
UNDERSTANDING NUTRITION

Eleanor Noss Whitney

Eva May Nunnelley Hamilton

Second Edition

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To the memory of Sam, who gave me the courage to begin to write about nutrition as I love to do, and to my children, Lynn, Russell, and Kara, whose love and understanding sustains me between times of inspiration.

ELLIE WHITNEY

To my late husband, Marshall, who throughout our marriage supported me in my academic ventures, and to our daughters, Gayle, Nancy, and Bonnie, who have sustained me with their joy in my varied activities.

MAY HAMILTON

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PREFACE TO THE SECOND EDITION

We wrote *Understanding Nutrition* primarily for ourselves and our students. It was to be the textbook we needed, and nothing like it was available at the time. We had no idea when it went to press that so many other teachers and students of nutrition would find in it what they, too, were looking for. We are gratified by the multitude of enthusiastic responses we have received and are happy to know that our effort at communicating the excitement and importance of nutrition has been successful.

In this, the second edition, we have amplified the sections that we felt were thin in the first. The chapters on vitamins and minerals and nutrition throughout the life cycle have been greatly expanded and updated. A discussion of fiber in the diet has been added to Chapter 1; the lipoproteins and their significance are explained in Chapter 6. New Highlights have been added to help the reader understand the relation of fat to cancer and the role of nutrition in stress.

The U.S. Dietary Goals were published just after the first edition of *Understanding Nutrition* came out, and they have had a tremendous impact on the public. We have presented them and the subsequent USDA Guidelines at intervals throughout this edition.

To help readers apply the information in the chapters, we have supplied a series of Self-Study sections that, taken together, constitute a complete diet analysis and revision. We have also greatly expanded the appendixes so that they now include information on sugar, sodium, fiber, fast foods, the Four Food Group Plan, the Canadian Dietary Standard, and many other items. As in the first edition, the index is as complete as we can make it; if you find anything missing, let us know.

We have made many other changes as well. In fact this is a completely rewritten book and we have put as much effort into it as we did into the first edition. But our primary aim has not changed, and we hope that through this book you will find the study of nutrition as fresh, lively, and enjoyable as we do.

NOTE TO THE STUDENT

You may have some questions in mind as you approach the study of nutrition. In getting to know students over the years, we have some idea of what your concerns may be.

I Keep Hearing Exciting News about Nutrition. How Can I Tell What to Believe? This is the commonest complaint we hear from students. Because of it, we have designed this book not to be just a book of facts but also a book of principles that you can use to assess the nutrition information you encounter elsewhere. Today's nutrition science stands firmly on the principles of chemistry and molecular biology. This book is based on those principles.

Even with the principles clearly in mind, however, it is sometimes hard to tell whether a statement made in the marketplace is a valid fact or a myth. Some major controversies currently raging in our field concern sugar, fiber, cholesterol, vitamin C and cancer, additives, and many other issues. It would not be fair to present these issues to you in textbook fashion as if they were settled, but it makes the study of our lively science needlessly dull to omit them. Our decision has been to reserve the **chapters** mostly for solid information, on which the experts in our field largely agree, and to present separate **Highlights** on the current issues, for more speculative material. The Highlights alternate with the chapters and are printed on colored pages to remind you that they convey more tentative information.

Even though we are scientists, in some cases we have no facts. Researchers in nutrition are earnestly endeavoring to learn more, but there are many areas where we are still in the dark. Students can be infuriated when a teacher seems to weasel: "I want the facts, and you are hedging. Give me the answer, straight and simple." It is frustrating to ask why and have a cautious scientist reply, "Well, we know this, and this, and . . ." but leave your question dangling. It is insulting to be told, "It's too complicated to understand," which sounds suspiciously like what mother used to say: "Wait until you are older, dear." But the truth of the matter is that there are a great many things we do not understand. One of the most exciting, as well as frustrating, experiences for students can be the dawning realization that they are approaching the outer bounds of human knowledge. The answers are simply not all in yet; no one knows what they all are; no one ever has. In nutrition, this is true in many areas. Nutrition is a growing, young science. Although its questions are immensely important and fascinating, that is all they are—questions. We have tried to be honest in this respect: to show you what we do know (with a high probability) and to admit what we don't.

