

# Understanding Nutrition

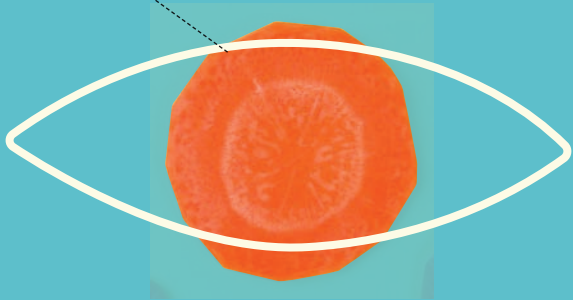
Eleanor Whitney, Sharon Rady Rolfes,  
Tim Crowe, Adam Walsh



Walnuts are a rich source of heart-healthy omega-3 fatty acids



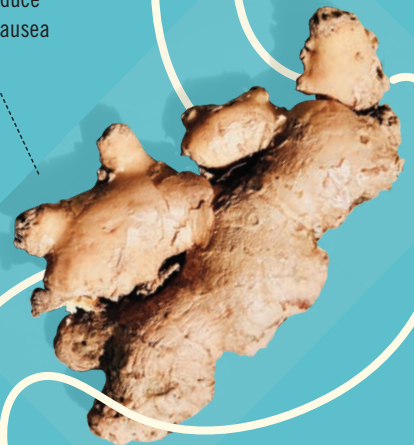
Beta-carotene gives carrots their orange colour while also helping our vision



The lycopene in tomatoes gives them their red colour and is a natural antioxidant



Compounds in ginger can help reduce feelings of nausea



Understanding Nutrition  
5th Edition  
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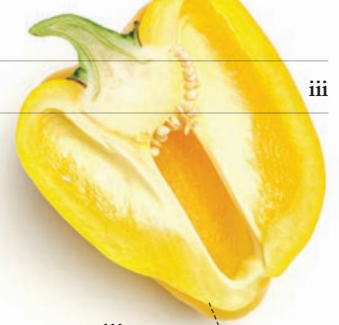
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Yellow capsicums are rich in lutein which belongs to the vitamin A family



Beetroot sprouts contain potassium and nitrates which is important for regulating blood pressure

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Pecans are a rich source of fibre, copper, thiamin and zinc



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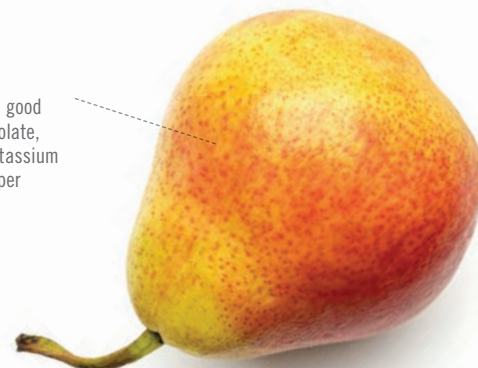
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Pears are a good source of folate, vitamin C, potassium and copper





Exposing chanterelle mushrooms to sunlight can boost their vitamin D levels

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Kale is an excellent source of vitamin K, but also contains carotenoids which are important in eye health





# Guide to the text

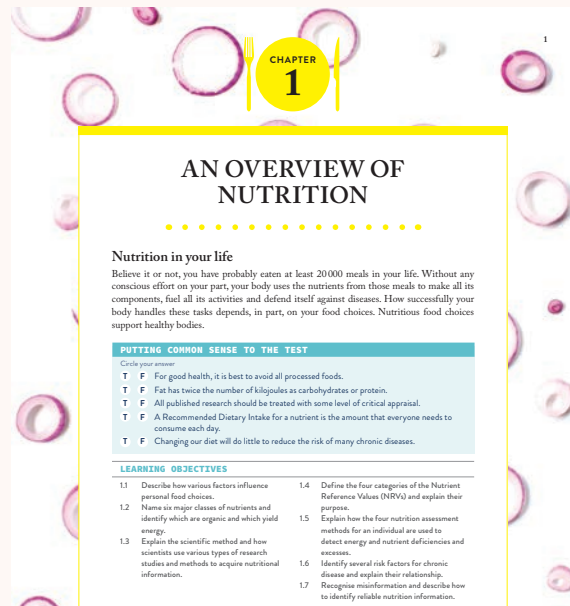
As you read this text you will find a number of features in every chapter to enhance your study of nutrition and help you understand how the theory is applied in the real world.

