

Nutrition

Sixth Edition

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Dedication

To Michelle with love.

— Paul Insel

*To Donna and Mackinnon for their sustenance of
love, support, and patience.*

— Don Ross

To my parents for their constant support and love.

— Kimberley McMahon

To my family with all my love.

— Melissa Bernstein



Brief Contents

Chapter 1	Food Choices: Nutrients and Nourishment	2
Chapter 2	Nutrition Guidelines and Assessment	30
	Spotlight on Dietary Supplements and Functional Foods	76
Chapter 3	Digestion and Absorption	104
Chapter 4	Carbohydrates	138
Chapter 5	Lipids	172
Chapter 6	Proteins and Amino Acids	214
Chapter 7	Alcohol	258
Chapter 8	Metabolism	284
Chapter 9	Energy Balance and Weight Management: Finding Your Equilibrium	322
	Spotlight on Obesity: The Growing Epidemic	360
Chapter 10	Fat-Soluble Vitamins	386
Chapter 11	Water-Soluble Vitamins	428
Chapter 12	Water and Major Minerals	464
Chapter 13	Trace Minerals	502
Chapter 14	Sports Nutrition: Eating for Peak Performance	542
	Spotlight on Eating Disorders	584
Chapter 15	Diet and Health	608
Chapter 16	Life Cycle: Maternal and Infant Nutrition	650
Chapter 17	Life Cycle: From Childhood to Adulthood	690
Chapter 18	Food Safety and Technology: Microbial Threats and Genetic Engineering	726
Chapter 19	World View of Nutrition: The Faces of Global Malnutrition	760



Contents

Preface xvii

About the Authors xxviii

Chapter 1

Food Choices: Nutrients and Nourishment 2

Why Do We Eat the Way We Do? 3

Personal Preferences 4
Sensory Influences: Taste, Smell, and Texture 5
Emotional and Cognitive Influences 5
Environment 7

Going Green 8

FYI: Food and Culture 9

The American Diet 11

Introducing the Nutrients 12

Definition of Nutrients 12
Carbohydrates 14
Lipids 14
Proteins 14
Vitamins 15
Minerals 15
Water 15
Nutrients and Energy 16
Energy in Foods 16
Diet and Health 17

Applying the Scientific Process to Nutrition 18

From Research Study to Headline 21

Publishing Experimental Results 21
Sorting Facts and Fallacies in the Media 22

FYI: The Affordable Care Act and Nutrition 24

Learning Portfolio 26

Key Terms 26
Study Points 26
Study Questions 26
Try This 27
Getting Personal 27
References 28

Chapter 2

Nutrition Guidelines and Assessment 30

Linking Nutrients, Foods, and Health 32

Going Green: Is the American Diet Contributing to a Warmer Planet? 33

Dietary Guidelines 35

Dietary Guidelines for Americans 35

From Dietary Guidelines to Planning: What You Will Eat 44

A Brief History of Food Group Plans 44

FYI: MyPlate: Foods, Serving Sizes, and Tips 45

Canada's Guidelines for Healthy Eating 47

Using MyPlate or *Canada's Food Guide* in Diet Planning 49

FYI: Portion Distortion 52

Exchange Lists 52

Using the Exchange Lists in Diet Planning 53

Recommendations for Nutrient Intake: The DRIs 54

Understanding Dietary Standards 54
A Brief History of Dietary Standards 54
Dietary Reference Intakes 54
Use of Dietary Standards 56

Food Labels 57

Ingredients and Other Basic Information 57
Nutrition Facts Panel 59
Daily Values 60
Nutrient Content Claims 61
Health Claims 61
Structure/Function Claims 62

FYI: Definitions for Nutrient Content Claims on Food Labels 63

Using Labels to Make Healthful Food Choices 64

Nutrition Assessment: Determining Nutritional Health 64

The Continuum of Nutritional Status 64
Nutrition Assessment of Individuals 65
Nutrition Assessment of Populations 65

Nutrition Assessment Methods 65

Anthropometric Measurements 65
Biochemical Tests 67
Clinical Observations 68
Dietary Intake 68
Methods of Evaluating Dietary Intake Data 69
Outcomes of Nutrition Assessment 69

Learning Portfolio 71

Key Terms	71
Study Points	71
Study Questions	71
Try This	72
Getting Personal	72
References	74

Spotlight on Dietary Supplements and Functional Foods 76

Dietary Supplements: Vitamins and Minerals 77

Moderate Supplementation	79
Megadoses in Conventional Medical Management	79
Megadosing Beyond Conventional Medicine:	
Orthomolecular Nutrition	81
Drawbacks of Megadoses	81

Dietary Supplements: Natural Health Products 82

Helpful Herbs, Harmful Herbs	83
Other Dietary Supplements	85

Dietary Supplements in the Marketplace 85

The FTC and Supplement Advertising	85
The FDA and Supplement Regulation	85
Supplement Labels	87

FYI: Shopping for Supplements 88

Canadian Regulations	89
Choosing Dietary Supplements	89
Fraudulent Products	90

Functional Foods 90

Phytochemicals Make Foods Functional	90
Foods Enhanced with Functional Ingredients and Additives	95
Regulatory Issues for Functional Foods	96
Health Claims for Functional Foods	96
Structure/Function Claims for Functional Foods	97
Strategies for Functional Food Use	97

FYI: Defining Complementary and Integrative Health: How Does Nutrition Fit? 98

Learning Portfolio 100

Key Terms	100
Study Points	100
Study Questions	101
Try This	101
Getting Personal	101
References	102

Chapter 3 Digestion and Absorption 104

Taste and Smell: The Beginnings of Our Food Experience 105

The Gastrointestinal Tract 106

Organization of the GI Tract	107
A Closer Look at Gastrointestinal Structure	108

Overview of Digestion: Physical and Chemical Processes 109

The Physical Movement and Breakdown of Food	109
The Chemical Breakdown of Food	109

Overview of Absorption 110

The Four Roads to Nutrient Absorption	110
---------------------------------------	-----

Going Green: Air + Water + Brown Stuff + Green Stuff = Compost! 112

Assisting Organs 113

Salivary Glands	114
Liver	114
Gallbladder	115
Pancreas	115

Putting It All Together: Digestion and Absorption 115

Mouth	115
Stomach	116
Small Intestine	117

FYI: Celiac Disease and Gluten Sensitivity 120

The Large Intestine	120
---------------------	-----

Circulation of Nutrients 121

Vascular System	121
Lymphatic System	122
Excretion and Elimination	123

Signaling Systems: Command, Control, and Defense 123

Nervous System	123
Hormonal System	124

Nutrition Science in Action: Screen Time and Diet Quality 125

Influences on Digestion and Absorption 126

Psychological Influences	126
Chemical Influences	126
Bacterial Influences	126

Nutrition and GI Disorders 127

Constipation	128
Diarrhea	128
Diverticulosis	128

FYI: Bugs in Your Gut? Health Effects of Intestinal Bacteria 129

Heartburn and Gastroesophageal Reflux	130
Irritable Bowel Syndrome	130
Colorectal Cancer	131
Gas	131
Ulcers	133

Functional Dyspepsia 134

Learning Portfolio 136

Key Terms 136

Study Points 136

Study Questions 136

Getting Personal 137

References 137

Chapter 4

Carbohydrates 138

What Are Carbohydrates? 139

Simple Carbohydrates: Monosaccharides and Disaccharides 141

Monosaccharides: The Single Sugars 141

Disaccharides: The Double Sugars 142

Complex Carbohydrates 144

Oligosaccharides 144

Polysaccharides 144

Carbohydrate Digestion and Absorption 148

Digestion 148

Absorption 149

Carbohydrates in the Body 151

Normal Use of Glucose 151

Regulating Blood Glucose Levels 152

Inadequate Regulation of Blood Glucose Levels: Diabetes Mellitus 153

Carbohydrates in the Diet 154

Recommendations for Carbohydrate Intake 154

Current Consumption 155

Choosing Carbohydrates Wisely 155

FYI: The Glycemic Index of Foods: Useful or Useless? 156

Moderating Added Sugar Intake 158

Going Green: Whole Grains: Delicious, Easy to Prepare, Affordable, Good for Your Health, and Good for the Environment 159

Nutrition Science in Action: Sugar-Sweetened and Artificially Sweetened Beverages and Type 2 Diabetes Mellitus 162

Carbohydrates and Health 163

Sugar and Dental Caries 163

FYI: Unfounded Claims Against Sugars 164

Fiber and Obesity 165

Fiber and Type 2 Diabetes 165

Fiber and Cardiovascular Disease 165

Fiber and Gastrointestinal Disorders 165

Negative Health Effects of Excess Fiber 166

Learning Portfolio 168

Key Terms 168

Study Points 168

Study Questions 168

Try This 169

References 169

Chapter 5

Lipids 172

What Are Lipids? 174

Fatty Acids Are Key Building Blocks 174

Chain Length 175

Saturation 175

Geometric and Positional Isomers 177

Essential and Nonessential Fatty Acids 178

Omega-3, Omega-6, and Omega-9 Fatty Acids 178

Building Eicosanoids and Omega-3 and Omega-6 Fatty Acids 179

Triglycerides 181

Triglyceride Structure 181

Triglyceride Functions 181

Triglycerides in Food 184

Commercial Processing of Fats 185

Going Green: Fish: Good for You and the Environment 186

FYI: Fats on the Health Store Shelf 186

Phospholipids 188

Phospholipid Structure 188

Phospholipid Functions 188

FYI: Which Spread for Your Bread? 189

Phospholipids in Food 191

Sterols 191

Sterol Structure 191

Cholesterol Functions 191

Cholesterol Synthesis 192

Sterols in Food 192

Lipids in the Body 192

Lipid Digestion 193

Lipid Absorption 195

Digestion and Absorption of Sterols 195

Transportation of Lipids in the Body 196

Chylomicrons 197

Very-Low-Density Lipoprotein 198

Intermediate-Density Lipoprotein 198

Low-Density Lipoprotein 198

High-Density Lipoprotein 199

Lipids in the Diet 199

Recommendations for Fat Intake 199
 Recommendations for Omega Fatty Acid Intake 201
 Health Effects of Omega Fatty Acids 202
 Current Dietary Intakes 203
 Fat Replacers: What Are They? Are They Safe? Do They Save Calories? 203

