

Understanding Normal and Clinical Nutrition

SIXTH
EDITION

Whitney • Cataldo • Rolfes

UNDERSTANDING NORMAL AND CLINICAL NUTRITION

SIXTH EDITION

Eleanor Noss Whitney

Corinne Balog Cataldo

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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 1 provides more details.)

1997–2001 Recommended Dietary Allowances (RDA) and Adequate Intakes (AI)

Age (yr)	Vitamins											
	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 AI (μg/day) ^d
Infants												
0–0.5	0.2	0.3	2	5	1.7	0.1	65	0.4	125	40	400	5
0.5–1	0.3	0.4	4	6	1.8	0.3	80	0.5	150	50	500	5
Children												
1–3	0.5	0.5	6	8	2	0.5	150	0.9	200	15	300	5
4–8	0.6	0.6	8	12	3	0.6	200	1.2	250	25	400	5
Males												
9–13	0.9	0.9	12	20	4	1.0	300	1.8	375	45	600	5
14–18	1.2	1.3	16	25	5	1.3	400	2.4	550	75	900	5
19–30	1.2	1.3	16	30	5	1.3	400	2.4	550	90	900	5
31–50	1.2	1.3	16	30	5	1.3	400	2.4	550	90	900	5
51–70	1.2	1.3	16	30	5	1.7	400	2.4	550	90	900	10
>70	1.2	1.3	16	30	5	1.7	400	2.4	550	90	900	15
Females												
9–13	0.9	0.9	12	20	4	1.0	300	1.8	375	45	600	5
14–18	1.0	1.0	14	25	5	1.2	400	2.4	400	65	700	5
19–30	1.1	1.1	14	30	5	1.3	400	2.4	425	75	700	5
31–50	1.1	1.1	14	30	5	1.3	400	2.4	425	75	700	5
51–70	1.1	1.1	14	30	5	1.5	400	2.4	425	75	700	10
>70	1.1	1.1	14	30	5	1.5	400	2.4	425	75	700	15
Pregnancy												
≤18	1.4	1.4	18	30	6	1.9	600	2.6	450	80	750	5
19–30	1.4	1.4	18	30	6	1.9	600	2.6	450	85	770	5
31–50	1.4	1.4	18	30	6	1.9	600	2.6	450	85	770	5
Lactation												
≤18	1.4	1.6	17	35	7	2.0	500	2.8	550	115	1200	5
19–30	1.4	1.6	17	35	7	2.0	500	2.8	550	120	1300	5
31–50	1.4	1.6	17	35	7	2.0	500	2.8	550	120	1300	5

NOTE: For all nutrients, values for infants are AI. The glossary on the inside back cover defines units of nutrient measure.

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

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

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

^d Vitamin D recommendations are expressed as cholecalciferol and assume an absence of adequate exposure to sunlight.

In addition to the values that serve as goals for nutrient intakes (presented in the table above), the Dietary Reference Intakes (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.

1997–2001 Tolerable Upper Intake Levels (UL)

Age (yr)	Vitamins									Minerals			
	Niacin (mg/day) ^a	Vitamin B ₆ (mg/day)	Folate (μg/day) ^a	Choline (mg/day)	Vitamin C (mg/day)	Vitamin A (μg/day) ^b	Vitamin D (μg/day)	Vitamin E (mg/day) ^c	Calcium (mg/day)	Phosphorus (mg/day)	Magnesium (mg/day) ^d	Iron (mg/day)	
Infants													
0–0.5	—	—	—	—	—	600	25	—	—	—	—	40	
0.5–1	—	—	—	—	—	600	25	—	—	—	—	40	
Children													
1–3	10	30	300	1000	400	600	50	200	2500	3000	65	40	
4–8	15	40	400	1000	650	900	50	300	2500	3000	110	40	
9–13	20	60	600	2000	1200	1700	50	600	2500	4000	350	40	
Adolescents													
14–18	30	80	800	3000	1800	2800	50	800	2500	4000	350	45	
Adults													
19–70	35	100	1000	3500	2000	3000	50	1000	2500	4000	350	45	
>70	35	100	1000	3500	2000	3000	50	1000	2500	3000	350	45	
Pregnancy													
≤18	30	80	800	3000	1800	2800	50	800	2500	3500	350	45	
19–50	35	100	1000	3500	2000	3000	50	1000	2500	3500	350	45	
Lactation													
≤18	30	80	800	3000	1800	2800	50	800	2500	4000	350	45	
19–50	35	100	1000	3500	2000	3000	50	1000	2500	4000	350	45	