## CHAPTER OPENING FEATURES

Connect **Nutrition in your life** with the essential chapter concepts right from the beginning of each chapter.

Think about your intuitive beliefs related to the nutrition topics covered in the chapter by taking the **Common sense test** at the start of every chapter. Check your answers in the margins when the topic is discussed. These are explained further in the end-of-chapter review.

Identify the key concepts that the chapter will cover with the **Learning objectives** at the start of each chapter.

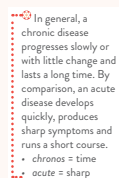


## FEATURES WITHIN CHAPTERS

Practise common nutrition tasks such as comparing nutrient density or calculating your energy requirements by working through the **How to boxes** throughout the book.



Connect key **Australian Dietary Guidelines** to your understanding of the chapter.



Extend your learning with the additional information notes highlighting interesting or important information about the topic being discussed.

### HOW TO: CALCULATE THE ENERGY AVAILABLE FROM FOODS

Practise calculating the energy available from foods.

- |   |  |
|---|--|
| 1. To calculate the energy available from a food, multiply the number of grams of carbohydrate, protein and fat by 17, 17 and 37, respectively. Then add the results together – e.g. 1 slice of bread with 1 tablespoon of peanut butter on it contains 16 grams carbohydrate, 7 grams protein and 9 grams fat. | 16 g carbohydrate × 17 kJ/g = 272 kJ<br>7 g protein × 17 kJ/g = 119 kJ<br>9 g fat × 37 kJ/g = 333 kJ<br>Total = 724 kJ |
|---|--|

From the information you calculated in step 1, you can determine the percentage of kilojoules each of the energy nutrients contributes to the total.

- |  |  |
|--|--|
| 2. To determine the percentage of kilojoules from fat, for example, divide the 333 kilojoules by the total 724 kilojoules. | 333 fat kJ ÷ 724 total kJ = 0.46<br>0.46 × 100 = 46% |
|--|--|
3. Then multiply by 100 to get the percentage.

Dietary recommendations that urge people to limit fat intake to 20 to 35 per cent of kilojoules refer to the day's total energy intake, not to individual foods. Still, if the proportion of fat in each food choice throughout a day exceeds 35 per cent of kilojoules, then the day's total surely will, too. Knowing that this snack provides 46 per cent of its kilojoules from fat alerts a person to the need to make lower-fat selections at other times that day.



## FEATURES WITHIN CHAPTERS

Explore relevant and up-to-date nutrition research in the **Current research in nutrition** boxes.

Evaluate how current research in the field informs our practical health and food choices in the **Applications of nutritional research** boxes in every chapter.

Consolidate your learning with the **Review it** summary paragraph at the end of each A-head section reviewing key concepts for that Learning Objective.

### CURRENT RESEARCH IN NUTRITION



#### The perils of highly processed foods

Do you believe the key to good health is to just cut out processed foods? The term 'processed food' may seem like a dietary demon that we need to avoid, but it is a concept that has little meaning and is unhelpful in informing food choices. Almost everything you eat is processed to an extent. Even cooking food is a form of food processing. A much more helpful concept is to divide food into categories based on their degree of processing. So, on the positive side think more of food that has been minimally processed and is still close to its natural state in appearance and nutritional quality. Here it is all about fruits, vegetables, fruits, wholegrains, nuts, milk, fresh meats and legumes. And against that, we have the foods we should be most concerned about – ultra-processed foods.