Lipids and Health 204

FYI: Does “Reduced Fat” Reduce Calories? Don’t Count on It! 205

Obesity 206
 Heart Disease 206
 Cancer 206

Nutrition Science in Action: Green Tea and Blood Lipids 208

Learning Portfolio 210

Key Terms 210
 Study Points 210
 Study Questions 210
 Try This 211
 Getting Personal 211
 References 211

Chapter 6

Proteins and Amino Acids 214

Why Is Protein Important? 215

Amino Acids Are the Building Blocks of Proteins 216

Amino Acids Are Identified by Their Side Groups 217
 Protein Structure: Unique Three-Dimensional Shapes and Functions 217
 Protein Denaturation: Destabilizing a Protein’s Shape 219

Functions of Body Proteins 219

Structural and Mechanical Functions 219
 Enzymes 220
 Hormones 222

FYI: Scrabble Anyone? 222

Immune Function 223

Going Green: Send in the Proteins 223

Fluid Balance 224
 Acid–Base Balance 224
 Transport Functions 225
 Source of Energy and Glucose 225

Protein Digestion and Absorption 226

Protein Digestion 226
 Amino Acid and Peptide Absorption 228

Proteins in the Body 230

Protein Synthesis 230

The Amino Acid Pool and Protein Turnover 231
 Synthesis of Nonprotein Molecules 231
 Protein and Nitrogen Excretion 232
 Nitrogen Balance 233

Proteins in the Diet 234

Recommended Intakes of Protein 234
 Protein Consumption 235

FYI: Do Athletes Need More Protein? 236

Protein Quality 237
 Evaluating Protein Quality and Digestibility 238
 Estimating Your Protein Intake 240
 Proteins and Amino Acids as Additives and Supplements 240

Vegetarian Diets 240

Why People Become Vegetarians 241
 Types of Vegetarians 241
 Health Benefits of Vegetarian Diets 242
 Health Risks of Vegetarian Diets 242
 Dietary Recommendations for Vegetarians 243

FYI: High-Protein Plant Foods 244

The Health Effects of Too Little or Too Much Protein 245

Protein–Energy Malnutrition 245

FYI: High-Protein Diets and Supplements 246

Excess Dietary Protein 248

Nutrition Science in Action: High-Protein Diets and Kidney Function 251

Learning Portfolio 253

Key Terms 253
 Study Points 253
 Study Questions 253
 Try This 254
 Getting Personal 254
 References 255

Chapter 7

Alcohol 258

History of Alcohol Use 260

The Character of Alcohol 260

Alcohol: Is It a Nutrient? 260

Alcohol and Its Sources 262

Alcohol Absorption and Metabolism 263

Clearing Alcohol from the Blood 264
 The Morning After 265
 Treating a Hangover 265

Individual Differences in Responses to Alcohol 266

When Alcohol Becomes a Problem 267

Alcohol in the Brain and the Nervous System 267

Alcohol's Effect on the Gastrointestinal System 269

FYI: Myths About Alcohol 269

FYI: Changing the Culture of Campus Drinking 270

Alcohol and the Liver 272

Fetal Alcohol Syndrome 272

Alcoholics and Malnutrition 274

Poor Diet 274

Vitamin Deficiencies 274

Mineral Deficiencies 274

Macronutrients 275

Body Weight 275

Does Alcohol Have Benefits? 275

Learning Portfolio 280

Key Terms 280

Study Points 280

Study Questions 280

Try This 280

References 280

Chapter 8

Metabolism 284

Energy: Fuel for Work 285

Transferring Food Energy to Cellular Energy 286

What Is Metabolism? 287

The Cell Is the Metabolic Processing Center 288

Who Are the Key Energy Players? 289

ATP: The Body's Energy Currency 289

NADH and FADH₂: The Body's Energy Shuttles 290

NADPH: An Energy Shuttle for Biosynthesis 291

Breakdown and Release of Energy 291

Extracting Energy from Carbohydrate 291

Extracting Energy from Fat 297

Fat Burns in a Flame of Carbohydrate 299

Going Green: Biofuel Versus Fossil Fuel 299

Extracting Energy from Protein 300

Alcohol Metabolism 301

Metabolizing Small Amounts of Alcohol 301

Metabolizing Large Amounts of Alcohol 302

Biosynthesis and Storage 303

Making Carbohydrate (Glucose) 303

Making Fat (Fatty Acids) 306

Making Ketone Bodies 307

FYI: Do Carbohydrates Turn into Fat? 308

Making Protein (Amino Acids) 309

Regulation of Metabolism 310

FYI: Key Intersections Direct Metabolic Traffic 310

Hormones of Metabolism 311

Special States 311

Feasting 311

Fasting 312

FYI: Metabolic Profiles of Important Sites 313

Nutrition Science in Action: Energy Intake and Expenditure During Video Games and Television Watching 317

Learning Portfolio 318

Key Terms 318

Study Points 318

Study Questions 319

Try This 319

References 320

Chapter 9

Energy Balance and Weight Management: Finding Your Equilibrium 322

Energy In 324

Regulation of Food Intake 324

Control by Committee 325

Energy Out: Fuel Uses 328

Major Components of Energy Expenditure 329

The Measurement of Energy Expenditure 332

Estimating Total Energy Expenditure 334

DRIs for Energy: Estimated Energy Requirements 334

FYI: How Many Calories Do I Burn? 335

Body Composition: Understanding Fatness and Weight 336

Assessing Body Weight 336

Assessing Body Fatness 337

Body Fat Distribution 339

Weight Management 340

The Perception of Weight 340

What Goals Should I Set? 341

Adopting a Healthy Weight-Management Lifestyle 342

Diet and Eating Habits 342

Going Green: Salad Days 343

Physical Activity 345

Thinking and Emotions 346

FYI: Learning Weight Management from Some of the “Biggest” Weight Experts: Sumo Wrestlers 347

Weight-Management Approaches 348

FYI: Behaviors That Will Help You Manage Your Weight 349

Underweight 353

Causes and Assessment 354

Weight-Gain Strategies 354

Learning Portfolio 356

Key Terms 356

Study Points 356

Study Questions 356

Try This 357

References 358

Spotlight on Obesity: The Growing Epidemic 360

Factors in the Development of Obesity 364

Biological Factors 364

Social and Environmental Factors 366

FYI: U.S. Obesity Trends: A Relentless Increase 369

FYI: Does Our Environment Make Us Fat? 371

Lifestyle and Behavior Factors 372

FYI: Is Food Addiction Real? 373

Childhood Overweight 375

Let’s Move! 376

Health Risks of Overweight and Obesity 376

FYI: Childhood and Teenage Obesity: “The First Generation That Does Not Outlive Its Parents” 376

Weight Cycling 380

Obesity Is a Preventable National Crisis 380

FYI: Can Medicines Lead to Obesity? 381

Learning Portfolio 382

Key Terms 382

Study Points 382

Study Questions 382

Try This 382

References 383

Chapter 10

Fat-Soluble Vitamins 386

Understanding Vitamins 387

Anatomy of the Vitamins 388

Fat-Soluble Versus Water-Soluble Vitamins 388

Storage and Toxicity 390

Provitamins 390

Vitamins in Foods 391

Vitamin A: The Retinoids and Carotenoids 391

Forms of Vitamin A 391

Storage and Transport of Vitamin A 392

Functions of Vitamin A 392

FYI: A Short History of Vitamins 395

Dietary Recommendations for Vitamin A 396

Sources of Vitamin A 396

Vitamin A Deficiency 398

Vitamin A Toxicity 399

The Carotenoids 400

Vitamin D 404

Forms and Formation of Vitamin D 405

Functions of Vitamin D 405

Going Green: Vitamin Buddies 407

Dietary Recommendations for Vitamin D 408

Sources of Vitamin D 408

Vitamin D Deficiency 409

Nutrition Science in Action: Vitamin D Supplements: D₂ Versus D₃ 411

Vitamin D Toxicity 412

Vitamin E 413

Forms of Vitamin E 413

Functions of Vitamin E 413

Dietary Recommendations for Vitamin E 415

Sources of Vitamin E 416

Vitamin E Deficiency 417

Vitamin E Toxicity 417

Vitamin K 417

Functions of Vitamin K 418

Dietary Recommendations for Vitamin K 418

Sources of Vitamin K 419

Vitamin K Deficiency 421

Vitamin K Toxicity 422

Learning Portfolio 424

Key Terms 424

Study Points 424

Study Questions 424

Try This 425

Getting Personal 425

References 425

Chapter 11

Water-Soluble Vitamins 428

The Water-Soluble Vitamins: Eight Bs and a C 429

The B Vitamins 431**Thiamin 432**

- Functions of Thiamin 432
- Dietary Recommendations for Thiamin 432
- Sources of Thiamin 433
- Thiamin Deficiency 433

FYI: Fresh, Frozen, or Canned? Raw, Dried, or Cooked? Selecting and Preparing Foods to Maximize Nutrient Content 434

Thiamin Toxicity 435

Riboflavin 435

- Functions of Riboflavin 435
- Dietary Recommendations for Riboflavin 436
- Sources of Riboflavin 436
- Riboflavin Deficiency 437
- Riboflavin Toxicity 437

