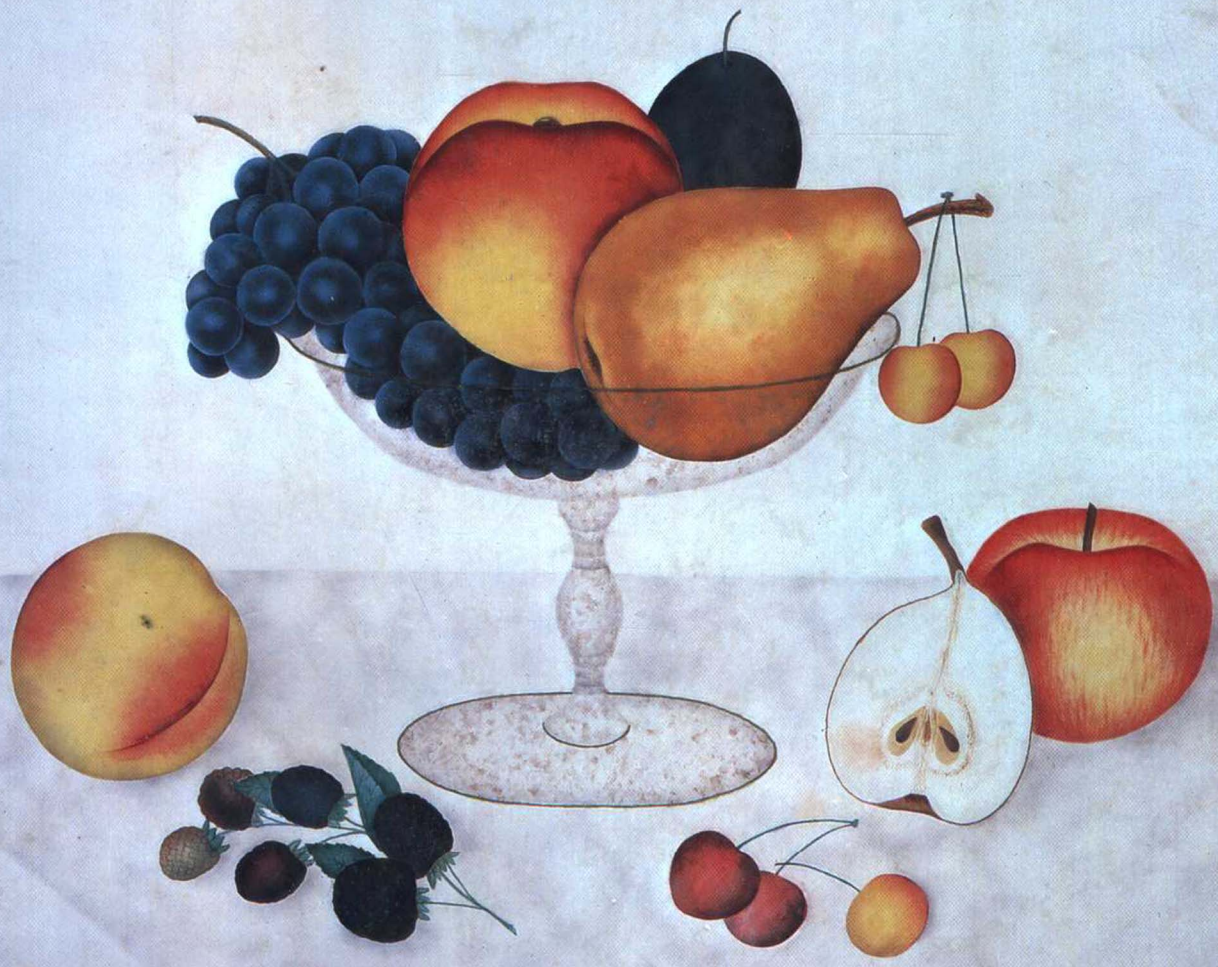
Hamilton and Whitney's

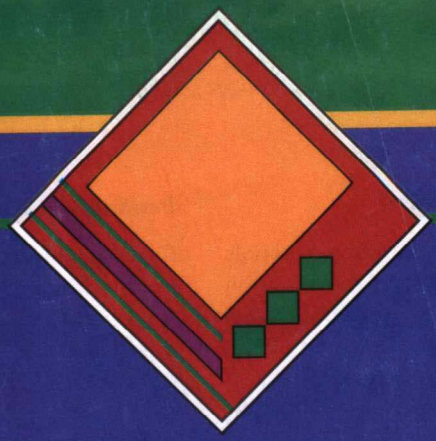
Nutrition

Concepts and Controversies



Sixth Edition

Frances Sizer and Eleanor Whitney



Hamilton/Whitney's

Nutrition

CONCEPTS AND CONTROVERSIES

SIXTH EDITION

Frances Sienkiewicz Sizer

Eleanor Noss Whitney

WEST PUBLISHING COMPANY

Minneapolis/St. Paul New York Los Angeles San Francisco

Preface

With this sixth edition, *Nutrition: Concepts and Controversies* celebrates its 15th anniversary of publication. These years of service to students and professors in the classrooms across the nation have brought us welcomed comments about our book. We have learned that our perspectives on established nutrition knowledge are exceptionally valuable, that our glimpses into areas of rapid change keep interest high, and that our personal writing style and clear figures appeal to both verbal and visual learners. We have also learned that today's students appreciate colorful pages, and this edition presents thoroughly updated fundamentals with an upbeat new design.

This sixth edition also sports some new practical features that carry the science of nutrition into the grocery store. Beginning in Chapter 2, each of six chapters presents a "Checking Out Food Labels" feature that illuminates the important new information found on food labels. The chapters on vitamins and minerals feature "Snapshots," capsules of information that depict food sources and teach some salient facts about each nutrient.

We hope that you will enjoy using this sixth edition as we have enjoyed creating it for you. Along with its new topics come amenities such as new art and photos that we feel complement the pages and assist in learning.

Chapter 1 of this edition begins with a personal challenge to nutrition science. It asks the question so many people ask of nutrition scientists: "What should I do, 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, the important role of cuisine in a person's heritage helps to spotlight and honor this country's multicultural nature.

Chapter 2 brings together the concepts of diet planning through food grouping systems and exchange systems, and features the new 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.

The next five chapters offer details on the nutrients. 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.

A series of five chapters then applies nutrition knowledge to specific life situations. Chapter 9 relates energy balance to body composition, obesity, and underweight, and presents weight maintenance as a life-long 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 previous chapters to two broad and rapidly changing areas within nutrition: immunity and disease prevention. Chapters 12 and 13 point out the importance of nutrition throughout the lifespan, from gestation through old age.