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

^b The UL for vitamin A applies to the preformed vitamin only.

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

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

Vitamins			Minerals											
Vitamin E RDA (mg/day) ^e	Vitamin K AI (µg/day)	Calcium AI (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)	
4	2.0	210	100	30	0.27	2	110	15	200	0.003	0.01	0.2	2	
5	2.5	270	275	75	11	3	130	20	220	0.6	0.5	5.5	3	
6	30	500	460	80	7	3	90	20	340	1.2	0.7	11	17	
7	55	800	500	130	10	5	90	30	440	1.5	1.0	15	22	
11	60	1300	1250	240	8	8	120	40	700	1.9	2	25	34	
15	75	1300	1250	410	11	11	150	55	890	2.2	3	35	43	
15	120	1000	700	400	8	11	150	55	900	2.3	4	35	45	
15	120	1000	700	420	8	11	150	55	900	2.3	4	35	45	
15	120	1200	700	420	8	11	150	55	900	2.3	4	30	45	
15	120	1200	700	420	8	11	150	55	900	2.3	4	30	45	
11	60	1300	1250	240	8	8	120	40	700	1.6	2	21	34	
15	75	1300	1250	360	15	9	150	55	890	1.6	3	24	43	
15	90	1000	700	310	18	8	150	55	900	1.8	3	25	45	
15	90	1000	700	320	18	8	150	55	900	1.8	3	25	45	
15	90	1200	700	320	8	8	150	55	900	1.8	3	20	45	
15	90	1200	700	320	8	8	150	55	900	1.8	3	20	45	
15	75	1300	1250	400	27	13	220	60	1000	2.0	3	29	50	
15	90	1000	700	350	27	11	220	60	1000	2.0	3	30	50	
15	90	1000	700	360	27	11	220	60	1000	2.0	3	30	50	
19	75	1300	1250	360	10	14	290	70	1300	2.6	3	44	50	
19	90	1000	700	310	9	12	290	70	1300	2.6	3	45	50	
19	90	1000	700	320	9	12	290	70	1300	2.6	3	45	50	

