

# NUTRITION SEVENTH EDITION

## CONCEPTS AND CONTROVERSIES

FRANCES SIZER

ELEANOR WHITNEY



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# NUTRITION

## CONCEPTS AND CONTROVERSIES

*Seventh Edition*

Frances Sienkiewicz Sizer

Eleanor Noss Whitney



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## Recommended Dietary Allowances (RDA), 1989<sup>a</sup>

Age (years)	Weight Height				Protein (g)	(RE) Vitamin A	(µg) Vitamin D	(mg) Vitamin E	(µg) Vitamin K	(mg) Vitamin C	(mg) Thiamin	(mg) Riboflavin	(mg equiv.) Niacin	(mg) Vitamin B <sub>6</sub>	(µg) Folate	(µg) Vitamin B <sub>12</sub>	(mg) Calcium	(mg) Phosphorus	(mg) Magnesium	(mg) Iron	(mg) Zinc	(µg) Iodine	(µg) Selenium
	(kg)	(lb)	(cm)	(inches)																			
<b>Infants</b>																							
0.0–0.5	6	13	60	24	13	375	7.5	3	5	30	0.3	0.4	5	0.3	25	0.3	400	300	40	6	5	40	10
0.5–1.0	9	20	71	28	14	375	10	4	10	35	0.4	0.5	6	0.6	35	0.5	600	500	60	10	5	50	15
<b>Children</b>																							
1–3	13	29	90	35	16	400	10	6	15	40	0.7	0.8	9	1.0	50	0.7	800	800	80	10	10	70	20
4–6	20	44	112	44	24	500	10	7	20	45	0.9	1.1	12	1.1	75	1.0	800	800	120	10	10	90	20
7–10	28	62	132	52	28	700	10	7	30	45	1.0	1.2	13	1.4	100	1.4	800	800	170	10	10	120	30
<b>Males</b>																							
11–14	45	99	157	62	45	1,000	10	10	45	50	1.3	1.5	17	1.7	150	2.0	1,200	1,200	270	12	15	150	40
15–18	66	145	176	69	59	1,000	10	10	65	60	1.5	1.8	20	2.0	200	2.0	1,200	1,200	400	12	15	150	50
19–24	72	160	177	70	58	1,000	10	10	70	60	1.5	1.7	19	2.0	200	2.0	1,200	1,200	350	10	15	150	70
25–50	79	174	176	70	63	1,000	5	10	80	60	1.5	1.7	19	2.0	200	2.0	800	800	350	10	15	150	70
51+	77	170	173	68	63	1,000	5	10	80	60	1.2	1.4	15	2.0	200	2.0	800	800	350	10	15	150	70
<b>Females</b>																							
11–14	46	101	157	62	46	800	10	8	45	50	1.1	1.3	15	1.4	150	2.0	1,200	1,200	280	15	12	150	45
15–18	55	120	163	64	44	800	10	8	55	60	1.1	1.3	15	1.5	180	2.0	1,200	1,200	300	15	12	150	50
19–24	58	128	164	65	46	800	10	8	60	60	1.1	1.3	15	1.6	180	2.0	1,200	1,200	280	15	12	150	55
25–50	63	138	163	64	50	800	5	8	65	60	1.1	1.3	15	1.6	180	2.0	800	800	280	15	12	150	55
51+	65	143	160	63	50	800	5	8	65	60	1.0	1.2	13	1.6	180	2.0	800	800	280	10	12	150	55
<b>Pregnant</b>																							
					60	800	10	10	65	70	1.5	1.6	17	2.2	400	2.2	1,200	1,200	320	30	15	175	65
<b>Lactating</b>																							
1st 6 mo					65	1,300	10	12	65	95	1.6	1.8	20	2.1	280	2.6	1,200	1,200	355	15	19	200	75
2nd 6 mo					62	1,200	10	11	65	90	1.6	1.7	20	2.1	260	2.6	1,200	1,200	340	15	16	200	75

<sup>a</sup>The allowances are intended to provide for individual variations among most normal, healthy people in the United States under usual environmental stresses. Diets should be based on a variety of common foods in order to provide other nutrients for which human requirements have been less well defined. See the text for a more detailed discussion of the RDA and of nutrients not tabulated.

SOURCE: *Recommended Dietary Allowances*, © 1989 by the National Academy of Sciences, National Academy Press, Washington D.C.