Chapter 14 focuses on foods. It considers the problems and advantages of food technology, with a special emphasis on food safety for consumers. Chapter 15 touches on the vast problems of the global food supply—world hunger, environmental pollution, overpopulation—and shows how everyday food choices link each person with the meaningful whole.

The Controversies of this book's title are optional readings printed with colored borders. Many are new to this edition and others have been updated. One that deserves special mention is Controversy 6, which compares the advantages and drawbacks of vegetarian and nonvegetarian foodways, leaving it to the reader to answer its title question, "Whose diet is best?" Controversy 9 tackles some pressing questions surrounding the issues of 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, along with the new diagnostic criteria for 1994. Controversy 13 offers a basic understanding of the roles nutrition plays in the regulation of the brain and applies scientific evidence to the currently popular question of whether nutrient supplements might improve brain functioning. Controversy 14 evaluates new food technologies and welcomes the reader to ponder the future. The final Controversy of this book outlines 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 personal applications of the concepts in the chapters. Consumer Cautions present information on juicing, supplements, and other nutrition-related marketplace choices 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. Terms in Controversy sections are grouped together and defined in tables within the sections. The reader who wishes to locate any definition can do so by consulting the index, which lists their page numbers in boldface type.

The appendixes have been updated. Notice especially Appendix A, which now presents the most complete listings ever of nutrient contents of over 1,700 foods. Appendix B supplies the RNI, Guidelines, and the Food Guide for our Canadian readers. Appendix C presents aids to calculations, with special emphasis on calculating percentages of calories from energy nutrients. Appendix D provides both the U.S. and Canadian Exchange Systems. Appendix E offers an invaluable list of current addresses and telephone numbers for those interested in additional information.

Our lists of source notes have grown longer in this edition, partly because nutrition information in scientific journals has increased exponentially in the recent past, and partly in response to requests from readers who wish to develop bibliographies on our topics. To make space, we have removed many older source notes, but anyone who wishes to obtain our older sources can do so easily by consulting an older edition of this book, or by contacting the publisher.