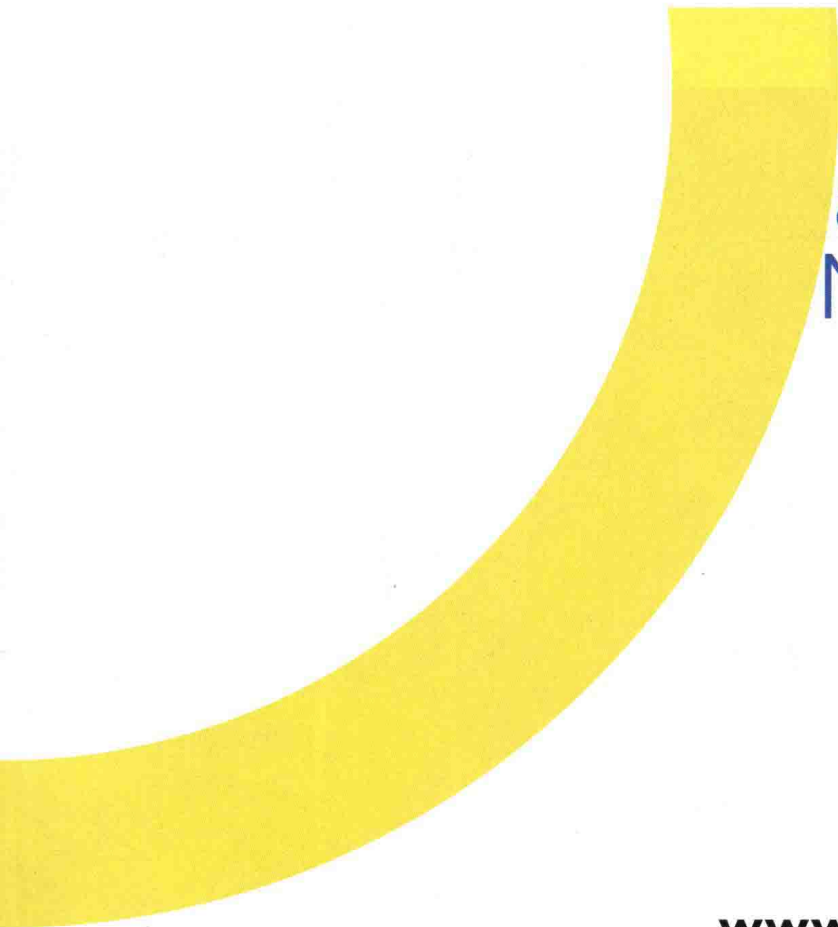
^e Vitamin E recommendations are expressed as α-tocopherol.

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Minerals										
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)	
4	—	45	—	—	0.7	—	—	—	—	
5	—	60	—	—	0.9	—	—	—	—	
7	200	90	1000	2	1.3	300	3	0.2	—	
12	300	150	3000	3	2.2	600	6	0.3	—	
23	600	280	5000	6	10	1100	11	0.6	—	
34	900	400	8000	9	10	1700	17	1.0	—	
40	1100	400	10,000	11	10	2000	20	1.0	1.8	
40	1100	400	10,000	11	10	2000	20	1.0	1.8	
34	900	400	8000	9	10	1700	17	1.0	—	
40	1100	400	10,000	11	10	2000	20	1.0	—	
34	900	400	8000	9	10	1700	17	1.0	—	
40	1100	400	10,000	11	10	2000	20	1.0	—	

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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Understanding Normal and Clinical Nutrition