Niacin 437

- Functions of Niacin 437
- Dietary Recommendations for Niacin 438
- Sources of Niacin 438
- Niacin Deficiency 438
- Niacin Toxicity and Medicinal Uses of Niacin 439

Pantothenic Acid 440

- Functions of Pantothenic Acid 440
- Dietary Recommendations for Pantothenic Acid 440
- Sources of Pantothenic Acid 441
- Pantothenic Acid Deficiency 441
- Pantothenic Acid Toxicity 441

Biotin 442

- Functions of Biotin 442
- Dietary Recommendations for Biotin 442
- Sources of Biotin 442
- Biotin Deficiency 442
- Biotin Toxicity 443

Vitamin B₆ 443

- Functions of Vitamin B₆ 443
- Dietary Recommendations for Vitamin B₆ 444
- Sources of Vitamin B₆ 444
- Vitamin B₆ Deficiency 444
- Vitamin B₆ Toxicity and Medicinal Uses of Vitamin B₆ 445

Folate 446

- Functions of Folate 446
- Dietary Recommendations for Folate 447
- Sources of Folate 447
- Folate Deficiency 447

Vitamin B₁₂ 450

- Functions of Vitamin B₁₂ 451

Absorption of Vitamin B₁₂ 451

Dietary Recommendations for Vitamin B₁₂ 452

Going Green: Resisting Oxidative Stress 452

Sources of Vitamin B₁₂ 453

Vitamin B₁₂ Deficiency 454

Vitamin B₁₂ Toxicity 454

Vitamin C 455

Functions of Vitamin C 455

Dietary Recommendations for Vitamin C 456

Sources of Vitamin C 456

Vitamin C Deficiency 456

Vitamin C Toxicity 457

Choline: A Vitamin-like Compound 458

Conditional Nutrients 458

Bogus Vitamins 459

Learning Portfolio 461

Key Terms 461

Study Points 461

Study Questions 461

Try This 462

References 462

Chapter 12**Water and Major Minerals 464****Water: The Essential Ingredient for Life 465**

Functions of Water 466

Electrolytes and Water: A Delicate Equilibrium 467

Intake Recommendations: How Much Water Is Enough? 468

Water Excretion: Where Does the Water Go? 469

Water Balance 470

Alcohol, Caffeine, and Common Medications Affect Fluid Balance 473

Dehydration 473

Water Intoxication 474

Going Green: The Thirst for Water Resources 474

FYI: Tap, Filtered, or Bottled: Which Water Is Best? 475

Major Minerals 476

Minerals in Fluid Balance 477

Minerals in Foods 477

Bioavailability 477

Sodium 478

Functions of Sodium 478

Hyponatremia 479

Hypernatremia 480

Hypertension 480

Nutrition Science in Action: Calcium and Vitamin D and Abdominal Fat in Overweight and Obese Adults 481

Potassium 482

- Functions of Potassium 482
- Dietary Recommendations for Potassium 482
- Sources of Potassium 482
- Hypokalemia 482
- Hyperkalemia 483

Chloride 484

- Functions of Chloride 484
- Dietary Recommendations for Chloride 484
- Sources of Chloride 484
- Hypochloremia 484

Calcium 485

- Functions of Calcium 485
- Regulation of Blood Calcium 486
- Dietary Recommendations for Calcium 488
- Sources of Calcium 488
- Calcium Absorption 489
- Hypocalcemia 489

FYI: Calcium Supplements: Are They Right for You? 490

- Hypercalcemia 491
- Osteoporosis 491

Phosphorus 491

- Functions of Phosphorus 492
- Dietary Recommendations for Phosphorus 492
- Sources of Phosphorus 492
- Hypophosphatemia 493
- Hyperphosphatemia 493

Magnesium 493

- Functions of Magnesium 494
- Dietary Recommendations for Magnesium 494
- Sources of Magnesium 494
- Hypomagnesemia 495
- Hypermagnesemia 495

Sulfur 496

Learning Portfolio 498

- Key Terms 498
- Study Points 498
- Study Questions 499
- Try This 499
- References 499

Chapter 13

Trace Minerals 502

What Are Trace Elements? 503

- Why Are Trace Elements Important? 504
- Other Characteristics of Trace Elements 504

Iron 505

- Functions of Iron 505
- Regulation of Iron in the Body 506
- Dietary Recommendations for Iron 510
- Sources of Iron 510
- Iron Deficiency and Measurement of Iron Status 510
- Iron Toxicity 512

Going Green: Could Iron Help Cool Global Warming? 513

Zinc 513

- Functions of Zinc 514
- Regulation of Zinc in the Body 515
- Dietary Recommendations for Zinc 516
- Sources of Zinc 517
- Zinc Deficiency 517
- Zinc Toxicity 518

Selenium 518

FYI: Zinc and the Common Cold 519

- Functions of Selenium 519
- Regulation of Selenium in the Body 520
- Dietary Recommendations for Selenium 521
- Sources of Selenium 521
- Selenium Deficiency 522
- Selenium Toxicity 522

Iodine 522

- Functions of Iodine 523
- Iodine Absorption and Metabolism 523
- Dietary Recommendations for Iodine 523
- Sources of Iodine 523
- Iodine Deficiency 524
- Iodine Toxicity 524

Copper 525

- Functions of Copper 525
- Copper Absorption, Use, and Metabolism 525
- Dietary Recommendations and Food Sources for Copper 525
- Copper Deficiency 526
- Copper Toxicity 527

Manganese 527

- Functions of Manganese 527
- Manganese Absorption, Use, and Homeostasis 527
- Dietary Recommendations and Food Sources for Manganese 528
- Manganese Deficiency 528
- Manganese Toxicity 528

Fluoride 529

Functions of Fluoride	529
Fluoride Absorption and Excretion	529
Dietary Recommendations for Fluoride	529
Sources of Fluoride	530
Fluoride Deficiency, Toxicity, and Pharmacological Applications	530
Chromium	531
Functions of Chromium	531
Chromium Absorption, Transport, and Excretion	531
Dietary Recommendations and Food Sources for Chromium	531
Chromium Deficiency	532
Chromium Toxicity	532
Molybdenum	532
Molybdenum Absorption, Use, and Metabolism	532
Dietary Recommendations and Food Sources for Molybdenum	532
FYI: Chromium, Exercise, and Body Composition	533
Molybdenum Deficiency and Toxicity	533
Other Trace Elements and Ultratrace Elements	534
Arsenic	534
Boron	534
Nickel	535
Silicon	535
Vanadium	535
<i>Learning Portfolio</i>	<i>537</i>
Key Terms	537
Study Points	537
Study Questions	538
Try This	538
References	538
Chapter 14	
Sports Nutrition: Eating for Peak Performance	542
Nutrition and Physical Performance	543
Exercise Intensity	545
Muscle-Strengthening Exercises	545
Flexibility and Neuromotor Exercises	545
Some Is Better Than None	546
Energy Systems, Muscles, and Physical Performance	547
ATP–CP Energy System	547
Lactic Acid Energy System	548
Oxygen Energy System	548
Teamwork in Energy Production	548
Glycogen Depletion	549
Endurance Training	549
Muscles and Muscle Fibers	549
Optimal Nutrition for Athletic Performance	552
Energy Intake and Exercise	553
Carbohydrate and Exercise	553
FYI: Lactate Is Not a Metabolic Dead-End	554
Going Green: Exercise High	555
Carbohydrate Loading	555
Carbohydrate Intake Before Extensive Exercise	556
Carbohydrate Intake During Extensive Exercise	556
Carbohydrate Intake Following Extensive Exercise	556
Dietary Fat and Exercise	558
Fat Intake and the Athlete	558
Protein and Exercise	558
Protein Recommendations for Athletes	558
FYI: Nutrition Periodization: Tailoring Nutrition Intake to Exercise Goals	559
Protein Intake and the Athlete	560
Protein Intake After Extensive Exercise	560
Dangers of High Protein Intake	560
Vitamins, Minerals, and Athletic Performance	561
B Vitamins	561
Calcium	561
Iron	561
Other Trace Minerals	562
Fluid Needs During Extensive Exercise	562
Hydration	563
Sports Drinks	564
Muscle Cramps	565
Nutrition Needs of Young Athletes	566
Nutrition Supplements and Ergogenic Aids	566
Regulation and Concerns About Dietary and Herbal Supplements	567
Convenience Supplements	568
Weight-Gain Powders	568
Nutrition Science in Action: Elite Adolescent Athletes' Use of Dietary Supplements	569
Amino Acids	571
Creatine	571
Antioxidants	572
Caffeine	572
Ephedrine	573
Sodium Bicarbonate	573
Chromium	574
Iron	574
Beta-Alanine	574

Weight and Body Composition 574

- Weight Gain: Build Muscle, Lose Fat 575
- Weight Loss: The Panacea for Optimal Performance? 575
- Weight Loss: Negative Consequences for the Competitive Athlete? 576
- Female Athlete Triad 577

Learning Portfolio 580

- Key Terms 580
- Study Points 580
- Study Questions 581
- Try This 581
- References 581

Spotlight on Eating Disorders 584

The Eating Disorder Continuum 585

No Simple Causes 587

Anorexia Nervosa 589

- Causes of Anorexia Nervosa 589
- Warning Signs 590
- Treatment 590

Bulimia Nervosa 592

- Causes of Bulimia 593

FYI: Diary of an Eating Disorder 594

- Obsessed by Thoughts of Food 594
- Treatment 595

Binge-Eating Disorder 595

- Stress and Conflict Often Trigger Binge Eating 596
- Treatment 596

Body Dysmorphic Disorder 597

Night-Eating Syndrome 598

Males: An Overlooked Population 598

- An Unrecognized Disorder 599

Anorexia Athletica 599

The Female Athlete Triad 600

- Triad Factor 1: Disordered Eating 600
- Triad Factor 2: Amenorrhea 600
- Triad Factor 3: Premature Osteoporosis 600

