost purely genetic, like the anemia of sickle-cell disease. Some may be inherited (or the tendency to develop them may be inherited in the genes) but may be influenced by diet, like some forms of diabetes. Some are purely dietary, like the vitamin and mineral deficiency diseases.



Many older people suffer from debilitating conditions that could have been largely prevented had they known and applied the nutrition principles known today. The **chronic diseases**—heart disease, diabetes, some kinds of cancer, dental disease, and adult bone loss—all have a connection to poor diet.^{1*} These diseases cannot be prevented by a good diet alone; they are to some extent determined by a person's genetic constitution, activities, and lifestyle. Within the range set by your genetic inheritance, however, the likelihood of developing these diseases is strongly influenced by your daily choices.

KEY POINT

- Nutrition profoundly affects health.

Did You Know?

Anemia is a blood condition in which red blood cells, the body's oxygen carriers, are inadequate or impaired and so cannot meet the oxygen demands of the body.

Did You Know?

The human genome is 99.9% the same in all people; all of the normal variations such as differences in hair color, as well as variations that result in diseases such as sickle-cell anemia, lie in the 0.1% of the genome that varies.

Genetics and Individuality

Consider the role of genetics. Genetics and nutrition affect different diseases to varying degrees (see Figure 1–1). The anemia caused by sickle-cell disease, for example, is purely hereditary and thus appears at the left of Figure 1–1 as a genetic condition largely unrelated to nutrition. Nothing a person eats affects the person's chances of contracting this anemia, although nutrition therapy may help ease its course. At the other end of the spectrum, iron-deficiency anemia most often results from undernutrition. Diseases and conditions of poor health appear all along this continuum, from almost entirely genetically based to purely nutritional in origin; the more nutrition-related a disease or health condition is, the more successfully sound nutrition can prevent it.

Furthermore, some diseases, such as heart disease and cancer, are not one disease but many. Two people may both have heart disease, but not the same form; one person's cancer may be nutrition-related but another's may not be. Individual people differ genetically from each other in thousands of subtle ways, so no simple statement can be made about the extent to which diet can help any one person avoid such diseases or slow their progress.

The identification of the human **genome** establishes the entire sequence of the **genes** in human **DNA**. This work has, in essence, revealed the body's instructions for making all of the working parts of a human being. A new wealth of information has emerged to explain the workings of the body, and nutrition scientists are working quickly to apply this knowledge to benefit human health. Later chapters expand on the emerging story of nutrition and the genes.

KEY POINTS

- Diet influences long-term health within the range set by genetic inheritance.
- Nutrition has little influence on some diseases but strongly affects others.

¹ Reference notes are found in Appendix F.

Why should people bother to be physically active? While a person's daily food choices can powerfully affect health, the combination of nutrition and physical activity is more powerful still. People who combine regular physical activity with a nutritious diet can expect to receive at least some of these benefits:

Reduced risks of cardiovascular diseases, diabetes, certain cancers, hypertension, others.

Increased endurance, strength, and flexibility.

More cheerful outlook and less likelihood of depression.

Improved mental functioning.

Feeling of vigor.

Feeling of belonging—the companionship of sports.

Stronger self-image.

Reduced body fat, increased lean tissue.

A more youthful appearance, healthy skin, and improved muscle tone.

Greater bone density and lessened risk of adult bone loss in later life.

Increased independence in the elderly.


Sound, beneficial sleep.

Faster wound healing.

Reduced menstrual symptoms.

Improved resistance to infection.

If even half of these benefits were yours for the asking, wouldn't you step up to claim them? In truth, they are yours to claim, at the price of including physical activity in your day. Chapter 10 explores the topics of fitness and physical activity.

start now!  Ready to make a change? Go to Diet Analysis Plus online and track your physical activities—all of them—for three days. (The Concepts in Action activity at the end of this chapter will also use this information.) After you have recorded your activities, see how much time you spent exercising at a moderate to vigorous level. Could you increase your level and amount of activity?