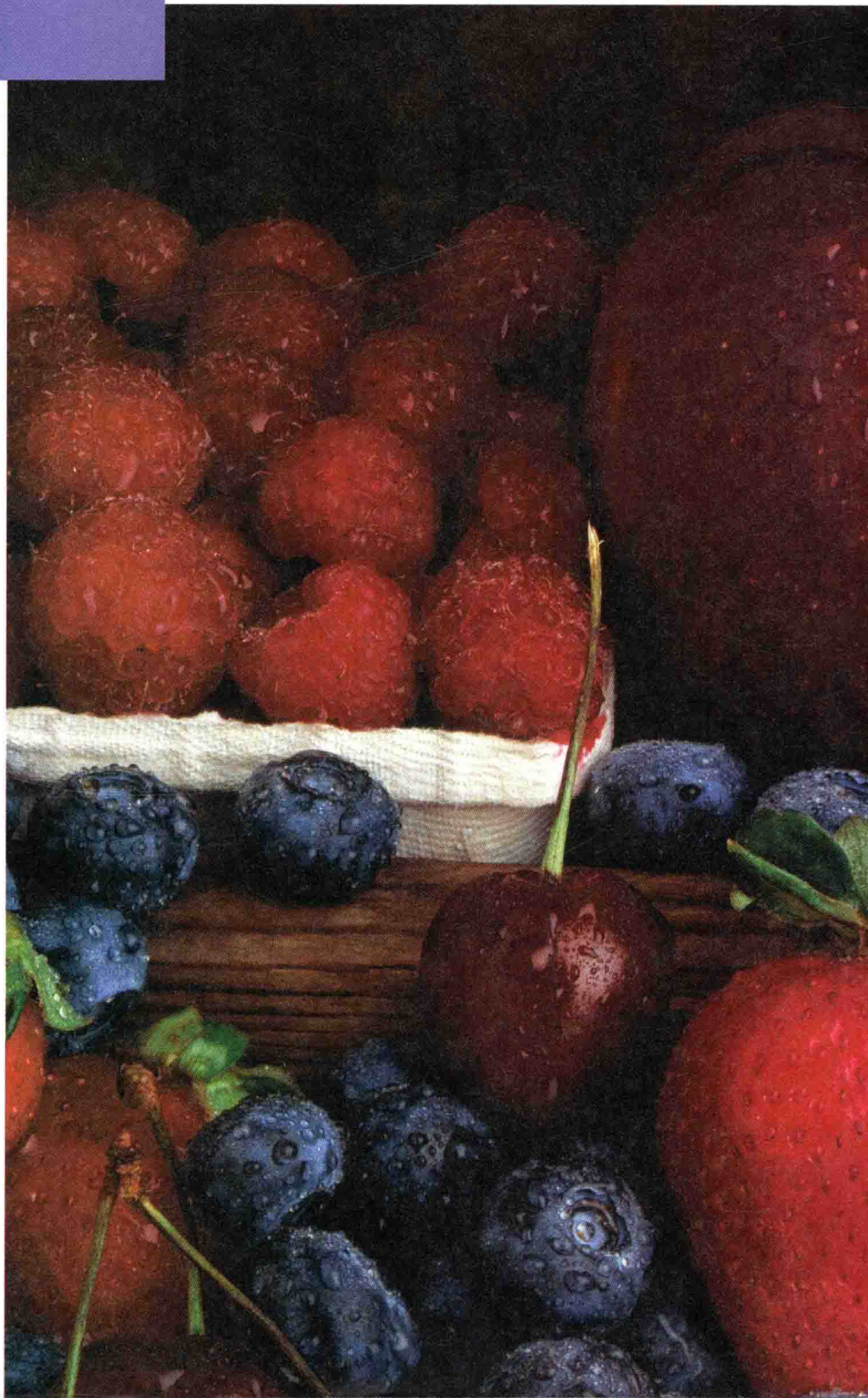
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To

All my children,
stepchildren, and
grandchildren, and to
my loved ones who
enrich my life today
beyond measure:
Council, Vicki, Arthur,
Brad, John, David,
Jarod, Mechelle,
Brittany, Jacob, and all.

ELLIE

To

My husband and
soulmate Mike Fogel,
who lifts my spirits
and brightens my days.

CORKIE

To

My parents, Tom and
Gladys Rady, whose
love and guidance
throughout the years
enabled me to fulfill
my dreams.

SHARON



ABOUT THE AUTHORS

Eleanor Noss Whitney, Ph.D., received her B.A. in biology from Radcliffe College in 1960 and her Ph.D. in biology from Washington University, St. Louis, in 1970. Formerly on the faculty at Florida State University, and a dietitian registered with the American Dietetic Association, she now devotes full time to research, writing, and consulting. Her earlier publications include articles in *Science*, *Genetics*, and other journals. Her textbooks include *Understanding Nutrition*, *Nutrition Concepts and Controversies*, *Life Span Nutrition: Conception through Life*, *Nutrition and Diet Therapy*, and *Nutrition for Health and Health Care* for college students and *Making Life Choices* for high school students. Her most intense interests currently include energy conservation, solar energy uses, alternatively fueled vehicles, and ecosystem restoration.

Corinne Balog Cataldo, M.M.Sc., R.D., C.N.S.D., received her B.S. in community health nutrition from Georgia State University in 1976 and her M.M.Sc. in clinical dietetics from Emory University in 1979. She has worked in private practice in Atlanta, as a clinical dietitian and metabolic support nutritionist at Georgia Baptist Medical Center in Atlanta, as a faculty member and dietetic internship coordinator at Emory University, and as a nutritionist with the Infant Formula Council. She has made numerous presentations, and in addition to this book, she has written a manual on tube feedings and the books *Nutrition and Diet Therapy*, *Nutrition for Health and Health Care*, and *Understanding Clinical Nutrition*. She is a certified nutrition support dietitian.