Pregorexia 601

Infantile Anorexia 601

Combating Eating Disorders 602

Learning Portfolio 604

- Key Terms 604

- Study Points 604
- Study Questions 605
- Try This 605
- References 605

Chapter 15 Diet and Health 608

Nutrition and Chronic Disease 609

- Nutrition Informatics 610
- Healthy People 2020 610
- Health Disparities 610

Obesity and Chronic Disease 611

Physical Inactivity and Chronic Disease 611

Genetics and Disease 611

- The Workings of DNA and Genes 611

Cardiovascular Disease 613

- The Cardiovascular System and Cardiovascular Disease 614
- What Is Atherosclerosis? 614
- Risk Factors for Atherosclerosis 616
- Dietary and Lifestyle Factors for Reducing Atherosclerosis Risk 617

Nutrition Science in Action: Multi-Ethnic Study of Atherosclerosis 619

- Putting It All Together 622

Hypertension 623

- What Is Blood Pressure? 623
- What Is Hypertension? 624
- Renin and Hypertension 624
- Stress and Hypertension 624
- Risk Factors for Hypertension 624
- Dietary and Lifestyle Factors for Reducing Hypertension 625
- Putting It All Together 627

- Cancer 627

- What Is Cancer? 628

- Risk Factors for Cancer 628

- Dietary and Lifestyle Factors for Reducing Cancer Risk 630

Going Green: What Do Smokers Eat? 631

- Putting It All Together 632

Diabetes Mellitus 632

- What Is Diabetes? 633

- Low Blood Glucose Levels: Hypoglycemia 636

- Risk Factors for Diabetes 636

FYI: The Pima Indians 638

- Dietary and Lifestyle Factors for Reducing Diabetes Risk 639

Management of Diabetes 639

Nutrition 640

Putting It All Together 640

Metabolic Syndrome 641

Osteoporosis 641

What Is Osteoporosis? 642

Risk Factors for Osteoporosis 642

Dietary and Lifestyle Factors for Reducing Osteoporosis

Risk 643

Putting It All Together 644

Learning Portfolio 646

Key Terms 646

Study Points 646

Study Questions 646

Try This 647

References 647

Chapter 16

Life Cycle: Maternal and Infant Nutrition 650

Pregnancy 651

Nutrition Before Conception 651

Physiology of Pregnancy 654

Maternal Weight Gain 657

Energy and Nutrition During Pregnancy 658

Nutrients to Support Pregnancy 659

FYI: Vegetarianism and Pregnancy 660

Food Choices for Pregnant Women 661

Substance Use and Pregnancy Outcome 663

Special Situations During Pregnancy 664

Lactation 666

Breastfeeding Trends 666

Physiology of Lactation 666

Nutrition for Breastfeeding Women 667

Practices to Avoid During Lactation 669

Benefits of Breastfeeding 669

Contraindications to Breastfeeding 670

Resources for Pregnant and Lactating Women and Their Children 671

Infancy 671

Infant Growth and Development 672

Energy and Nutrient Needs During Infancy 673

Newborn Breastfeeding 676

Alternative Feeding: Infant Formula 677

Going Green: How Safe Are Plastics? 678

Breast Milk or Formula: How Much Is Enough? 678

Feeding Technique 679

Introduction of Solid Foods into the Infant's Diet 679

Developmental Readiness for Solid Foods 680

Feeding Problems During Infancy 682

FYI: Fruit Juices and Drinks 684

Learning Portfolio 686

Key Terms 686

Study Points 686

Study Questions 687

Try This 687

References 688

Chapter 17

Life Cycle: From Childhood to Adulthood 690

Childhood 691

Energy and Nutrient Needs During Childhood 691

Influences on Childhood Food Habits and Intake 693

FYI: Food Hypersensitivities and Allergies 694

Nutritional Concerns of Childhood 695

Going Green: Farmers' Markets 698

Adolescence 699

Physical Growth and Development 699

Nutrient Needs of Adolescents 700

Nutrition-Related Concerns for Adolescents 702

Staying Young While Growing Older 704

Weight and Body Composition 705

Physical Activity 705

Immunity 707

Taste and Smell 707

Gastrointestinal Changes 707

Nutrient Needs of the Mature Adult 708

Energy 709

Protein 709

Carbohydrate 710

Fat 710

Water 710

Vitamins and Minerals 711

To Supplement or Not to Supplement 712

Nutrition-Related Concerns of Mature Adults 713

Drug–Drug and Drug–Nutrient Interactions 713

Depression 713

Anorexia of Aging 715

Arthritis 715

Bowel and Bladder Regulation 715

Dental Health 716

Vision Problems 716

Osteoporosis 716

Alzheimer Disease 717
Overweight and Obesity 717

Meal Management for Mature Adults 717

Managing Independently 718
Wise Eating for One or Two 718
Finding Community Resources 718

Look Into the Future 719

Learning Portfolio 721

Key Terms 721
Study Points 721
Study Questions 721
Try This 722
References 722

Chapter 18

Food Safety and Technology: Microbial Threats and Genetic Engineering 726

Food Safety 727

Harmful Substances in Foods 728

FYI: Seafood Safety 733

Keeping Food Safe 739

Going Green: Ocean Pollution and Mercury Poisoning 740

FYI: At War with Bioterrorism 742

Who Is at Increased Risk for Foodborne Illness? 745

FYI: Safe Food Practices 746

A Final Word on Food Safety 747

Food Technology 747

Food Preservation 747

Genetically Engineered Foods 749

A Short Course in Plant Genetics 749

FYI: Are Nutrigenomics in Your Future? 752

Genetically Engineered Foods: An Unstoppable Experiment? 752

Benefits of Genetic Engineering 753

Risks 754

Regulation 755

Learning Portfolio 757

Key Terms 757
Study Points 757
Study Questions 758
Try This 758
Getting Personal 758
References 759

Chapter 19

World View of Nutrition: The Faces of Global Malnutrition 760

Malnutrition in the United States 761

The Face of American Malnutrition 762

Prevalence and Distribution 763

Attacking Hunger in America 765

FYI: Hungry and Homeless 767

Malnutrition in the Developing World 768

The World Food Equation 769

Going Green: Can Chocolate Help the Planet? 770

The Fight Against Global Hunger 771

Social and Economic Factors 771

Infection and Disease 772

Political Disruptions 773

FYI: AIDS and Malnutrition 774

Agriculture and Environment: A Tricky Balance 774

Environmental Degradation 775

Malnutrition: Its Nature, Its Victims, and Its Eradication 775

FYI: Tough Choices 776

Learning Portfolio 781

Key Terms 781
Study Points 781
Study Questions 782
Try This 782
References 782

Appendix A Dietary Reference Intakes 784

Appendix B Food Composition Tables 788

Appendix C Exchange Lists for Diabetes 892

Appendix D USDA Food Intake Patterns 904

Appendix E Nutrition and Health for Canadians 907

Appendix F The Gastrointestinal Tract 922

Appendix G Biochemical Structures 925

Appendix H Major Metabolic Pathways 940

Appendix I Calculations and Conversions 945

Appendix J Growth Charts 952

Glossary 955

Index 975



Preface

Welcome to the sixth edition of *Nutrition*. Changes in nutrition-related information have never been more exciting or important than they are today. *Nutrition* takes students on a fascinating journey beginning with curiosity and ending with a solid knowledge base and a healthy dose of skepticism for the endless ads and infomercials promoting “new” diets and food products. We want students to learn enough about their nutritional and health status to use this new knowledge in their everyday lives.

The new standards emerging in the science of nutrition inspire us to provide comprehensive, current, and accurate information on the most pressing issues. For example, you will find a focus on “the obesity epidemic” and the challenges the nutrition community is taking on to help resolve this chronic problem. You should find the overall content, organization, and features remain, but, within this framework, key topics and issues have been updated with new features and the most recent information available. Our goals in writing this book can be stated simply:

- To present science-based, accurate, up-to-date information in an accessible format
- To involve students in taking responsibility for their nutrition, health, and well-being
- To instill a sense of competence and personal power in students

The first of these goals means making expert knowledge about nutrition available to the individual. *Nutrition* presents current information to students about topics and issues that concern them—a balanced diet, nutritional supplements, weight management, exercise, and a multitude of others. Current, complete, and straightforward coverage is balanced with user-friendly features designed to make the text appealing.

Our second goal is to involve students in taking responsibility for their nutrition and health. To encourage students to think about the material they’re reading and how it relates to their own lives, *Nutrition* uses innovative pedagogy and unique interactive features. We invite students to examine the issues and to analyze their nutrition-related behaviors.

Our third goal in writing *Nutrition* is the most important: to stimulate a sense of competence and personal

power in the students who read this book. Everyone has the ability to monitor, understand, and affect his or her own nutritional behaviors.

Accessible Science

Nutrition makes use of the latest in learning theory and balances the behavioral aspects of nutrition with an accessible approach to scientific concepts. You will find this book to be a comprehensive resource that communicates nutrition both graphically and personally.

We present technical concepts in an engaging, non-intimidating way with an appealing parallel development of text and annotated illustrations. Illustrations in all chapters use consistent representations. For example, each type of nutrient has a distinct color and shape. Icons of an amino acid, a protein, a triglyceride, and a glucose molecule represent “characters” in the nutrition story and are instantly recognizable as they appear throughout the book.

This book is unique in the field of nutrition and leads the way in depicting important biological and physiological phenomena, such as emulsification, glucose regulation, digestion and absorption, and fetal development. Extensive graphic presentations make nutrition and physiological principles come alive.