Our purpose in writing this book is to enhance the understanding of nutrition science in ways that apply to everyday life and thereby to enhance the quality of life for our readers. We hope you find this book enlightening and useful, and that you will enjoy it. And to all our long-time readers, happy anniversary.

Acknowledgments

We are grateful to our associates, Linda DeBruyne and Sharon Rolfes for their valued assistance in our work. We thank Linda DeBruyne especially for Chapters 7 and 8 of this edition and for her work on the Food Diary and Activity Manual. Thanks to Sharon Rolfes and Stephanie Johnson for the creation of the video disk that accompanies this edition. Thanks also to Caroline Ann Sizer for her unflagging effort and joyful assistance at each stage of this writing, and for her encouragement, which made heavy tasks seem lighter. Thanks, too, to our associate Lori Turner for much of the *Instructor's Manual;* thanks to Margaret Hedley, University of Guelph, who prepared the Canadian material for the manual; and to Linda Hahn, California State University, Los Angeles, who prepared the section on Teaching Strategies for the manual. For the special Instructor's Edition of the text, we thank Judy Kaufman of Monroe Community College for preparing all margin references to the multi-media resources and Lori Turner, Tallahassee Community College, for preparing the Lecture Outlines that open the instructor's version of the text. Many thanks also to Louise Little of the University of Delaware for her content review of our food label features. Special thanks to Simin Bolourchi Vaghefi, University of North Florida, and to Geoffrey Webb, University of East London, for inviting us to their classes at the University of North Florida and for their many good ideas. Thanks to John Woolsey and associates for bringing our figures to their full potential. To Tom Peterson and Tom Harm of Quest Photographic, our thanks for creating the attractive photographs of food throughout the book. Our thanks also to Gary Carroll for his charming cartoons.

Special thanks to our editors, Peter Marshall, Becky Tollerson, Stacy Lenzen, and Chris Hurney, and to their staff, for their tireless efforts to ensure the highest quality of all facets of this book. Thanks also to Jana Kicklighter of Georgia State University for preparing the *Student Study Guide* and the *Test Bank.* Thanks also to Bob Geltz, Betty Hands, Nancy Belleque and their staff at ESHA research for the table of food composition (Appendix A), and for the computerized diet analysis program that accompanies this book. Thanks, too, to Janet Bollow for our appealing new design. To our reviewers, many heartfelt thanks for their many thoughtful ideas and suggestions.

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Contents in Brief

Contents

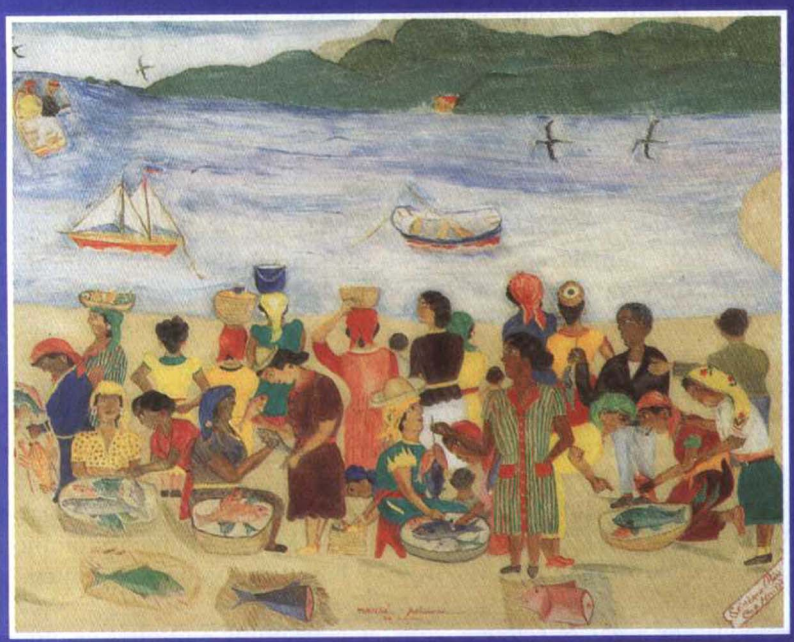
CHAPTER 5

CHAPTER 6

CHAPTER 7

CHAPTER 1

Food Choices and Human Health



Sènéque Obin 1893–1977, *Marché* Poissons before 1957 (Fish Market), Collection of Siri von Reis, New York, New York