In attempting to present a fair picture of current nutrition research in the Highlights, we have found ourselves at times confused, frustrated, angered, and amused. If you too respond this way in reading the maybes and probablys of today's nutrition issues, then be assured that you are close to the reality of our science. Any book that claims at this time to present absolute answers to all questions is actually only presenting one person's prejudices. The writer may be proved right in years to come, but some of the winners have not yet been declared. If you wish to be informed on the current issues, you will have to accept the ambiguities and contradictions in the evidence and the disagreements among the experts as an intrinsic part of scientific research in progress.

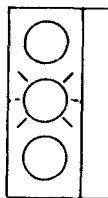
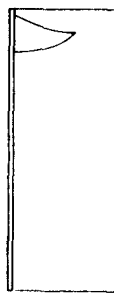
But Then How Can I Choose What to Believe? In the absence of all the facts, we still have to live and make decisions. Should you eat polyunsaturated fats? Avoid tuna? Beef? Sugar? It would not be fair to answer simply "We don't know" to all these questions. Where the answers are uncertain today, we owe it to you to help in developing the skill to evaluate new information as it appears tomorrow. Our field is beset with claims and appeals, and all of us as consumers need to be equipped to deal with them.

There are some guidelines that would help you discriminate between reliable information and false advertising. It seems to us that a separate chapter devoted to this subject would not serve the purpose. You need continuous, repeated exposure to the kinds of claims made to consumers, and you need practice in assessing them. We offer frequent opportunities, by way of **Digressions** throughout the text, for you to examine such sources of nutrition information and to assess their reliability against the criteria of accurate scientific reporting.

In these digressions we have identified the most common characteristics of fraudulent advertising with **flag signs** that will help you to recognize spurious claims; the most common misunderstandings that arise from reading about nutrition research are identified with **caution signs**.

The Digressions are set off with color; if they prove too distracting you can skip them and possibly come back to them later. But they constitute a theme that runs throughout the book.

In some cases we have clear-cut evidence that a claim being made on the marketplace is fraudulent. We feel obligated to explain and elaborate these cases. It is not enough to tell you these are myths and provide nothing to replace them. But there is another problem: It seems to us that it is also not enough to say "That is a myth, and this is a fact." After all, aren't "they" saying their myth is a fact? Confronted with a choice between what "they" say and what "we" (in a nutrition text) say, you are in the bind of having to choose whom to believe, with nothing further to go on. We hope, by providing relevant information, to show you that what we say is more probably true than the myth you might otherwise believe. You will understand why the low-carbohydrate diet



is ill advised when you know that carbohydrate is needed to metabolize fat in the body and how the body may be damaged when carbohydrate is not available. You will understand why taking large doses of vitamin C may be harmful when you know what can happen to people who indulge in that practice.

In using some of our space to deal with current issues, consumer questions, and health food myths, we have elected not to present an encyclopedic book of all the important knowledge that has been accumulated in our rapidly expanding field. Instead, we have stressed concepts, using selected facts to illustrate the principles on which they are based. Information in the chapters is, however, amplified by abundant additional information in the **appendixes**. We hope you will explore them and find them useful. We believe it is important to gain an acquaintance with the general principles of nutrition, as well as to develop the incentive and ability to identify reliable nutrition information on your own. Armed with this skill, you can continually gather and apply the information that is relevant to your own particular concerns.

I Have Heard Some Very Scary Rumors about Foods. Am I Right to Worry about What I May Be Doing to Myself with My Diet? Under a wide range of conditions, the body cares beautifully for itself. To indicate this, we have emphasized physiology more heavily than most textbooks do. Only when people understand and appreciate natural health can they use their knowledge to enhance it. Still, there are circumstances in which physiology becomes abnormal and diseases arise. Cardiovascular disease, cancer, diabetes, and alcoholism are among the major diseases in the developed countries. Nutritional factors and carcinogens found in foods have an influence on the incidence and severity of all these diseases. The relationship between nutrition and disease does not traditionally fall within the province of a beginning textbook, but we feel that it is important to show how nutritional status and food choices may affect susceptibility to these diseases and so have devoted a few pages to each of them.

We also invite you to study your own diet and to compare its characteristics with the recommendations of nutrition authorities. The Self-Studies that appear at the end of most Highlights will help you evaluate your nutritional lifestyle.

I Hate Eating What's Good for Me. Are You Going to Tell Me I Shouldn't Have the Foods I Like? Absolutely not. There is no one right way to eat and no food that must be included to make a diet healthful—not liver, not carrots, not even orange juice. Eating is primarily a pleasure for most people, and people choose foods mostly on the basis of their own personal taste preferences. But if you wish to make knowledgeable choices so that you can both enjoy and benefit from the foods you eat, this book will help you to do so.