Dietary Guidelines for Americans, 2015–2020

The *Dietary Guidelines for Americans, 2015–2020* reflects advances in the scientific understanding of the importance of improving diets and increasing physical activity, two of the most important factors reducing obesity and preventing chronic diseases in Americans. Eating a healthy balance of nutritious foods continues as a central point in the *Dietary Guidelines*, which serves to provide Americans with the information they need in order to make informed choices about their diet. Focused on science-based recommendations on food and nutrition, the *Dietary Guidelines for Americans, 2015–2020* empowers the American public to make shifts in what they eat and drink diet in favor of good health. As you read this text, look for key recommendations of the *Dietary Guidelines* highlighted in the margins.

Food Labeling

The Food and Drug Administration announced a new and redesigned Nutrition Facts label that will be required on most packaged food by July 2018. In an effort to encourage consumers to make more informed decisions, changes on the new label include such things as highlighting calories per serving and serving sizes more prominently, featuring a separate line showing how much sugar has been added to the food, and including updated Dietary Value information. The new label is discussed in Chapter 2, “Nutrition Guidelines and Assessment,” and has been incorporated into all Label to Table features found throughout the text.

New to this Edition

For this edition, the latest scientific evidence, recommendations, and national standards have been incorporated throughout each chapter.

Key Highlights

- Updated content reflects the *Dietary Guidelines for Americans, 2015–2020* released in January 2016, as well as the redesigned Nutrition Facts label, released in May 2016.
- The new Getting Personal feature, found in most of the end-of-chapter Learning Portfolios, encourages students to apply their nutritional knowledge to understanding their own diets.
- Revised statistics and data incorporated throughout the text reflect the current state of nutrition in America and the world.
- Revised food source charts in the vitamins and minerals chapters more clearly convey common sources for vitamins and minerals.
- Updated Position Statements from the Academy of Nutrition and Dietetics, the American Heart Association, and other organizations appear throughout the text.
- Updated references utilize the latest science in the field.
- New and updated FYI, Going Green, and Quick Bite features provide in-depth discussions of controversial issues and topics for classroom discussion.

Chapter 1—Food Choices

- New section discusses the impact of eating away from home
- New FYI feature: “The Affordable Care Act and Nutrition”

- New Quick Bite features: “Try It Again, You Just Might Like It,” “Does Being Overweight Spread from Person to Person?” and “High-Fructose Corn Syrup”
- Updated section on the impact of healthy food experiences early in life on forming healthy eating habits throughout the life cycle
- Updated discussion of the effect TV advertisements have on childhood nutrition

Chapter 2—Nutrition Guidelines and Assessment

- Revised description and discussion of the Nutrition Facts label, reflecting changes announced in May 2016
- New discussion of FDA regulations regarding the labeling of gluten-free foods
- New Going Green feature: “Is the American Diet Contributing to a Warmer Planet?”
- New Quick Bite feature: “Variety is Key”
- Revised FYI feature: “Portion Distortion”

Spotlight on Dietary Supplements and Functional Foods

- New table highlights groups for whom nutritional supplementation may be recommended
- Revised FYI feature: “Defining Complementary and Integrative Health”
- Updated Position Statement from the Academy of Nutrition and Dietetics: “Functional Foods”

Chapter 3—Digestion and Absorption

- New FYI feature: “Celiac Disease and Gluten Sensitivity”
- New Quick Bite feature: “Living Without a Gallbladder”
- Updated discussion regarding the link between red meat consumption and colorectal cancer
- Updated Nutrition Science in Action feature: “Screen Time and Diet Quality”
- Updated FYI feature: “Bugs in Your Gut? Health Effects of Intestinal Bacteria”
- Streamlined description of emulsification and its role in fat digestion
- In-depth discussion of the effect of medications on food absorption

Chapter 4—Carbohydrates

- New table summarizing the effects of fiber on digestion and absorption, and the health benefits of these effects
- New comparison of soluble and insoluble fibers
- New discussion of agave sweeteners
- Streamlined discussion of artificial sweeteners, with new table summarizing nonnutritive sweeteners and sweet substances
- Expanded discussion of resistant starches
- Expanded FYI features: “The Glycemic Index of Foods: Useful or Useless?” and “Unfounded Claims Against Sugars,” with new sections on “Sugar and Type 2 Diabetes” and “High-Fructose Corn Syrup (HFCS), Obesity, and Disease”

Chapter 5—Lipids

- New sections providing recommendations for omega fatty acid intake and summarizing the health effects of omega-3 fatty acids
- New Position Statement from the Academy of Nutrition and Dietetics: “Fatty Acids for Healthy Adults”
- Streamlined section on fat replacers
- Revised Going Green feature: “Fish: Good For You and the Environment”
- Revised FYI feature: “Fats on the Health Store Shelf,” which now delves into coconut oil and grapeseed oil
- Revised table incorporating American Heart Association Diet and Lifestyle Recommendations
- Updated American Heart Association Position Statement: “Omega-3 Fatty Acids”

Chapter 6—Proteins and Amino Acids

- New discussion regarding whether eating more protein helps build more muscle
- New table providing dietary suggestions for vegetarians
- New FYI feature: “High Protein Diets and Supplements”
- New Quick Bite feature: “Eating Lower on the Food Chain is Good for the Planet”
- New Position Statement from the Academy of Nutrition and Dietetics: “Vegetarian Diets”
- Revised Going Green feature: “Send in the Proteins”
- Revised FYI feature: “Do Athletes Need More Protein?” incorporating latest information from the Academy of Nutrition and Dietetics

Chapter 7—Alcohol

- New discussion of the prehistoric origins of alcohol
- Revised description of alcohol metabolism

Chapter 8—Metabolism

- Updated information on the role of carnitine in cardiovascular efficiency during exercise

Chapter 9—Energy Balance

- New discussion of digital private counseling programs
- New Quick Bite feature “The Raw Foods Diet”
- New description of metabolically healthy obesity
- Revised section on FDA-approved weight-loss medications
- Updated section on portion distortion phenomenon
- Updated Going Green feature: “Salad Days”
- Updated discussions regarding over-the-counter drugs, dietary supplements, and surgery for weight loss

Spotlight on Obesity

- New section on the link between gut microbiota and obesity
- New Quick Bite features: “Can You Pick Your Partners?” and “Your Microbiota and You”
- New statistics concerning obesity rates in Asia and the Middle East
- Revised FYI feature: “U.S. Obesity Trends: A Relentless Increase”

Chapter 10—Fat-Soluble Vitamins

- New table summarizes fat-soluble vitamins, their functions, and the results of deficiency and megadoses
- New table compares fat-soluble and water-soluble vitamins
- New table lists common carotenoids and their potential benefits

Chapter 11—Water-Soluble Vitamins

- New table summarizes water-soluble vitamins, their functions, and the results of deficiency and megadoses

Chapter 12—Water and Major Minerals

- New section discusses minerals in fluid balance

- Updated Going Green feature: “The Thirst for Water Resources”
- Updated FYI feature: “Tap, Filtered, or Bottled: Which Water is Best?”

Chapter 13—Trace Minerals

- New discussion of arsenic levels in rice-based products
- New reference to sea salts as sources of iodine

Chapter 14—Sports Nutrition

- New discussion of exercise intensity, muscle-strengthening exercises, and flexibility and neuromotor exercises
- New section on ephedrine
- Updated coverage of protein and hydration recommendations for athletes
- Updated discussion of nutrition supplements and ergogenic aids
- Updated section on caffeine
- Expanded discussion of the American Medical Association and American College of Sports Medicine’s *Exercise is Medicine* initiative

Spotlight on Eating Disorders

- New introduction of the acronym OSFED (Other Specified Feeding or Eating Disorder)

Chapter 15—Diet and Health

- New section on nutrition informatics
- New Quick Bite features: “Adaptation Gone Awry,” “Smartphones Advance Artificial Pancreas,” and “What Smells in Blood Pressure?”
- Revised section delving into whether intakes of saturated and trans fat and cholesterol should be limited

Chapter 16—Life Cycle: Maternal and Infant Nutrition

- New Position Statement from the Academy of Nutrition and Dietetics: “Nutrition and Lifestyle for a Healthy Pregnancy Outcome”

- New table presenting a meal plan for a vegan pregnancy

Chapter 17—Life Cycle: From Childhood Through Adulthood

- New content discussing the increase in use of e-cigarettes among American high school students
- Updated information relating to lead toxicity
- Revised Quick Bite feature: “The Dangers of Teenage Smoking”

Chapter 18—Food Safety and Technology

- New FYI feature: “Are Nutrigenomics in Your Future?”
- New table listing food safety mistakes
- New information regarding the FDA’s voluntary plan to phase out the use of certain antibiotics for enhanced food production in farm animals
- Revised section on genetically engineered foods
- Revised table providing USDA’s labeling requirements for organic foods
- Updated Going Green feature: “Ocean Pollution and Mercury Poisoning”

Chapter 19—World View of Nutrition

- New Quick Bite features: “Urban Food Production” and “Tackling Food Insecurity”
- Expanded information on iodine deficiency disorders
- Revised table provides poverty guidelines based on household size
- Updated Position Statement from the Academy of Nutrition and Dietetics: “Addressing World Hunger, Malnutrition, and Food Insecurity”

The Pedagogy

Nutrition focuses on teaching behavioral change, personal decision making, and up-to-date scientific concepts in a number of novel ways. This interactive approach addresses different learning styles, making it the ideal text to ensure mastery of key concepts. Beginning with Chapter 1, the material engages students in considering their own behavior in light of the knowledge they are gaining. The pedagogical aids that appear in most chapters include the following:

The **Think About It** questions at the beginning of each chapter present realistic nutrition-related situations and ask students to consider how they would behave in such circumstances.