Contents

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

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

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

1 If you care about your body, and if you have strong feelings about **food,** then you have much to gain from learning about **nutrition**—the study of how food nourishes the body. It is a fascinating, much talked-about subject. Each day, newspapers, radio, and television broadcast stories of new findings on nutrition and heart health, nutrition and cancer avoidance. Daily, magazine advertisements and television commercials bombard you with multicolored pictures of delicious foods to tempt you—pizza, burgers, cakes, sweet drinks, alcoholic beverages, and many more. Several times a day you get hungry and turn from your other activities to eat a meal. And if you are like most people, you wonder, "Is this food good for me?" or you berate yourself, "I probably shouldn't be eating this."

The study of nutrition can benefit both your physical and emotional health. When you learn which foods serve you best, you can work out ways of choosing foods, planning meals, and designing your **diet** wisely. This benefits your physical health. In addition, food facts can dispel food fears. Knowing the facts can relieve you of feeling guilty or worried that you aren't eating well. Thus, you can enhance your enjoyment of eating, and this benefits your emotional health.

Nutrition is a science—a field of knowledge composed of facts. Scientists have obtained these facts by systematically observing what people eat and noting how healthy they are, and also by experimenting to see how various foods and diets affect animals' and people's health. From these observations and experiments, they have assembled many findings and have drawn conclusions, such as "A diet high in fat presents a risk of heart disease and cancer," or "Up to a certain point, sugar in the diet presents no harm to health," or "Certain minimum amounts of vitamin A and the mineral zinc are indispensable to maintain the health of the eyes."

Further scientific investigation then goes on to answer further questions, such as "Just how high in fat can the diet be without harming health?" "How does fat relate to heart disease and cancer?" "Just how much sugar is OK?" "What does excess sugar do to health?" "Just how much vitamin A and zinc are needed to maintain vision?" "What, exactly, do these nutrients do in the body?"

Unlike some other areas of science, such as astronomy and physics, nutrition is a relatively young science. Most nutrition research has been conducted within the past century, that is, since 1900. The first vitamin was identified in 1897, and the first protein structure was not fully described until 1945. Much remains to be learned about foods' and nutrients' effects on the body. Because nutrition science is an active, changing, growing body of knowledge, you often hear reports of scientific findings that seem to contradict other findings and of interpretations of those findings that conflict with one another.

For this reason, people who don't understand how science operates may despair as they try to understand from current reports what is really going on. They may even become distrustful: "The scientists themselves don't even know what is true; how am I supposed to know?" To help consumers make correct judgments regarding their food choices and diets, the first section of this chapter is devoted to the apparent scientific contradictions in nutrition science.

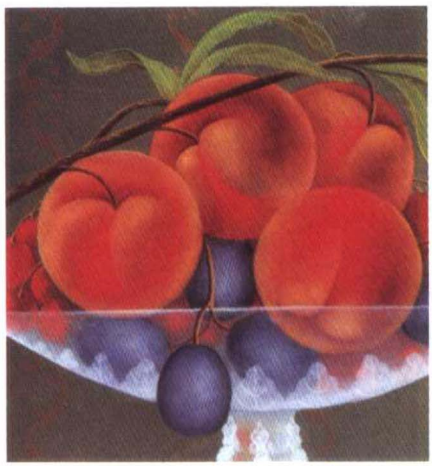
Other than the points just now being investigated, many facts in nutrition are known with great certainty—enough to fill this book and many more. And where there are conflicts and contradictions, researchers today are energetically attempting to resolve them. Everyone wants to know how food

affects health—naturally, because we love food and we care about our health.

This book devotes many chapters to the science of nutrition. This chapter provides background on the human level by offering answers to the following questions:

1. What does food do for the body and its owner?
2. What sorts of foods should Americans eat today to best support their health?

If the Scientists Don't Know, How Can I?



Everyone stampedes for oat bran, red wine, or fish oil based on today's news that these products are good for health. Then tomorrow's news reports, "it isn't true after all," and everyone drops oat bran, red wine, and fish oil and takes up the next latest craze. Meanwhile, they complain with frustration, "Those scientists don't know anything."