## Estimated Safe and Adequate Daily Dietary Intakes of Additional Selected Vitamins and Minerals (United States)<sup>a</sup>

VITAMINS		
AGE (years)	Biotin (µg)	Pantothenic Acid (mg)
<b>Infants</b>		
0-0.5	10	2
0.5-1	15	3
<b>Children</b>		
1-3	20	3
4-6	25	3-4
7-10	30	4-5
11+	30-100	4-7
<b>Adults</b>	30-100	4-7

TRACE ELEMENTS <sup>b</sup>					
Age (years)	Chromium (µg)	Molybdenum (µg)	Copper (mg)	Manganese (mg)	Fluoride (mg)
<b>Infants</b>					
0-0.5	10-40	15-30	0.4-0.6	0.3-0.6	0.1-0.5
0.5-1	20-60	20-40	0.6-0.7	0.6-1.0	0.2-1.0
<b>Children</b>					
1-3	20-80	25-50	0.7-1.0	1.0-1.5	0.5-1.5
4-6	30-120	30-75	1.0-1.5	1.5-2.0	1.0-2.5
7-10	50-200	50-150	1.0-2.0	2.0-3.0	1.5-2.5
11+	50-200	75-250	1.5-2.5	2.0-5.0	1.5-2.5
<b>Adults</b>	50-200	75-250	1.5-3.0	2.0-5.0	1.5-4.0

<sup>a</sup>Because there is less information on which to base allowances, these figures are not given in the main table of the RDA and are provided here in the form of ranges of recommended intakes.

<sup>b</sup>Because the toxic levels for many trace elements may be only several times usual intakes, the upper levels for the trace elements given in this table should not be habitually exceeded.

SOURCE: *Recommended Dietary Allowances*, © 1989 by the National Academy of Sciences, National Academy Press, Washington, D.C.

## Estimated Minimum Requirements of Sodium, Chloride, and Potassium

Age (years)	Sodium <sup>a</sup> (mg)	Chloride (mg)	Potassium <sup>b</sup> (mg)
<b>Infants</b>			
0.0-0.5	120	180	500
0.5-1.0	200	300	700
<b>Children</b>			
1	225	350	1,000
2-5	300	500	1,400
6-9	400	600	1,600
<b>Adolescents</b>	500	750	2,000
<b>Adults</b>	500	750	2,000

<sup>a</sup>Sodium requirements are based on estimates for growth and for replacement of obligatory losses. They cover a wide variation of physical activity patterns and climatic exposure but do not provide for large, prolonged losses from the skin through sweat.

<sup>b</sup>Dietary potassium may benefit the prevention and treatment of hypertension and recommendations to include many servings of fruits and vegetables would raise potassium intakes to about 3,500 mg/day.

SOURCE: *Recommended Dietary Allowances*, © 1989 by the National Academy of Sciences, National Academy Press, Washington, D.C.

## Median Heights and Weights and Recommended Energy Intakes (United States)

AGE (years)	WEIGHT		HEIGHT		AVERAGE ENERGY ALLOWANCE	
	kg	lb	cm	inches	cal per kg	cal per day <sup>a</sup>
<b>Infants</b>						
0.0–0.5	6	13	60	24	108	650
0.5–1.0	9	20	71	28	98	850
<b>Children</b>						
1–3	13	29	90	35	102	1,300
4–6	20	44	112	44	90	1,800
7–10	28	62	132	52	70	2,000
<b>Males</b>						
11–14	45	99	157	62	55	2,500
15–18	66	145	176	69	45	3,000
19–24	72	160	177	70	40	2,900
25–50	79	174	176	70	37	2,900
51+	77	170	173	68	30	2,300
<b>Females</b>						
11–14	46	101	157	62	47	2,200
15–18	55	120	163	64	40	2,200
19–24	58	128	164	65	38	2,200
25–50	63	138	163	64	36	2,200
51+	65	143	160	63	30	1,900
<b>Pregnant (2nd and 3rd trimesters)</b>						+ 300
<b>Lactating</b>						+ 500

<sup>a</sup>Average energy allowances have been rounded.  
SOURCE: *Recommended Dietary Allowances*, © 1989 by the National Academy of Sciences, National Academy Press, Washington, D.C.

## Daily Values (used on food labels)

Daily Reference Values (DRV)		Reference Daily Intakes (RDI)			
Food Component	DRV	Nutrient	Amount	Nutrient	Amount
protein <sup>c</sup>	50 g	Thiamin	1.5 mg	Vitamin K	80 µg
fat	65 g <sup>d</sup>	Riboflavin	1.7 mg	Calcium	1,000 mg
saturated fatty acids	20 g	Niacin	20 mg	Iron	18 mg
cholesterol	300 mg <sup>e</sup>	Biotin	300 µg	Zinc	15 mg
total carbohydrate	300 g	Pantothenic Acid	10 mg	Iodine	150 µg
fiber	25 g	Vitamin B <sub>6</sub>	2 mg	Copper	2 mg
sodium	2,400 mg	Folate	400 µg	Chromium	120 µg
potassium	3,500 mg	Vitamin B <sub>12</sub>	6 µg <sup>f</sup>	Selenium	70 µg
		Vitamin C	60 mg	Molybdenum	75 µg
		Vitamin A	5,000 IU <sup>g</sup>	Manganese	2 mg
		Vitamin D	400 IU <sup>g</sup>	Chloride	3,400 mg
		Vitamin E	30 IU <sup>g</sup>	Magnesium	400 mg
				Phosphorus	1 g