The **Chapter Menu** at the beginning of each chapter gives students a preview of topics that will be covered.

Learning Objectives focus students on the key concepts of each chapter and the material they will learn.

Chapter 1

Food Choices: Nutrients and Nourishment

Revised by Kimberley McMahon

THINK About It

- 1 What, if anything, might persuade or influence you to change your food preferences?
- 2 Are there some foods you definitely avoid? If so, do you know why?
- 3 What do you think is driving the popularity of vitamins and other supplements?
- 4 Where do you get the majority of your information about nutrition?

CHAPTER Menu

- Why Do We Eat the Way We Do?
- Introducing the Nutrients
- Applying the Scientific Process to Nutrition
- From Research Study to Headline
- Key Terms
- Study Points
- Study Questions
- Try This
- Getting Personal
- References

LEARNING Objectives

- Define *nutrition*.
- Identify factors that influence food choice.
- Describe the typical American diet.
- Identify the six classes of nutrients essential for health.
- Describe the basic steps in the nutrition research process.
- Recognize credible scientific research and reliable sources of nutrition information.

nutrition The science of foods and their components (nutrients and other substances), including the relationships to health and disease (actions, interactions, and balances); processes within the body (ingestion, digestion, absorption, transport, functions, and disposal of end products); and the social, economic, cultural, and psychological implications of eating.

Why Do We Eat the Way We Do?
 Do you “eat to live” or “live to eat”? For most of us, the first is certainly true—you must eat to live. But there can be times when our enjoyment of food is more important to us than the nourishment we get from it. Factors such as age, gender, genetic makeup, occupation, lifestyle, family, and cultural background affect our daily food choices. We use food to project a desired image, forge relationships, express friendship, show creativity, and disclose our feelings. We cope with anxiety or stress by eating or not eating; we reward ourselves with food for a good grade or a job well done; or, in extreme cases, we punish failures by denying ourselves the benefit and comfort of eating.

Quick Bite
Try It Again, You Just Might Like It
 Studies have found that children between the ages of 2 and 6 years commonly dislike things that are new or unfamiliar. This is also the time when kids are most likely to reject vegetables. Kids have a better chance to overcome this tendency if they are repeatedly exposed to the food they initially reject—somewhere between 5 and 15 exposures should do it.

- People with **malabsorption syndromes** such as cystic fibrosis often take large nutrient doses to compensate for nutritive losses and to override intestinal barriers to absorption.
- Megadoses of vitamin B₁₂ can overcome the malabsorption seen in pernicious anemia, a condition in which a key substance needed for vitamin B₁₂ absorption is lacking.

A vitamin at megadose levels can have *pharmacological activity*—that is, it acts as a drug. Nicotinic acid (niacin) is a good example. At usual levels (around 10 or 20 milligrams), it functions as a vitamin, but at levels 50 or 100 times higher it acts as a drug to lower blood lipid levels. Niacin has been used since the 1950s as a lipid-altering drug for low-density lipoprotein (LDL) cholesterol and is currently an effective agent available for raising high-density lipoprotein (HDL) cholesterol.⁸ Like any drug, though, it can have serious side effects.⁹

Megadosing Beyond Conventional Medicine: Orthomolecular Nutrition

In 1968, Linus Pauling, the best-known advocate of megadosing, coined the term **orthomolecular medicine**. To him, *orthomolecular* meant achieving the optimal nutrient levels in the body.¹⁰ Few nutritionists argue with the importance of optimum nutrition. In fact, some nutritionists share Pauling's concerns that the typical diet is too refined and processed to provide adequate nutrients and that intake equal to RDA values may not be high enough to achieve optimal body levels.

Most nutritionists would argue, however, with the high doses Pauling recommended to attain those optimal body levels and with the therapeutic value he and his followers attributed to those doses. Most notably, Pauling suggested in the early 1970s that an optimal daily intake of vitamin C was 2,000 milligrams—more than 30 times the current Daily Value. (See **FIGURE SF.2**.) Dr. Pauling claimed megadoses of vitamin C prevented or cured the common cold. Although many researchers have attempted to confirm this theory, studies do not support the idea that vitamin C prevents colds. A few studies found that colds were slightly less severe or less frequent in those who took high doses of vitamin C, but most studies found no beneficial effect.¹¹

Drawbacks of Megadoses

Megadose vitamins and minerals remain popular, but when taken without recommendation or prescription from a qualified health professional, they can cause problems. Because high doses of a nutrient can act as a drug, with a drug's risk of adverse side effects, people who choose to take megadoses should always check first with their doctors.

Excesses of some nutrients can create deficits of other nutrients. High doses of supplemental minerals, especially calcium, iron, zinc, and copper, can interfere with absorption of the others.¹² If you use high doses of the fat-soluble vitamin A, it is easy to reach toxic levels. Even megadoses of water-soluble vitamins can be problematic; for example, nerve damage can result from vitamin B₆ at 50 to 100 times the DV. **FIGURE SF.3** lists some more examples of medical side effects that can occur from megadose supplementation. It is good practice to review the DRI tables for tolerable upper intake levels (UL) before taking any vitamin and mineral supplement.

► **malabsorption syndromes** Conditions that result in imperfect, inadequate, or otherwise disordered gastrointestinal absorption.

Position Statement:
American Heart Association

Vitamin and Mineral Supplements
The American Heart Association recommends that healthy people get adequate nutrients by eating a variety of foods in moderation, rather than by taking supplements.

"The Dietary Recommended Intakes (DRIs) published by the Institute of Medicine are the best available estimates of safe and adequate dietary intakes," says the AHA. "There aren't sufficient data to suggest that healthy people benefit by taking certain vitamin or mineral supplements in excess of the DRIs." Moreover, "vitamin or mineral supplements aren't a substitute for a balanced, nutritious diet that limits excess calories, saturated fat, trans fat, sodium and dietary cholesterol. This dietary approach has been shown to reduce coronary heart disease risk in both healthy people and those with coronary disease."

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► **orthomolecular medicine** The preventive or therapeutic use of high-dose vitamins to treat disease.

Position Statements from distinguished organizations such as the Academy of Nutrition and Dietetics, the American College of Sports Medicine, and the American Heart Association relate to the chapter topics and bolster the assertions made by the authors by showcasing concurrent opinions held by some of the leading organizations in nutrition and health.

Key Terms are in boldface type the first time they are mentioned. Their definitions also appear in the margins near the relevant textual discussion, making it easy for students to review material.

THINK About 1



FIGURE SF.9 U.S. Pharmacopeia verification mark. Dietary supplements can earn the USP-Verified mark through a comprehensive testing and evaluation process. Registered trademark of The United States Pharmacopoeial Convention. Used with permission.

verification mark helps assure consumers, health care professionals, and supplement retailers that a product has passed USP's rigorous program and does the following:

- Contains the ingredients declared on the product label
- Contains the amount or strength of ingredients declared on the product label
- Meets requirements for limits on potential contaminants
- Has been manufactured properly by complying with USP and FDA standards for current good manufacturing practices (cGMPs)

Fraudulent Products

Some health advocates consider the burgeoning market of dietary supplements an unwelcome return to the "snake oil" era of the late nineteenth and early twentieth centuries, when "magic" potions and cures were sold door-to-door and at county fairs and markets. The Internet and social media marketing are changing the industry because they are a prominent vehicle for promoting and selling products, reaching millions of people worldwide instantly at any time.

Most manufacturers work hard to ensure the quality of their products, yet some supplements on the market are nothing more than a mixture of ineffective ingredients. In recent years, the FDA has found hundreds of fraudulent products that contain hidden or deceptively labeled ingredients.³³ Most frequently recalled products with potentially harmful ingredients are those that are promoted for weight loss, sexual enhancement, and bodybuilding. When considering the use of dietary supplements, do your homework—make sure the product is safe and effective. It's always a good idea to ask your health care professional for help in distinguishing between reliable and questionable information.

► **Key Concepts** When 2017 *Open Range Light 319RLS* considering a dietary supplement, it is important to consider the product and its claims carefully. Be aware that some products may promise more than they can deliver. A good indicator of quality is the USP verification mark, but this does not guarantee that a product will fulfill its claims.

Quick Bites sprinkled throughout the book offer fun facts about nutrition-related topics such as exotic foods, social customs, origins of phrases, folk remedies, medical history, and so on.

Key Concepts summarize previous text and highlight important information.

Quick Bite

Jell-O and Your Nails
You may have heard that taking gelatin can make your nails stronger. Not true. Fingernails get their strength from sulfur in amino acids. Gelatin has no sulfur-containing amino acids.



FIGURE SF.10 Soy is rich in phytochemicals. Soybeans contain phytochemicals called isoflavones. High intake of soy products such as tofu is linked to a lower incidence of heart disease and cancer.

► **functional food** A food that may provide a health benefit beyond basic nutrition.

► **lycopene** One of a family of plant chemicals, the carotenoids. Others in this big family include alpha-carotene and beta-carotene.

► **phytochemicals** Substances in plants that may possess health-protective effects, even though they are not essential for life.

Functional Foods

What do garlic, tomato sauce, tofu, and oatmeal all have in common? They aren't in the same food group, nor do they have the same nutrient composition. Instead, all of these foods could be considered "functional foods." Although there is not yet a legal definition for the term, a **functional food** is widely considered to be a food or food component that provides a health benefit beyond basic nutrition.³⁴ Garlic contains sulfur compounds that may reduce heart disease risk, and tomato sauce is rich in **lycopene**, a compound that may reduce prostate cancer risk. The soy protein in tofu and the fiber in oatmeal can help reduce the risk of heart disease. (See **FIGURE SF.10**.) The functional food industry has grown rapidly since its birth in Japan in the late 1980s and in 2014, reached almost \$177 billion dollars of sales worldwide. In the U.S., functional food and beverage sales account for 5 percent of the overall food market.^{35–37}

Phytochemicals Make Foods Functional

Many functional foods get their health-promoting properties from naturally occurring compounds that are not considered nutrients but are called **phytochemicals**. Although the word *phytochemical* may sound intimidating, its

THINK About It 3



Defining Complementary and Integrative Health: How Does Nutrition Fit?