In truth, though, it is a scientist's business not to know. Scientists ask questions—that's their job. Then they design experiments designed to test for various possible answers. When they have ruled out some possibilities and found evidence for others, they submit their findings, not to the news media, but to boards of reviewers composed of other scientists who will try to pick them apart. If the reviewers consider the conclusions to be well supported by the evidence, they endorse the work for publication, not in the news media, but in scientific journals where still other scientists can read it.

Once a new finding is published, it is still only preliminary. The next step is for other scientists to attempt to duplicate what the first ones have done or to challenge the findings by designing experiments to disprove them.

Only when a finding has stood up to rigorous, repeated testing in several kinds of experiments performed by several different researchers is it finally considered confirmed. Even then, to be strict about it, no such thing as a *fact* exists in science. Science consists of *hypotheses* that can always be challenged and revised. Some, though, like the hypothesis that the earth revolves about the sun, are so well supported by so many observations and experimental findings that they are generally accepted as facts. What we "know" in nutrition is confirmed in the same way: it results from years of replicating study findings.

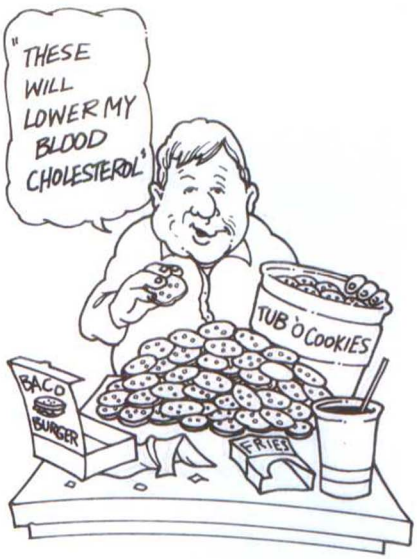
The news media are hungry for new findings, though, and reporters often latch onto ideas from the scientific labs before they have been fully tested. To tell the truth, sometimes scientists get excited about their findings, too, and leak them to the press before they have been through a rigorous review conducted by their peers. As a result, the public often is exposed to late-breaking news stories from scientific labs before the findings are fully confirmed. Then when the hypothesis being tested fails to hold up to a later challenge, consumers feel betrayed by what is simply the normal course of science at work.

It follows that if you act on new science news that is hot off the press, you do so at your own risk. Applying a new nutrition finding is not like buying a new appliance: there is no warranty; it is not backed by consumer testing; and it is not a crime for the finding to be invalidated.

It also follows that people who take action based on single studies are almost always acting impulsively, not scientifically. The real scientists are

trend watchers. They evaluate the methods used in each study, assess each study in light of all the evidence gleaned from other studies, and little by little, modify their picture of what is true. As evidence accumulates, they become more and more confident about being able to make recommendations that apply to people's health and lives. Single studies are interesting, perhaps even exciting, but learn to withhold judgment about how to apply the findings until they have been repeated and confirmed.

Media sensationalism may even overrate the importance of true, replicated findings. This happened when oat bran hit the news. Oat bran has been shown to lower blood cholesterol, a lipid indicative of heart-disease risk, but bran is one of several hundred factors that affect blood cholesterol. A news report on oat bran may fail to mention that cutting fat intake is still the major blood cholesterol-lowering step to take. Science is constantly building on an already-existing foundation of knowledge, but journalists and television reporters often pick single news items and blow them up out of proportion to the whole.[1]



Also, new findings need definition. Oat bran is truly a cholesterol reducer; but how much bran does it take to produce the desired effects? Do little oat-bran pills or powders meet the need? Do oat-bran cookies? How many? Does everyone respond the same way to them? How much of a dietary indiscretion can a person commit and still rectify it with oat-bran cookies? One reviewer dealing with a report on this very topic observed, "To get the equivalent of the oat fiber in one bowl of oatmeal, it would [be] necessary to eat 90 cookies."[2] An oat bran muffin eaten after a high-fat, fast-food lunch and steak dinner cannot undo all the damage that the meal did.

People who know how science works do not let reports of single findings throw them. After one study found no cholesterol-lowering effect of oat bran on a particular population under a particular set of conditions, many people abandoned oats as a cholesterol fighter. This was a mistake because the bulk of available evidence still supports the original finding. Today, oat bran's cholesterol-lowering effect is considered to be established.[3] The whole process of discovery, challenge, and vindication took almost ten years of research; some take many years longer.