Sharon Rady Rolfes, M.S., R.D., received her B.S. in psychology and criminology in 1974 and her M.S. in nutrition and food science in 1982 from Florida State University. She is a founding member of Nutrition and Health Associates, an information resource center that maintains an ongoing bibliographic database that tracks research in over 1000 nutrition-related topics. Her other publications include the textbooks *Understanding Nutrition*, *Understanding Clinical Nutrition*, *Life Span Nutrition: Conception through Life*, and *Nutrition for Health and Health Care* and a multimedia CD-ROM called *Nutrition Interactive*. In addition to writing, she also lectures at universities and at professional conferences and serves as a consultant for various educational projects. She maintains her registration as a dietitian and membership in the American Dietetic Association.

PREFACE

THE CONTENTS of the sixth edition of *Understanding Normal and Clinical Nutrition* reflect the dramatic changes that have transpired in nutrition science and health care delivery since the first edition was written. Many current research topics—such as phytochemicals, leptin, complementary therapies, and the metabolic syndrome—weren't even mentioned in the first edition. This edition discusses each of these topics, and more. As with each previous edition, every chapter has been substantially revised to reflect the many changes that have occurred in the field of nutrition. Even though the information is new, this edition maintains the same goals: to reveal the facts about nutrition, and to show readers how to apply this information to their daily lives and clinical practice.

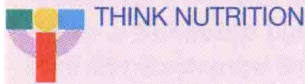
• **The Chapters** • *Understanding Normal and Clinical Nutrition* presents the core information of an introductory nutrition course. Chapter 1 wastes no time in exploring why we eat the foods we do and continues with a brief overview of the nutrients, the science of nutrition, recommended nutrient intakes, assessment, and important relationships between diet and health. Chapter 2 describes the diet-planning principles and food guides used to create diets that support good health and includes instructions on how to read a food label. In Chapter 3, readers follow the journey of digestion and absorption as the body transforms foods into nutrients. Chapters 4 through 6 describe carbohydrates, fats, and proteins—their chemistry, roles in the body, and places in the diet. Then Chapter 7 shows how the body derives energy from these three nutrients. Chapters 8 and 9 continue the story with a look at the benefits and dangers of weight loss and weight gain. Chapters 10 through 13 complete the introductory lessons by describing the vitamins, the minerals, and water—their roles in the body, deficiency and toxicity symptoms, and sources. Chapters 14, 15, and 16 present the special nutrient needs of people through the life cycle—pregnancy and lactation; infancy, childhood, and adolescence; and adulthood and the later years.

The remaining chapters of the book focus on the nutrition care of clients with health problems. Chapter 17 describes the ways illnesses and their treatments alter nutrient needs and shows how health care professionals assess the affects of illness on nutrition status. Chapter 18 provides an in-depth look at potential interactions between nutrients and prescription medications, over-the-counter medications, herbs, and other dietary supplements. Chapter 19 discusses how health care professionals make plans for clients' nutrition care. Chapters 20 through 29 explore specific diseases. Chapters 20 and 21 examine health problems that affect the upper and lower GI tract. Chapters 22 and 23 explain special ways of feeding people who cannot eat conventional foods. Chapter 24 looks at the ways severe stresses affect metabolism and nutrient needs. Chapter 25 provides an overview of diabetes mellitus. Chapters 26 through 28 discuss disorders of the heart, blood vessels, lungs, kidneys, and liver. The last chapter describes the multiple effects of cancers and HIV infections on nutrition status.

• **The Highlights** • Every chapter is followed by a highlight. Each highlight provides readers with a review of a topic that relates to the companion chapter. New highlights in this edition feature functional foods, a quick and easy way to plan and prepare healthy meals, the immune system, multiple organ failure, the metabolic syndrome, dialysis, and gallstones.