Alternative approaches to health care are therapies and treatments outside the medical mainstream. Historically, they tend to be based mainly on observation or anecdotal evidence rather than controlled research. According to the National Center for Complementary and Integrative Health, "Large population-based surveys have found that the use of alternative medicine—unproven practices used in place of conventional medicine—is rare. Integrative health care, defined as a comprehensive, often interdisciplinary approach to treatment, prevention and health promotion that brings together complementary and conventional therapies, is more common."

The term **alternative** suggests practices that replace conventional ones. **Complementary** implies practices that are used in addition to conventional ones. A practice that combines both conventional and complementary treatments for which there is evidence of safety and effectiveness is referred to as **integrative**. For example, using only herbs to combat diarrhea caused by conventional AIDS medications and taking supplements to replace lost vitamins would be alternative, whereas using herbs and integrative health care including a broad range of healing therapies and philosophies. Several among them involve nutrition, including special diet therapies, phytotherapy (herbalism), orthomolecular medicine, and other biologic interventions. The use of an integrative approach to health and wellness has grown within care settings across the United States, including hospitals, hospices, and military health facilities.

More than 30 percent of adults and about 12 percent of children in the United States use some form of complementary therapy.* Commonly used complementary therapies include a variety of natural products and diet-based practices, as well as mind-body practices such as deep breathing exercises, prayer, and relaxation techniques; tai chi and yoga; acupuncture; spinal manipulation (chiropractic care); tai chi and yoga; acupuncture; massage therapy; and movement therapies. People seek out complementary therapies for numerous reasons, including fear of aging, personal beliefs, and distrust of institutional medicine.

Where Does Nutrition Fit?

A number of alternative therapies involve nutrition, and sometimes the line between standard and alternative nutrition is not clear. A variety of health conditions, such as diabetes, gastrointestinal disorders, and kidney disease, require special diets. Alternative nutrition practices include diets to prevent and treat diseases not shown to be diet-related (see **Figure A**). What often makes these practices "alternative" is the limited nature of the diet, the lack of rigorous scientific evidence showing effectiveness, and the divergence of these practices from science-based healthy eating patterns such as the Mediterranean diet, DASH diet, or MyPlate. Other practices outside the nutritional mainstream from science-based healthy eating patterns include diets that rely on only raw foods and the extensive use of herbal and botanical supplements as well as megadoses of vitamin/mineral supplements, which we have already discussed. Most nutritionists consider vegetarianism a routine variation of a normal diet, particularly if the vegetarian's motivation is religious or philosophical, the result of a concern for animals, or an aversion to animal products. When a meat eater goes vegetarian in an attempt to prevent or cure disease, that's alternative.

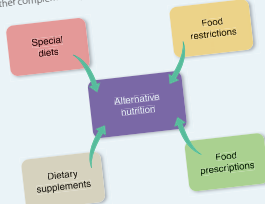


FIGURE A Alternative nutrition practices. Although many mainstream medical practices may involve special dietary regimens, alternative nutrition practices often are overly restrictive, depart from established dietary guidelines, and lack rigorous scientific evidence.

Food Restrictions and Food Prescriptions

Societies throughout the world commonly use dietary changes to treat or prevent illness. The specifics vary from place to place, however, which suggests that they are based on cultural factors rather than science. In recent years, we have seen yeast-free diets, dairy-free diets, both free diets, white-flour-free diets, cleansing diets, raw food diets, and low-carbohydrate and high-carbohydrate diets, both low-red-meat and high-red-meat diets, caffeine-free diets, salicylate-free diets, and more. People with subjective symptoms such as headaches, fatigue, or back pain have been instructed to avoid irrational lists of "allergenic foods" based on "blood screening." We've also seen illogical instructions on how to combine foods or what foods not to combine. For weight loss, we've had grapefruit diets, hard-boiled-egg diets, cottage-cheese diets, water diets, high-fat diets, low-fat diets, and blue-foods-only diets; the list goes on and on. Many types of diets can be described as alternative. Their origins and claims vary, and their proponents often cannot show that they improve health; some alternative diets can actually be harmful by restricting foods and thereby lowering the body's intake of necessary nutrients. Such fad diets come and go. Most often they are not based on science and eventually fail to interest people when they don't work. Those few that prove effective and

FYI (For Your Information) offers more in-depth discussions of controversial and timely topics, such as unfounded claims about the effects of sugar, whether athletes need more protein, and the usefulness of the glycemic index.

Containing new and current scientific research, **Nutrition Science in Action** is an exciting feature that walks students through science experiments involving nutrition. Each *Nutrition Science in Action* presents observations and hypotheses or study questions, an experimental plan, and results, conclusions, and discussions that allow students to apply their knowledge of nutrition to real-life experiments outside of the classroom.

Nutrition Science in Action

Screen Time and Diet Quality

Background

Excessive screen-time behaviors, such as using a computer and watching TV, for more than two hours daily have been linked with many unhealthy dietary practices, including lower intake of fruits and vegetables and higher intake of fat and total energy. A greater level of screen time also has been linked to higher mortality, obesity, and cardiometabolic disease in both adults and children. Overall dietary quality is an important factor in health and weight status, and therefore deserves examination.

Study Purpose

The study purpose was to quantify associations between screen time and overall dietary quality in a sample of 1,008 young adolescents.

Experimental Plan

Dietary quality was assessed using a Web-based food behavior questionnaire, including a 24-hour diet recall. The questionnaire was also used to assess eating and screen-time behavior as well as nutrient intake.

Results

Results identified that the majority of participants consumed a snack in the evening hours, which contributed to about 11 percent of their daily

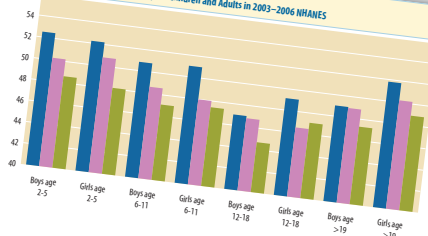
calorie intake. Increased after school/evening screen time was associated with fewer evening snack servings of fruits and vegetables and an overall increase in evening snack food portion sizes. Overall, participants with more than six hours of after school/evening screen time were less likely to have a good overall diet quality compared with those who acquired less than one hour of after school/evening screen time.

Conclusion and Discussion

The results of this study support and expand on previous investigations findings that in children, as well as in adults, better dietary quality is associated with less screen time. Both dietary intake and amount of time spent in front of a television or computer are modifiable through lifestyle intervention. This association could help to further develop and expand programs that address health promotion and disease prevention.

Cocone J, Woodruff SJ, Fryer K, Campbell T, Cole M. Associations among evening snacking, screen time, weight status, and overall diet quality in young adolescents. *App Physiol Nutr Metab*. 2013;38(7):78–84.

TABLE A
Healthy Eating Index 2005* by Television-Watching Category for Children and Adults in 2003–2006 NHANES



*Values calculated as least-squared means with adjustment for age, BMI (percentile for all children), physical activity (daily minutes moderate-to-vigorous physical activity for children aged 12–18 years and adults) and weekly times of "hard play" for children aged 2–11 years), and ethnicity. *p*-values were calculated on unadjusted means. Data from Sison SB, Shay DK, Broyles ST, Leyva M. Television-viewing time and dietary quality among U.S. children and adults [Table 2, p. 199]. *Am J Prev Med*. 2012;43(2):196–200.

Updated to reflect the most current environmental concerns, **Going Green** boxes address the nutrition community's concern about the importance of environmental issues in our time. This environmental theme runs through each chapter and expands our nutrition focus to show that we are all citizens of an endangered planet with opportunities to reduce our environmental footprint.



Going Green

Fish: Good for You and the Environment

Fatty fish or fatty meat? What is a “good” source of fat, a lean protein high in vitamins and minerals, and does not contribute to the production of methane greenhouse gas? Fish! Methane, produced by farm animals, is a powerful greenhouse gas and is considered 20 times more powerful than carbon dioxide at trapping solar energy. In comparison, no methane is produced from harvesting salmon, and fish offers you a healthier meal than a ribeye steak. Choosing to eat fish while decreasing your beef intake not only will give you all of the health benefits associated with omega-3 fatty acids, but also will potentially decrease dangerous greenhouse gas production. An American Heart Association scientific statement on fish consumption, fish oils, omega fatty acids, and cardiovascular disease emphasizes the benefits of eating fish and recommends at least two servings of fish per week. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are the omega-3 fatty acids found in oily fish, with mackerel, salmon, trout, sardines, and herring being excellent sources. Approximately 1 gram of EPA/DHA can be obtained from 100 grams (3.5 ounces) of oily fish. There are many choices when it comes to incorporating healthful fats into your diet. Just remember, even though these fatty acids provide a “good” source of fat, don’t go overboard. Fat is still fat, even if it is good for you and for the environment, so make your choices wisely.

Data from Rigby A. Omega-3 choices: fish or flax? *Today's Dietitian*. 2004;6(1):37; Hernandez E. Omega-3 oils as food ingredients [webcast]. 2007. Institute of Food Technologists; and Mantzioris E, Cleland LG, Gibson RA, et al. Biochemical effects of a diet containing foods enriched with n-3 fatty acids. *Am J Clin Nutr*. 2000;72:42–48.