In science, single findings almost never make a crucial difference to the whole picture, but like single frames in a movie, they contribute a little to it. It takes many such frames to tell the whole story.

Because science is a step-by-step, information-gathering and testing process, some of the older reports are among the most valuable. A hypothesis first advanced in 1960 that stands up to many kinds of testing for several decades has real strength. Naturally, though, when it is reported today, it is the researchers who reported the original finding who are properly given the credit for it. Scientific information is not like new cars or this year's hemlines; "new" does not usually mean "improved." In fact, any science report based on "all new references" is suspect, for truly strong facts are based on years of strong, original work. This is why, even in science books published just this year, you'll see references to older reports. In science, some of the oldies are the real goodies; they not only were exciting and new when they first appeared, but they have stood up to the test of time.

KEY POINT Scientists uncover nutrition facts by experimenting. Single findings must be replicated before they can be considered valid. New nutrition news is not always to be believed; old news has stood up to the test of time.

Table 1-1
Elements in the Six Classes of Nutrients

The nutrients listed in the colored area contain carbon and are organic.	Carbon	Oxygen	Hydrogen	Nitrogen[a]	Minerals[b]
Water		X	X		
Carbohydrate	X	X	X		
Fat	X	X	X		
Protein	X	X	X	X	
Vitamins	X	X	X	X	
Minerals					X

[a]All of the B vitamins contain nitrogen, *amine* means nitrogen.
[b]Protein and some vitamins contain the mineral sulfur; vitamin B_{12} contains the mineral cobalt.

energy the capacity to do work. The energy in food is chemical energy; it can be converted to mechanical, electrical, heat, or other forms of energy in the body. Food energy is measured in calories, defined on page 12.

nutrients components of food that help to nourish the body, that is, to provide energy, to serve as building material, to help maintain or repair body parts, or for growth. The nutrients include water, carbohydrate, fat, protein, vitamins, and minerals.

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

energy-yielding nutrients the nutrients the body can use for energy. (They may also supply building blocks for body structures.)

The Human Body and Its Food

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

The body also requires six kinds of **nutrients**—families of molecules indispensable to its functioning—and foods deliver these. Table 1-1 lists the six classes of nutrients. Four of these six are **organic,** that is, the nutrients are derived from living things that have captured solar energy, either directly or indirectly, and converted the energy into compounds containing the element carbon. The human body is made of the same materials as foods are, arranged in different ways (Figure 1-1).

The Nutrients in Foods

Foremost among the six classes of nutrients in foods is *water,* which is constantly lost from the body and must constantly be replaced. Among the four organic nutrients, three are **energy-yielding nutrients,** meaning that the body can use the energy they contain. The *carbohydrates* and *fats* (formally called *lipids*) are especially important energy-yielding nutrients. As for *protein,* it does double duty: it can yield energy, but it also provides materials that form structures and working parts of body tissues. (Alcohol yields energy, too, but it is not a nutrient; see Table 1-4's note, page 13.)

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

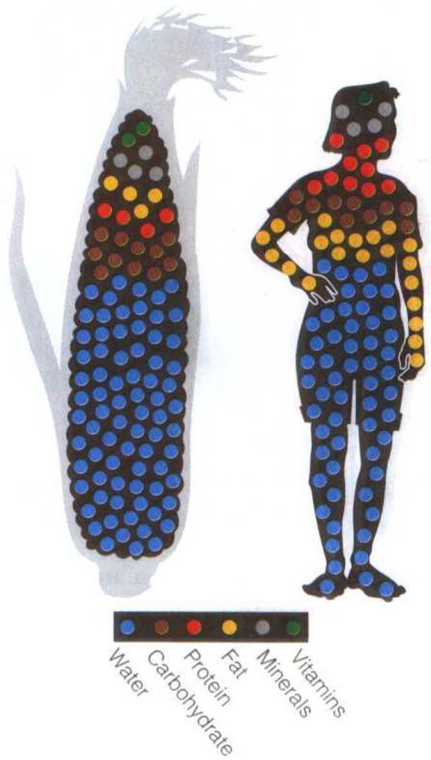


Figure 1-1
MATERIALS OF FOOD AND THE HUMAN BODY
Foods and the human body are made of the same materials.