• **Special Features** • The chapters in this edition have been designed with special features to enhance learning. For example, definitions are provided

◆ Did you know that an adult has 10,000 tastebuds? ◆



CASE STUDY



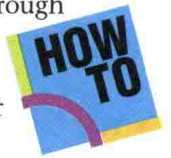
whenever new terms are introduced. These definitions often include pronunciations and derivations to facilitate understanding. A glossary at the end of the text includes all defined terms.



New to this edition are health promotion icons in the first part of the book that call the reader's attention to

the many connections between specific nutrients and health. Another new feature found in each of the first 16 chapters is a fascinating fact offered just for fun. These informative tidbits may not be on the exam, but they are sure to amuse readers and stimulate discussion. Also new to this edition and found in later chapters are "Think nutrition" reminders. These boxes prompt readers to be alert for nutrition problems when clients have specific illnesses or symptoms.

Many chapters include "How to" sections that guide readers through problem-solving tasks. For example, the "How to" in Chapter 1 shows readers how to calculate energy intake from the grams of carbohydrate, fat, and protein in a food; another "How to" in Chapter 26 describes how to help clients implement heart-healthy diets.



Several chapters in the first part of the book close with a "Making It Click" section. Later chapters include case studies and "Clinical Applications" sections. The problems posed in these sections enable readers to apply the chapter material to hypothetical situations. Readers who successfully master these exercises will be well prepared for "real-life" nutrition-related problems.



IN SUMMARY

Each major section within a chapter concludes with a summary paragraph that reviews the key concepts. Similarly, summary tables cue readers to important reviews.

Also featured in the early chapters of this edition are the Healthy People 2010 nutrition-related priorities, which are presented whenever their subjects are discussed. Healthy People 2010 is a report developed by the U.S. Department of Health and Human Services that establishes national objectives in health promotion and disease prevention for the year 2010.



HEALTHY PEOPLE 2010

These nutrition-related priorities are presented throughout the text whenever their subjects are discussed.

How are you doing?



Nutrition Assessment Checklist



Diet-Drug Interactions



Nutrition on the Net



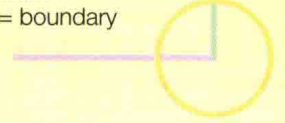
New to this edition are the "How are you doing?" questions at the end of each of the earlier chapters that reflect the *Dietary Guidelines*. These questions prompt readers to ponder their own eating habits and activity patterns. Later chapters include "Nutrition assessment checklists" that help readers evaluate the impact of various disorders on nutrition status by highlighting the medical, drug, nutrient intake, anthropometric, laboratory, and physical findings that are particularly relevant to a specific group of clients.

New to the later chapters of this edition are "Diet-Drug Interactions" boxes. These boxes describe the nutrition-related concerns of the medications used to treat the disorders described in the chapter.

Each chapter and many highlights also conclude with Nutrition on the Net—a list of websites and interactive Internet activities for further study of topics covered in the accompanying text. These listings do not imply an endorsement of the

definition (DEF-eh-NISH-en):
the meaning of a word.

- **de** = from
- **finis** = boundary



organizations or their programs. We have tried to provide reputable sources, but cannot be responsible for the content of these sites. (Read Highlight 1 to learn how to find reliable information on the Internet.)

Each chapter ends with study questions in essay and multiple-choice format. Study questions offer readers the opportunity to review the major concepts presented in the chapters in preparation for exams. The page numbers after each essay question refer readers to discussions that answer the question; multiple-choice answers appear on the last page of the chapter.

Study Questions



• **The Appendixes** • The appendixes are valuable references for a number of purposes. Appendix A summarizes background information on the hormonal and nervous systems, complementing Appendixes B and C on basic chemistry, the chemical structure of nutrients, and major metabolic pathways. Appendix D describes measures of protein quality. Appendix E provides supplemental information about nutrition assessment, and Appendix F lists nutrition resources, including websites. Appendix G presents the U.S. Exchange System. Appendix H is a 2000-item food composition table compiled from the latest nutrient database assembled by ESHA Research, Inc., of Salem, Oregon. Appendix I presents recommendations from the World Health Organization (WHO) and information for Canadians—the Choice System and guidelines to healthy eating and physical activity. Appendix J provides information about enteral formulas.