Ultra-processed foods are industrial formulations of food-derived substances that contain little if any whole food. Ultra-processed foods often include ingredients not commonly used in home cooking such as flavourings, colourings, emulsifiers and other additives. A key feature of ultra-processed foods is that they are usually appetising and pleasing to the taste buds, convenient, sold in large packages and highly marketed.

Ultra-processed foods are the types of foods that are over-represented in the list of discretionary food choices. Such foods are not an essential part of a nutritious diet. Now nutritional researchers are linking these foods as a major driver of overweight and obesity, while also contributing to non-communicable diseases, such as heart disease, **type 2 diabetes** and certain cancers.

### APPLICATIONS OF NUTRITIONAL RESEARCH



#### The key dietary patterns of long-term health

Diet plays a big part in health. As the typical Western diet moved to more overly refined and energy dense foods, rates of obesity and type 2 diabetes mirrored this change. A major scientific review has taken things back to basics to reinforce where the best health gains are to be found with diet.<sup>15</sup>

The review looked at the diet and chronic disease links from 304 meta-analyses and systematic reviews published in the last 63 years. Type 2 diabetes, overweight and obesity, cancer and cardiovascular disease together accounted for most of the chronic disease links found.

As for dietary patterns, the findings showed that plant-based foods were more protective against the risk of developing chronic disease compared with animal-based foods. Among plant foods, grain-based foods seemed to have a small edge over fruits and vegetables. So much for the anti-grain sentiment that is popular at the moment!

For animal-based foods, dairy products overall were considered neutral on health, and fish was considered protective. Red and processed meats were linked to a higher disease risk. For tea-lovers, the research confirmed this popular drink as being the most protective against disease risk. On the other end of the spectrum, to no-one's surprise, soft drinks had few redeeming health benefits.

A person selects foods for a variety of reasons. Whatever those reasons may be, food choices influence health. Individual food selections neither make nor break a diet's healthfulness, but the balance of foods selected over time can make an important difference to health. For this reason, people are wise to think 'nutrition' when making their food choices.

## END-OF-CHAPTER FEATURES

At the end of each chapter you'll find several tools to help you review, practise and extend your knowledge of the key learning outcomes.

- Reflect on your own personal nutritional choices in the **Nutrition portfolio**.
- Review the major chapter concepts in preparation for exams by completing the **Study questions**.
- Master the common **Nutrition calculations** introduced in the **How to** chapter features.
- Expand your knowledge by exploring the online resources listed in **Nutrition on the net**.

### NUTRITION PORTFOLIO

Each chapter in this book ends with simple 'Nutrition portfolio' activities that invite you to review key messages and consider whether your personal choices are meeting the dietary goals introduced in the text. By keeping a journal of these 'Nutrition portfolio' assignments, you can

- For the foods and snacks you eat over a typical day, identify the factors that most influence your choices.
- List the chronic disease risk factors and conditions [see **Table 1.8**] that you or members of your family have.

### STUDY QUESTIONS

#### Multiple choice questions

Answers can be found at the back of the book.

- When people eat the foods that are influenced by the companionship of friends and family in a group, their choices are influenced by:
  - habit
  - ethnic heritage or tradition
  - personal preference
  - social interactions.

- The energy-yielding nutrients are:
  - fats, minerals and water
  - minerals, proteins and vitamins
  - carbohydrates, fats and vitamins
  - carbohydrates, fats and proteins.

- Studies of populations that reveal correlations between dietary habits and disease incidence are termed:
  - clinical trials

### NUTRITION CALCULATIONS

Many chapters end with problems to give you practice in doing simple nutrition-related calculations. Although the situations are hypothetical, the numbers are real, and calculating the answers (see the answers section at the back of this book) provides a valuable nutrition lesson. Once you have mastered these examples, you will be prepared to examine your own food choices. Be sure to show your calculations for each problem.

- How many kilojoules does the rice provide from these energy nutrients?
 