Other Lifestyle Choices

Besides food choices, other lifestyle choices also affect people's health. Tobacco use and alcohol and other substance abuse can destroy health. Physical activity, sleep, stress, and other environmental factors can also help prevent or reduce the severity of some diseases. Physical activity is so closely linked with nutrition in supporting health that most chapters of this book offer a feature called Think Fitness, such as the one near here.

KEY POINT

- Life choices, such as being physically active or using tobacco or alcohol, can improve or damage health.

Healthy People: Nutrition Objectives for the Nation

LO 1.2 Describe the national *Healthy People* objective for the nation, and identify some nutrition-related objectives.

In its publication *Healthy People*, the U.S. Department of Health and Human Services sets specific 10-year objectives to guide national health promotion efforts.² The vision of *Healthy People 2020* is a society in which all people live long, healthy lives. Table 1–2 provides a quick scan of the nutrition and weight-related objectives set for this decade. The inclusion of nutrition and food-safety objectives shows that public health officials consider these areas to be top national priorities.

In 2010, the nation's health report was mixed: the average blood cholesterol levels had dropped, but most people's diets lacked enough fruits, vegetables, and whole grains; and physical activity levels needed improvement.³ Positive strides had been made toward reducing harm from certain foodborne infections, heart disease, and several cancers, but on the negative side, the numbers of overweight people and people with diabetes continue to rise. To fully meet the current *Healthy People* goals, our nation must take steps to change its habits.

chronic diseases degenerative conditions or illnesses that progress slowly, are long in duration, and that lack an immediate cure; chronic diseases limit functioning, productivity, and the quality and length of life. Examples include heart disease, cancer, and diabetes.

genome (GEE-nome) the full complement of genetic information in the chromosomes of a cell. In human beings, the genome consists of about 35,000 genes and supporting materials. The study of genomes is *genomics*. Also defined in Controversy 11.

genes units of a cell's inheritance; sections of the larger genetic molecule DNA (deoxyribonucleic acid). Each gene directs the making of one or more of the body's proteins.

DNA an abbreviation for deoxyribonucleic (de-OX-ee-RYE-bow-nu-CLAY-ick) acid, the thread-like molecule that encodes genetic information in its structure; DNA strands coil up densely to form the chromosomes (Chapter 3 provides more details).

Table 1–2

Healthy People 2020, Selected Nutrition and Body Weight Objectives

Many other Objectives for the Nation are available at www.healthypeople.gov.

Chronic Diseases
<ul style="list-style-type: none"> Reduce the proportion of adults with osteoporosis. Reduce the death rates from cancer, diabetes, heart disease, and stroke. Reduce the annual number of new cases of diabetes.
Food Safety
<ul style="list-style-type: none"> Reduce outbreaks of certain infections transmitted through food. Reduce severe allergic reactions to food among adults with diagnosed food allergy.
Maternal, Infant, and Child Health
<ul style="list-style-type: none"> Reduce the number of low birthweight infants and preterm births. Increase the proportion of infants who are breastfed. Reduce the occurrence of fetal alcohol syndrome (FAS). Reduce iron deficiency among children, adolescents, women of child-bearing age, and pregnant women. Reduce blood lead levels in children. Increase the number of schools offering breakfast. Increase vegetables, fruits, and whole grains in the diets of those aged 2 years and older, and reduce solid fats and added sugars.
Eating Disorders
<ul style="list-style-type: none"> Reduce the proportion of adolescents who engage in disordered eating behaviors in an attempt to control their weight.
Physical Activity and Weight Control
<ul style="list-style-type: none"> Increase the proportion of children, adolescents, and adults who are at a healthy weight. Reduce the proportions of children, adolescents, and adults who are obese. Reduce the proportion of people who engage in no leisure-time physical activity. Increase the proportion of schools that require daily physical education for all students.
Food Security
<ul style="list-style-type: none"> Eliminate very low food security among children in U.S. households.

Source: www.healthypeople.gov.

The next section shifts our focus to the nutrients at the core of nutrition science. As your course of study progresses, the individual nutrients may become like old friends, revealing more and more about themselves as you move through the chapters.