<sup>a</sup>Based on 2,000 calories a day for adults and children over 4 years old.  
<sup>b</sup>Formerly the U.S. RDA, based on National Academy of Sciences' 1968 Recommended Dietary Allowances.  
<sup>c</sup>DRV for protein does not apply to certain populations; Reference Daily Intake (RDI) for protein has been established for these groups: children 1 to 4 years: 16 g; infants under 1 year: 14 g; pregnant women: 60 g; nursing mothers: 65 g.  
<sup>d</sup>(g) grams  
<sup>e</sup>(mg) milligrams  
<sup>f</sup>(µg) micrograms  
<sup>g</sup>Equivalent values for the three RDI nutrients expressed as IU are: vitamin A, 875 RE; vitamin D, 6.5 µg; vitamin E, 9 mg.

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*To my husband, Jack Yaeger,  
who never ceases to amaze me with the  
depths of his goodness, with love.  
Ellie*

*To my mother, Bernice Sienkiewicz, who heals us all;  
to Harriet Harlan, for the memories we share;  
to Karen Cooley and Eric Favier, mes amis;  
and to wonderful Philip Webb, whom I love.  
Fran*

## 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 the Florida State University, and a dietitian registered with the American Dietetic Association, she now devotes full time to research, writing, and consulting in nutrition, health, and environmental issues. Her earlier publications include articles in *Science*, *Genetics*, and other journals. Her textbooks include *Understanding Nutrition*, *Understanding Normal and Clinical Nutrition*, *Nutrition and Diet Therapy*, and *Essential Life Choices* for college students and *Making Life Choices* for high-school students. Her most intense interests presently include energy conservation, solar energy uses, alternatively fueled vehicles, and ecosystem restoration.

Frances Sienkiewicz Sizer, M.S., R.D., F.A.D.A., attended Florida State University where, in 1980, she received her B.S., and in 1982, her M.S. in nutrition. She is certified as a charter Fellow of the American Dietetic Association. She is a founding member and vice president of Nutrition and Health Associates, an information and resource center in Tallahassee, Florida, that maintains an ongoing bibliographic database that tracks research in more than 1,000 topic areas of nutrition. Her textbooks include *Life Choices: Health Concepts and Strategies*; *Making Life Choices*; *The Fitness Triad: Motivation, Training, and Nutrition*; and others. She has recently completed *Nutrition Interactive*, an instructional college-level nutrition CD-ROM. In addition to writing, she lectures at universities and at national and regional conferences.

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# PREFACE

Six editions of *Nutrition: Concepts and Controversies* have been tested by students and professors in classrooms across the nation. In each edition, we apply what we have learned from past readers, changing the book to meet changing times. Now, as we look ahead toward a new millennium, we face an even more rapidly changing future. In this edition, we have expanded our balanced portrayal of nutrition's new frontiers, retained our accurate presentation of established nutrition knowledge, and heightened our sense of personal connection with instructors and learners alike. We still write in the informal, clear style for which we have received plaudits. For both verbal and visual learners, our style and our clear, colorful figures keep interest high and understanding at a peak. New photos and abundant figures adorn many of the pages, adding pleasure and clarity to the reading.

In the seventh edition, you will find some new practical features to connect science concepts with food choices. Sections called *Do It* invite students to apply chapter concepts to everyday encounters with nutrition. The *Do Its* of Chapters 1 and 10 offer ways to judge nutrition information from the media and from makers of supplements for athletes. Those of Chapters 2 through 9 guide students along approaches taken by menu planners. In one approach, demonstrated in the *Do It* sections of Chapters 4 through 8, the planner answers the question of how many grams, milligrams, and micrograms of nutrients a meal provides and compares the totals to a standard such as the RDA. An alternative food-based approach to menu planning, demonstrated in Chapters 2 and 9, is the food group approach. The student is asked to assess the adequacy of meals by comparing them with the Food Guide Pyramid recommendations. The final *Do It* of Chapter 11 ties together the previous exercises and allows students to stretch their skills by identifying meals that best meet the goals of the *Dietary Guidelines for Americans* and other recommendations.