But Your Science Scares Me. Do I Have to Learn Chemistry to Understand Nutrition? Yes. This is the hard part and the most rewarding. We make no apologies: This is a science book, a book that presents the realities as they are understood, as they really are. We are not privileged to change those realities for your convenience or our own. Our approach is biochemical. However, we believe that it is not necessary to have studied chemistry and biology extensively before embarking on the study of nutrition. We have assumed only a high school background in these sciences. The background chemistry is reviewed and explained in Appendix B to provide a refresher course. Further concepts that underlie nutrition are presented gradually in a logical sequence as they are needed; they are fully explained. Detailed diagrams of biochemical structures in Appendix C give you the option for further study of this aspect of nutrition.

In mastering the chemical concepts, you may find it helpful first to read each chapter for the general ideas involved and then to study the marginal **definitions**, which explain the chemistry in words. We have also employed verbal analogies wherever possible, comparing enzymes to machines, the process of digestion to a disassembly line, and nutrient molecules to Tinker Toys whose sticks are the electrons. These are not intended to insult you; if they seem too simple-minded for you (and they may be, especially if you have studied chemistry before), please be patient and allow us to indulge in what for us is the enjoyable and harmless practice of playing with words and ideas.

The rewards of understanding nutrition at the molecular level are as great as the effort needed to gain that understanding. When you have struggled with an unfamiliar system, picked it apart, looked at it from every angle, and finally put it back together again, you'll find that suddenly everything falls into place. The experience of grasping a whole new concept in chemistry is an "Aha!" experience that can generate tremendous excitement and pleasure. Once understood, these concepts will not slip away. When you learned to read (through effort), to play the piano (with practice), to ride a bicycle (with painful falls), these skills stayed with you. So will nutritional chemistry once you learn it. It too will stay with you, giving you a skill and a new dimension of understanding that can be used again and again to see deeper into things.

In our introduction we state that human beings are a collection of molecules that move. To say this is not to say that human beings are nothing more than molecules. Do not be affronted at what may seem to be a mechanistic view of humankind. We are sharing with you this way of seeing things, not because it is "the" reality but because it is a part of reality, a way of seeing that can deepen and enhance your understanding of yourself. We find the chief reward of our study of nutrition to be that it enhances our lives, our understanding, and our effectiveness as human beings.