KEY POINT

- Each decade, the U.S. Department of Health and Human Services sets health and nutrition objectives for the nation.

The Human Body and Its Food

LO 1.3 Define the term *nutrient* and be able to list the six major nutrients.

As your body moves and works each day, it must use **energy**. The energy that fuels the body's work comes indirectly from the sun by way of plants. Plants capture and store the sun's energy in their tissues as they grow. When you eat plant-derived foods such as fruits, grains, or vegetables, you obtain and use the solar energy they have stored. Plant-eating animals obtain their energy in the same way, so when you eat animal tissues, you are eating compounds containing energy that came originally from the sun.

Table 1–3

Elements in the Six Classes of Nutrients

The nutrients that contain carbon are organic.

	Carbon	Oxygen	Hydrogen	Nitrogen	Minerals
Water		✓	✓		
Carbohydrate	✓	✓	✓		
Fat	✓	✓	✓		
Protein	✓	✓	✓	✓	b
Vitamins	✓	✓	✓	✓ ^a	b
Minerals					✓

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^aAll of the B vitamins contain nitrogen; amine means nitrogen.

^bProtein and some vitamins contain the mineral sulfur; vitamin B₁₂ contains the mineral cobalt.

The body requires six kinds of nutrients—families of molecules indispensable to its functioning—and foods deliver these. Table 1–3 lists the six classes of nutrients. Four of these six are **organic**; that is, the nutrients contain the element carbon derived from living things.

Meet the Nutrients

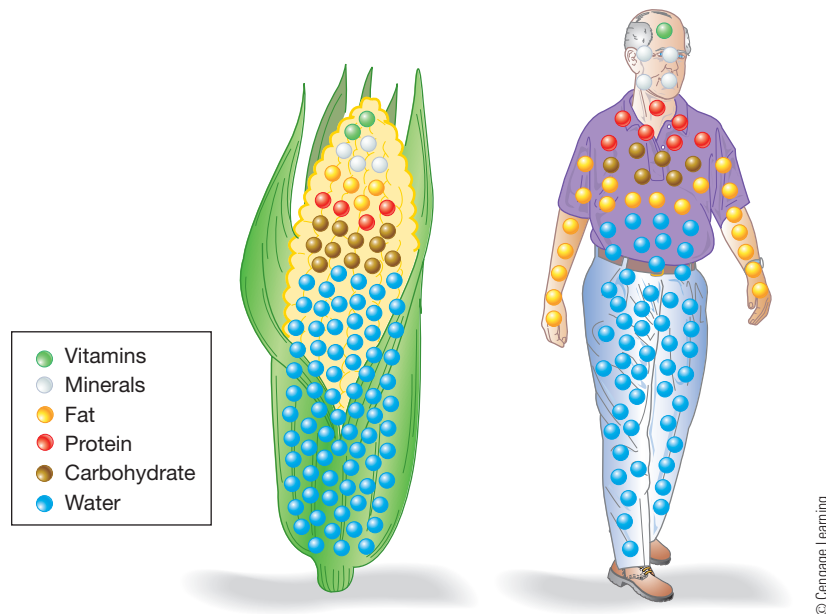
The human body and foods are made of the same materials, arranged in different ways (see Figure 1–2). When considering quantities of foods and nutrients, scientists often measure them in **grams**, units of weight.

The Energy-Yielding Nutrients Foremost among the six classes of nutrients in foods is water, which is constantly lost from the body and must constantly be

Figure 1–2

Components of Food and the Human Body

Foods and the human body are made of the same materials.



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energy the capacity to do work. The energy in food is chemical energy; it can be converted to mechanical, electrical, thermal, or other forms of energy in the body. Food energy is measured in calories, defined on page 8.

organic carbon containing. Four of the six classes of nutrients are organic: carbohydrate, fat, protein, and vitamins. Organic compounds include only those made by living things and do not include compounds such as carbon dioxide, diamonds, and a few carbon salts.

grams units of weight. A gram (g) is the weight of a cubic centimeter (cc) or milliliter (ml) of water under defined conditions of temperature and pressure. About 28 grams equal an ounce.