• **The Inside Covers** • The inside covers put commonly used information at your fingertips. The front covers present the current nutrient recommendations (introduced in Chapter 1); the inside back cover (left) features the Daily Values used on food labels (presented in Chapter 2) and a glossary of nutrient measures; and the inside back cover (right) shows the suggested weight ranges for various heights (discussed in Chapter 8). Aids to Calculations can be found on the last two pages of the book.

• **Closing Comments** • We have tried to keep the number of references manageable. Many statements that have appeared in previous editions with references now appear without them, but every statement is backed by research, and the authors will supply references upon request. We have not provided a separate list of suggested readings, but have tried to include references that will provide readers with additional details or a good overview of the subject. Nutrition is a fascinating subject, and we hope our enthusiasm for it comes through on every page.

ELEANOR NOSS WHITNEY
CORINNE BALOG CATALDO
SHARON RADY ROLFES
MAY 2001

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To produce a book requires the coordinated effort of a team of people—and, no doubt, each team member has another team of support people as well. We salute, with a big round of applause, everyone who has worked so diligently to ensure the quality of this book.

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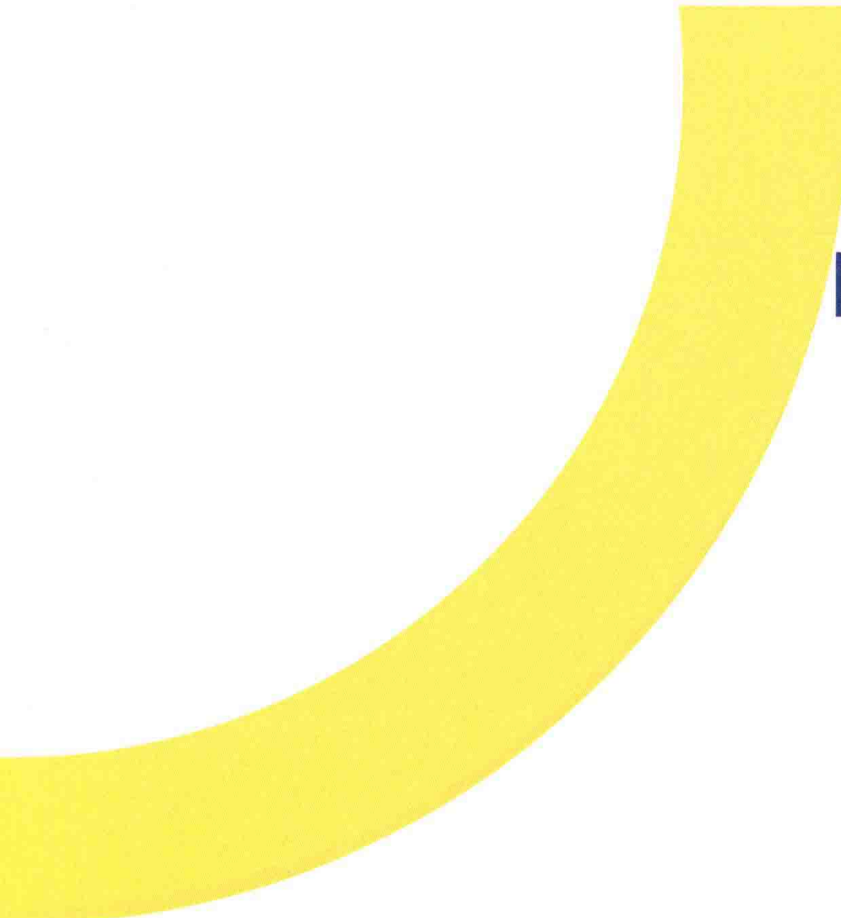
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