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PART ONE

THE ENERGY NUTRIENTS: Carbohydrate, Fat, and Protein

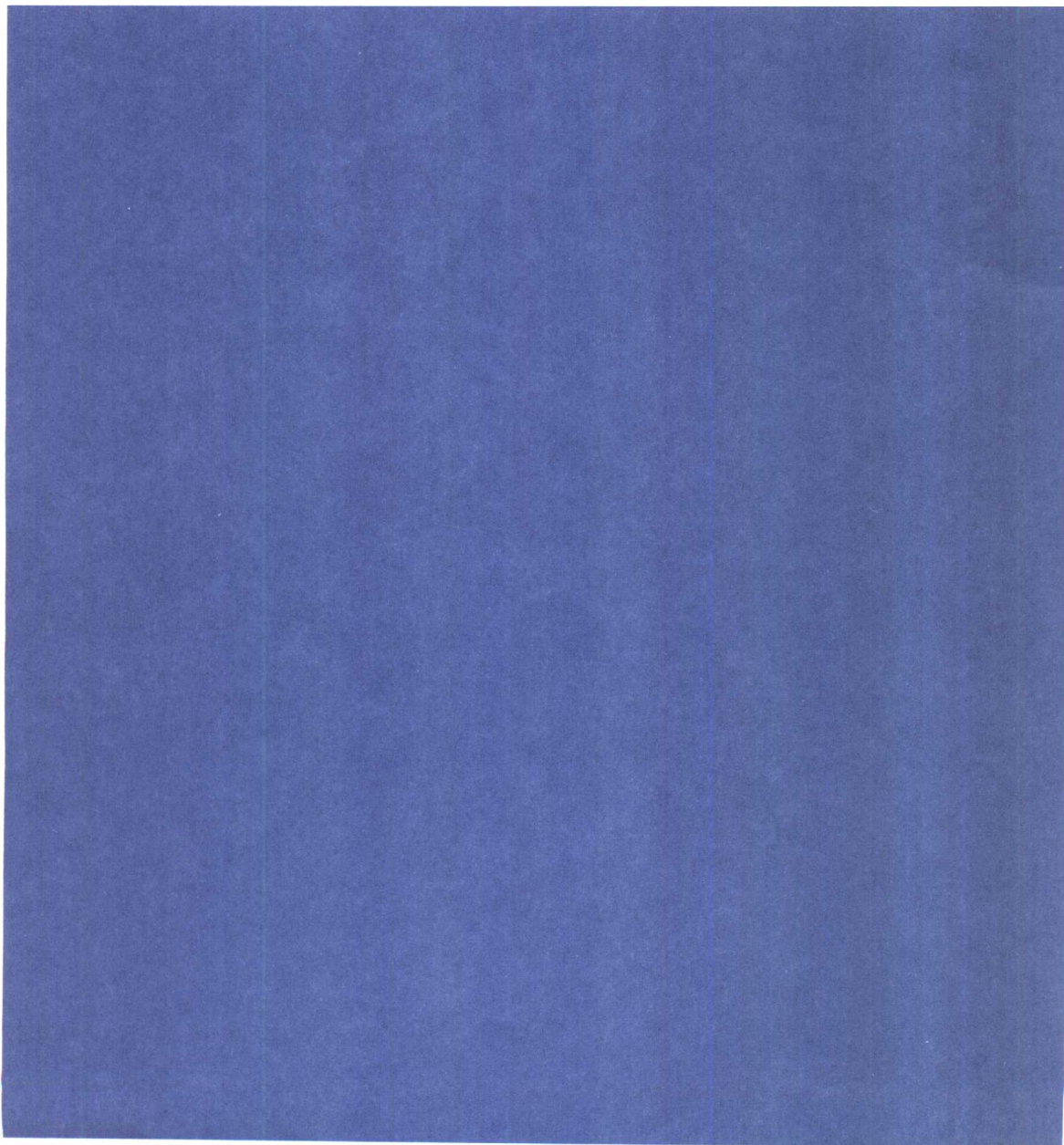
INTRODUCTION

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The Nutrients

The Principal Actors:

 The Energy Nutrients



MOLECULES: The Unseen Actors

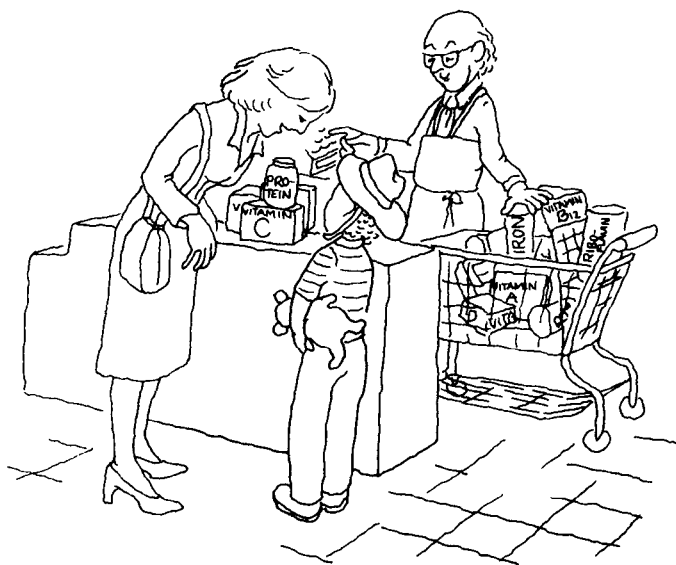
All things are in process and nothing stays still. . . . You would not step twice into the same river.

HERACLITUS

You are a collection of molecules that move. All these moving parts are arranged into patterns of extraordinary complexity and order—cells, tissues, and organs. The arrangement is constant, but its parts are continuously being replaced. Your skin, which has reliably covered you from the time you were born, is not the same skin that covered you seven years ago; it is made entirely of new cells. The fat beneath your skin is not the same fat that was there a year ago. Your oldest red blood cell is only 120 days old, and the entire lining of your digestive tract is renewed every three days. To maintain your “self,” you must continually replace the pieces you lose.

All of these pieces have come from your food: You are made entirely of what you have eaten. This is not meant to imply, of course, that if you ate spaghetti last night, you are made of spaghetti now! Some complex events take place between your eating of food and its becoming “you.” A bowl of spaghetti or a piece of apple pie must be entirely taken apart and

food: nutritive material taken into the body to keep it alive and to enable it to grow (**nutri-** **tive:** containing nutrients).



“Darling, would you go back to aisle 6 and get us another 40 milligrams of iron?”