Another powerful new feature in this edition is the *Self-Check*, a series of review questions at the end of each chapter. These sections allow students to quickly review each chapter's content, and the answers in Appendix G provide immediate feedback. These *Self-Check* questions were provided by Judy Kaufman who has used our text with her students at Monroe Community College for many years.

By popular demand, we have retained our *Snapshots* of vitamins and minerals, capsules of information that depict food sources and teach some salient facts about each nutrient. We have added a Snapshot to Chapter 11, emphasizing foods rich in phytochemicals, nonnutrient substances that hold promise for preventing diseases. Food sources of the energy-yielding nutrients are depicted more vividly than ever before by way of new graphics and photographs.

We hope that you will enjoy the seventh edition of our text. Chapter 1 begins with a personal challenge to nutrition students. It asks the question so many



people ask of nutrition scientists: “What can I believe, when scientists keep changing their minds?” We answer with a lesson in sound scientific thinking and the context in which study results may be rightly viewed. We then introduce the nutrients and explore the concept of nutrient density. Finally, a discussion of the important role of cuisine in a person’s heritage focuses on and honors this country’s multicultural nature. Chapter 2 brings together the concepts of diet planning through food grouping systems and features the Daily Food Guide with its pyramid of food choices. Chapter 3 presents a thorough, but brief, introduction to the workings of the human body with major emphasis on the digestive system. Chapters 4 through 6 are devoted to the energy-yielding nutrients—carbohydrates, lipids, and proteins. Chapters 7 and 8 present the vitamins, minerals, and water, with special emphasis on the emerging importance of the antioxidant nutrients. Chapter 9 relates energy balance to body composition, obesity, and underweight and presents weight maintenance as a lifelong effort. Chapter 10 presents the relationships between fitness, physical activity, and nutrition—relationships that are of interest to the casual exerciser and athlete alike. Chapter 11 applies the essence of the first ten chapters to two broad and rapidly changing areas within nutrition: immunity and disease prevention. It also discusses the emerging importance of phytochemicals in relation to disease prevention. Chapters 12 and 13 point out the importance of nutrition throughout the life span, from gestation through old age. Chapter 14 considers the problems and advantages of food technology, with emphasis on food safety. Chapter 15 touches on the vast problems of the global food supply—world hunger, pollution, overpopulation—and shows how everyday food choices link each person with the meaningful whole.

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 ends of each chapter and are printed with colored borders, delve into current scientific topics and emerging controversies. Some are new to this edition and the others have been updated. Of special current interest is Controversy 2, which compares Mediterranean foodways with those of the United States and Canada. By examining the advantages and drawbacks of each eating plan, the Controversy provides clues to which plan might hold the secret to a healthy heart. Controversy 7 sets up a lively competition between food and supplements as vitamin sources, exploring the research to date on the antioxidant vitamins. Controversy 9 tackles some pressing questions surrounding the safety and effectiveness of weight-loss diets, diet profiteers, and attitudes toward overweight people in this country. Controversy 10 presents current thinking about eating disorders. Controversy 14 evaluates new food technologies and invites the reader to look forward to and evaluate future innovations. Controversy 15 explores ways in which agriculture can ensure a high-quality food supply into the next century.

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 nutrition principles. *Consumer Corners* present information on amino acid supplements, vitamin C and the common cold, bottled water, marketing of infant formula, and other nutrition-related marketplace issues to empower students to make informed decisions.

New or major terms in chapters are defined in the margins of the pages where they are introduced and also in the Glossary at the end of the book.

Terms in Controversy sections are grouped together and defined in tables within the sections and in the Glossary. The reader who wishes to locate any term can do so by consulting the index, which lists the page numbers of definitions in boldface type.

The appendixes have been updated. Appendix A which now presents the most complete and accurate listings ever of the nutrient contents of more than 2,200 foods. Appendix B, *Canadiana*, supplies the RNI, the Guidelines, the Food Guide, Food Labels, and the Exchange System for our Canadian readers. Appendix C demonstrates nutrition calculations, with special emphasis on finding percentage of calories from fat in a diet and percentages of the Daily Values. Appendix D provides full coverage with applications of the U.S. Exchange System. Appendix E offers an invaluable list of current addresses, telephone numbers, and Internet web sites for those interested in additional information. We have collected all chapter and controversy references in Appendix F. Older source notes have been removed but are easily available by consulting older editions of this book or by contacting the publisher.

This seventh edition has been an exciting challenge to prepare. As always, our purpose in writing it is to enhance our readers' understanding of nutrition science and motivation to apply it. We 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. Stay up with the news, too. For despite all the conflicting messages, inflated claims, and even quackery that abound in news reports, true nutrition knowledge progresses with a genuine scientific spirit, and important new truths are constantly unfolding.

### Acknowledgments

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