Table 1–4**Calorie Values of Energy Nutrients**

The energy a person consumes in a day's meals comes from these three energy-yielding nutrients; alcohol, if consumed, also contributes energy.

Energy Nutrient	Energy
Carbohydrate	4 cal/g
Fat (lipid)	9 cal/g
Protein	4 cal/g

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Note: Alcohol contributes 7 cal/g that the human body can use for energy. Alcohol is not classed as a nutrient, however, because it interferes with growth, maintenance, and repair of body tissues.

Did You Know?

- Energy-yielding nutrients are also called macronutrients because they are needed in relatively large amounts in the diet.
- Vitamins and minerals are also called micronutrients because they are needed in smaller amounts.



© Michael Gray/Dreamstime.com

When you eat foods, you are receiving more than just nutrients.

replaced. Of the four organic nutrients, three are **energy-yielding nutrients**, meaning that the body can use the energy they contain. The carbohydrates and fats (fats are also called lipids) are especially important energy-yielding nutrients. As for protein, it does double duty: it can yield energy, but it also provides materials that form structures and working parts of body tissues. (Alcohol yields energy, too—see the note to Table 1–4).

Vitamins and Minerals The fifth and sixth classes of nutrients are the vitamins and the minerals. These provide no energy to the body. A few minerals serve as parts of body structures (calcium and phosphorus, for example, are major constituents of bone), but all vitamins and minerals act as regulators. As regulators, the vitamins and minerals assist in all body processes: digesting food; moving muscles; disposing of wastes; growing new tissues; healing wounds; obtaining energy from carbohydrate, fat, and protein; and participating in every other process necessary to maintain life. Later chapters are devoted to these six classes of nutrients.

The Concept of Essential Nutrients When you eat food, then, you are providing your body with energy and nutrients. Furthermore, some of the nutrients are **essential nutrients**, meaning that if you do not ingest them, you will develop deficiencies; the body cannot make these nutrients for itself. Essential nutrients are found in all six classes of nutrients. Water is an essential nutrient; so is a form of carbohydrate; so are some lipids, some parts of protein, all of the vitamins, and the minerals important in human nutrition.

Calorie Values Food scientists measure food energy in kilocalories, units of heat. This book uses the common word **calories** to mean the same thing. It behooves the person who wishes to control food energy intake and body fatness to learn the calorie values of the energy nutrients, listed in Table 1–4. The most energy-rich of the nutrients is fat, which contains 9 calories in each gram. Carbohydrate and protein each contain only 4 calories in a gram. Weight, measure, and other conversion factors needed for the study of nutrition are found in Appendix C at the back of the book.

Scientists have worked out ways to measure the energy and nutrient contents of foods. They have also calculated the amounts of energy and nutrients various types of people need—by gender, age, life stage, and activity. Thus, after studying human nutrient requirements (in Chapter 2), you will be able to state with some accuracy just what your own body needs—this much water, that much carbohydrate, so much vitamin C, and so forth. So why not simply take pills or **dietary supplements** in place of food? Because, as it turns out, food offers more than just the six basic nutrients.

KEY POINTS

- Foremost among the nutrients in food is water.
- The energy-yielding nutrients are carbohydrates, fats (lipids), and protein.
- The regulator nutrients are vitamins and minerals.
- Food energy is measured in calories; nutrient quantities are often measured in grams.

Can I Live on Just Supplements?

Nutrition science can state what nutrients human beings need to survive—at least for a time. Scientists are becoming skilled at making **elemental diets**—life-saving liquid diets of precise chemical composition for hospital patients and others who cannot eat ordinary food. These formulas, administered for days or weeks, support not only continued life but also recovery from nutrient deficiencies, infections, and wounds. Formulas can also stave off weight loss in the elderly or anyone in whom eating is impaired.

Formula diets are essential to help sick people to survive, but they do not enable people to thrive over long periods. Even in hospitals, elemental diet formulas do not support optimal growth and health, and may even lead to medical complications.⁴

Although serious problems are rare and can be detected and corrected, they show that the composition of these diets is not yet perfect for all people in all settings.