Label to Table helps students apply their new decision-making skills at the supermarket. It walks students through the various types of information that appear on food labels, including government-mandated terminology, misleading advertising phrases, and amounts of ingredients. This feature has been updated for this edition to reflect the new labeling guidelines released by the FDA in May 2016.

The **Learning Portfolio** at the end of each chapter condenses all aspects of nutrition information that students need to solidify their understanding of the material. The various formats will appeal to students according to their individual learning and studying styles.

The Nutrition Facts panel shown here highlights all of the lipid-related information you can find on a food label. Look at the top of the label, where it states that this product contains 35 calories from fat. Do you know how you can estimate this number from another part of the label? Recall (or look at the bottom of the label) that each gram of fat contains 9 kilocalories. If this food item has 4 grams of fat, then it should make sense that there are approximately 36 kilocalories provided by fat.

Total fat is the second thing you'll see, along with saturated and trans fat. Manufacturers are required to list only saturated and trans fat content on the label, but they can voluntarily list monounsaturated and polyunsaturated fat. Using this food label, you can estimate the amount of unsaturated fat by simply looking at the highlighted sections. There are 4 total grams of fat: 2.5 of them are saturated and 0.5 are trans. That means the remaining 1.0 gram is either polyunsaturated, monounsaturated, or a mix of both. Without even knowing what food item this label represents, you can see that it contains more saturated and trans fat than unsaturated fat (3.0 grams versus 1.0 gram).

Do you see the "6%" to the right of "Total Fat"? It does not mean that the food item contains 6 percent of its calories from fat. In fact, this food item contains 23 percent of its calories from fat (35 fat kilocalories ÷ 154 total kilocalories = 0.23, or 23% fat kilocalories). The 6% refers to the Daily Values, found below. You can see that a person who consumes 2,000 kilocalories per day could consume up to 65 grams of fat per day. This product contributes just 4 grams per serving, which is 6 percent of that amount (4 ÷ 65 = 0.06, or 6%). Note that the % Daily Value for saturated fat is 12 percent, which means that just a few servings of this food can contribute quite a bit of saturated fat to your diet. There is no DV for trans fat, but intake should be kept as low as possible. Cholesterol is also listed on this label (20 mg), along with its Daily Value.

Serving Size: 1 cup (248 g)					
Servings Per Container: 4					
Amount Per Serving					
Calories 154					
	Calories from fat 35				
Total Fat 4g	6%				
Saturated Fat 2.5g	12%				
Trans Fat 0.5g					
Cholesterol 20mg	4%				
Sodium 170mg	4%				
Total Carbohydrate 19g	4%				
Dietary Fiber 0g	0%				
Sugars 14g					
Protein 11g					
Vitamin A 4%	Vitamin C 6%				
Calcium 40%	Iron 0%				
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:					
Calories: 2,000					
Total Fat	Less Than 65g	2,500			
Sat Fat	Less Than 20g	60g			
Cholesterol	Less Than 300mg	25g			
Sodium	Less Than 2,400mg	300mg			
Total Carbohydrate	2,400mg	2,400mg			
Dietary Fiber	30g	37g			
Calories per gram:					
Fat	9	Carbohydrate	4	Protein	4

Learning Portfolio



Key Terms

adipocytes	182	lipophobic	174
adipose tissue	182	lipoprotein	195
alpha-linolenic acid	179	lipoprotein lipase	197
chain length	175	low-density lipoproteins (LDL)	198
cholesterol	191	micelles	194
choline	188	monoglycerides	181
chylomicron	195	monounsaturated fatty acid (MUFA)	176
cis fatty acid	177	nonessential fatty acids	178
conjugated linoleic acid (CLA)	177	omega-3 fatty acids	178
desaturation	178	omega-6 fatty acid	178
diglycerides	179	omega-9 fatty acid	178
eicosanoids	178	oxidation	185
elongation	178	phosphate group	188
essential fatty acids	181	phospholipids	174
ester	181	phytosterols	192
esterification	204	polyunsaturated fatty acid (PUFA)	176
fat replacers	174	saturated fatty acid	176
fatty acids	181	squalene	192
glycerol		sterols	174
high-density lipoproteins (HDL)	199	subcutaneous fat	182
hydrogenation	177	trans fatty acids	177
hydrophilic	174	triglycerides	173
hydrophobic	174	unsaturated fatty acid	176
intermediate-density lipoprotein (IDL)	198	very-low-density lipoproteins (VLDL)	198
lanugo	183	visceral fat	182
lecithin	190		
linoleic acid	179		
lipophilic	174		

- Two polyunsaturated fatty acids, linoleic acid and alpha-linolenic acid, are essential; they must be supplied in the diet. Phospholipids and sterols are made in the body and do not have to be supplied in the diet.
- Essential fatty acids are elongated and desaturated in the process of making "local hormones" called eicosanoids. These compounds regulate many body functions.
- Triglycerides are food fats and storage fats. They are composed of glycerol and three fatty acids.
- In the body, triglycerides are an important source of energy. Stored fat provides an energy reserve.
- Phospholipids are made of glycerol, two fatty acids, and a phosphate group with a nitrogen-containing component.
- Phospholipids are components of cell membranes and lipoproteins. Their unique affinity for both fat and water enables them to be effective emulsifiers in foods and in the body.
- Cholesterol is found in cell membranes and is used to synthesize vitamin D, bile salts, and steroid hormones. High levels of blood cholesterol are associated with heart disease risk.
- For adults, the Acceptable Macronutrient Distribution Range (AMDR) for fat is 20 to 35 percent of calories.
- Diets high in fat and saturated fat tend to increase blood levels of LDL cholesterol and increase risk for heart disease.
- Excess fat in the diet is linked to obesity, heart disease, and some types of cancer.

Study Questions

- How can different oils contain a mixture of polyunsaturated, monounsaturated, and saturated fats?
- What does the hardness or softness of a triglyceride typically signify?
- What is the most common form of lipid found in food?
- What are the positive and negative consequences of hydrogenating a fat?
- List the many functions of triglycerides.

Key Terms list all new vocabulary alphabetically with the page number of the first appearance. This arrangement allows students to review any term they do not recall and turn immediately to the definition and discussion of it in the chapter. This approach also promotes the acquisition of knowledge, not simply memorization.

Study Questions encourage students to probe deeper into the chapter content, making connections and gaining new insights. Although these questions can be used for pop quizzes, they will also help students to review, especially students who study by writing out material.

Study Points summarize the content of each chapter with a synopsis of each major topic. The points are in the order in which they appear in the chapter, so related concepts flow together.

6. Describe the difference between LDL and HDL in terms of cholesterol and protein composition.
7. What foods contain cholesterol?
8. Name the two essential fatty acids.

Try This

The Fat = Fullness Challenge

The goal of this experiment is to see whether fat affects your desire to eat between meals. Do this experiment for two consecutive breakfasts. Each meal is to include *only* the foods listed here. Try to eat normally for the other meals of the day and to eat around the same time of day. Each of these breakfasts has approximately the same calories, but one has a high percentage of them from fat, the other from carbohydrate. After each breakfast, take note of how many hours pass before you feel hungry again.

Day 1 (~420 kilocalories; 1.5 grams fat)

One 3-oz bagel with 3 Tbsp of jelly

Day 2 (~425 kilocalories; 18 grams fat)

1 medium blueberry muffin

Getting Personal

List all of the foods and drinks that you consume in a 24-hour period, ideally a day where your schedule is fairly predictable and you are eating what is considered normal for you.

1. Let's take a look at your fat intake.
 - What percentage of your calories came from fat?
 - What percentage of your calories saturated and unsaturated fat?
 - How about your cholesterol intake? Was it above or below the guidelines?
2. Review your day of eating and make a list of the foods you know contain fat.
 - What foods could you substitute to lower your total fat intake?
 - What changes can you make lower your trans-fat intake?
 - What would these substitutions do to the total calories in your diet?
3. Now look at your essential fatty acids.
 - Does your intake of Omega-3 and Omega-6 fatty acids meet the recommendations?
 - What foods contributed essential fatty acids to your diet?
 - Make a list of foods that would help increase your EFA intake.

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Try This activities are provide suggestions for hands-on activities that encourage students to put theory into practice. It will especially help students whose major learning style is experimental.

Getting Personal encourages students to consider their newly gained knowledge in the context of their own diets.

The Integrated Learning and Teaching Package

Integrating the text with constructive instructor resources is crucial to deriving their full benefit. Based on feedback from instructors and students, Jones & Bartlett Learning has made the following resources available to qualified instructors:

- Test Bank, including more than 1,250 questions
- Slides in PowerPoint format, featuring more than 500 slides
- Instructor's Manual, containing lecture outlines, discussion questions, and answers to the in-text Study Questions
- Image Bank, supplying key figures from the text
- Sample Syllabus, showing how a course can be structured around this text
- Transition Guide, providing guidance in switching from the previous edition

An interactive eBook is available with study questions that reinforce key concepts as well as 36 scientifically based animations that give students an accurate, accessible explanation of the major scientific concepts and physiological principles presented in *Nutrition*.

Diet analysis software is an important component of the behavioral change and personal decision-making focus of a nutrition course. **EatRight Analysis**, developed by ESHA Research, provides software that enables students to analyze their diets by calculating their nutrient intake and comparing it to recommended intake levels. EatRight Analysis offers dietary software online at EatRight.jblearning.com. With this online tool, you and your students can access personal records from any computer with Internet access. Through a variety of reports, students learn to make better choices regarding their diet and activity habits.



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The *Nutrition* author team represents a culmination of years of teaching and research in nutrition science and psychology. The combined experience of the authors yields a balanced presentation of both the science of nutrition and the components of behavioral change.

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