Lately, marketers have taken these liquid supplement formulas out of the medical setting and have advertised them heavily to healthy people of all ages as “meal replacers” or “insurance” against malnutrition. The truth is that real food is superior to such supplements. Most healthy people who eat a nutritious diet need no dietary supplements at all.

Even if a person’s basic nutrient needs are perfectly understood and met, concoctions of nutrients still lack something that foods provide. Hospitalized clients who are fed nutrient mixtures through a vein often improve dramatically when they can finally eat food. Something in real food is important to health—but what is it? What does food offer that cannot be provided through a needle or a tube? Science has some partial explanations, some physical and some psychological.

In the digestive tract, the stomach and intestine are dynamic, living organs, changing constantly in response to the foods they receive—even to just the sight, aroma, and taste of food. When a person is fed through a vein, the digestive organs, like unused muscles, weaken and grow smaller. Medical wisdom now dictates that a person should be fed through a vein for as short a time as possible and that real food taken by mouth should be reintroduced as early as possible. The digestive organs also release hormones in response to food, and these send messages to the brain that bring the eater a feeling of satisfaction: “There, that was good. Now I’m full.” Eating offers both physical and emotional comfort.

Foods are chemically complex. In addition to their nutrients, foods contain **phytochemicals**, compounds that confer color, taste, and other characteristics to foods. Some may be **bioactive** food components that interact with metabolic processes in the body and may affect disease risks. Even an ordinary baked potato contains hundreds of different compounds. Nutrients and other food components interact with each other in the body and operate best in harmony with one another.⁵ In view of all this, it is not surprising that food gives us more than just nutrients. If it were otherwise, *that* would be surprising.

KEY POINTS

- Food conveys emotional satisfaction and hormonal stimuli that contribute to health.
- Foods also contain phytochemicals.

The Challenge of Choosing Foods

LO 1.4 Summarize the five characteristics of a healthy diet and describe cultural or other influences on human food choices.

Well-planned meals convey pleasure and are nutritious, too, fitting your tastes, personality, family and cultural traditions, lifestyle, and budget. Given the astounding numbers and varieties available, a consumer can easily lose track of what individual foods contain and how to put them together into a health-promoting diet. A few guidelines can help.

The Abundance of Foods to Choose From

A list of the foods available 100 years ago would be relatively short. It would consist of **whole foods**—foods that have been around for a long time, such as vegetables, fruits, meats, milk, and grains (see Table 1–5 for a glossary of food types). These foods have been called basic, unprocessed, natural, or farm foods. By whatever name, choosing a sufficient variety of these foods each day is an easy way to obtain a nutritious diet. On a given day, however, almost three-quarters of our population consume too few vegetables, and two-thirds of us fail to consume enough fruit.⁶ Also, although people generally consume a few servings of vegetables, the vegetable they most often choose is potatoes, usually prepared as French fries. Such dietary patterns make development of chronic diseases more likely.



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Some foods offer phytochemicals in addition to the six classes of nutrients.

energy-yielding nutrients the nutrients the body can use for energy—carbohydrate, fat, and protein. These also may supply building blocks for body structures.

essential nutrients the nutrients the body cannot make for itself (or cannot make fast enough) from other raw materials; nutrients that must be obtained from food to prevent deficiencies.

calories units of energy. In nutrition science, the unit used to measure the energy in foods is a kilocalorie (also called *kcalorie* or *Calorie*): it is the amount of heat energy necessary to raise the temperature of a kilogram (a liter) of water 1 degree Celsius. This book follows the common practice of using the lowercase term *calorie* (abbreviated *cal*) to mean the same thing.

dietary supplements pills, liquids, or powders that contain purified nutrients or other ingredients (see Controversy in Chapter 7).

elemental diets diets composed of purified ingredients of known chemical composition; intended to supply all essential nutrients to people who cannot eat foods.

phytochemicals compounds in plant-derived foods (*phyto* means “plant”).

bioactive having biological activity in the body. See also the Controversy in Chapter 2.