_____	=	_____	kJ protein
_____	=	_____	kJ carbohydrate
_____	=	_____	kJ fat
Total	=	_____	kJ

- What percentage of the energy in the fried rice comes from each of the energy-yielding

### NUTRITION ON THE NET

Analyse the nutrient composition of foods online. To learn more about the nutrient content of the foods you eat, you can access the full NUTTAB Food Composition Database provided by Food Standards Australia New Zealand from <http://www.foodstandards.gov.au/science/monitoringnutrients/pages/default.aspx>

- Search for 'nutrition' at the National Health and Medical Research Council site: <http://www.nhmrc.gov.au>

the World Health Organization: <http://www.fao.org> and <http://www.who.org>

- Read about the Selected Highlights from the 2017–18 National Health Survey <https://www.abs.gov.au/statistics/health/health-conditions-and-risks/national-health-survey-first-results/2017-18>
- Read about food and nutrition monitoring in New Zealand by searching 'nutrition survey' at <http://www.health.govt.nz>

## HIGHLIGHTS

Every chapter is followed by a highlight that provides readers with an in-depth look at a current, and often controversial, topic that relates to its companion chapter

- Develop your understanding of these key topics by responding to the **critical thinking questions**.
- Research these thought-provoking topics further by exploring the weblinks listed in **Nutrition on the net**.

### HIGHLIGHT ACTIVITIES

#### CRITICAL THINKING QUESTIONS

- 1 How would you judge the accuracy or validity of nutrition information?
- 2 You have just received a forwarded email from a friend warning that the artificial sweetener aspartame is a TOXIN that causes muscle spasms, leg numbness, stomach cramps, vertigo, dizziness, headaches, innitius, joint pain, depression, anxiety, slurred speech, blurred vision, and memory loss. It goes on

to say that this DEADLY POISON causes blindness, multiple sclerosis, brain tumours, and cancer! The message alleges that aspartame remains on the market because of a conspiracy between FSANZ and the manufacturer to keep these dangers hidden from the public. How can you determine whether these claims are legitimate warnings or an irresponsible hoax?

#### NUTRITION ON THE NET

- Analyse the nutrient composition of foods online: To learn more about the nutrient content of the foods you eat, you can access the full NUTTAB Food Composition Database provided by Food Standards Australia New Zealand at <http://www.foodstandards.gov.au/science/monitoringupdates/pages/default.aspx>
- Find an accredited practising dietitian in your area by consulting the Dietitians Australia website; also find out which nutrition and dietetics courses are accredited by the association: <https://dietitiansaustralia.org.au>
- Learn about the Registered Nutritionist program at the Nutrition Society of Australia: <http://www.nsa.ssn.au>
- For foods commonly eaten in New Zealand, you can analyse their nutrient content from the database maintained by Plant and Food New Zealand: <http://www.foodcomposition.co.nz>
- Learn more about quackery from Stephen Barrett's Quackwatch: <http://www.quackwatch.org>
- Visit the National Council against Health Fraud: <http://www.ncahf.org>
- Check out health-related hoaxes and urban legends: <http://www.urbanlegends.about.com>
- Find reliable research articles: <https://pubmed.ncbi.nlm.nih.gov>

### HIGHLIGHT 1

## 1.7 NUTRITION INFORMATION AND MISINFORMATION: ON THE NET AND IN THE NEWS

Do keto diets really help with weight loss, or is it better to practise intermittent fasting? What is plant-based eating all about? Will nutrigenomics have the answers to all our health questions? Is the microbiome helpful or harmful? Food and nutrition trends such as these have always swirled around the world of nutrition. Some arise out of the latest research and have the backing of scientific evidence. They have staying power, whereas those based on nonsense fade away as soon as the next fanciful trend catches our attention. Upcoming chapters present the scientific findings of these and other trending topics, but it is most important that readers be able to spot a trend and determine its validity.

How can people distinguish valid nutrition information from misinformation? One excellent approach is to notice who is providing the information. The 'who' behind the information is not always evident, though, especially in the world of electronic media. Keep in mind that people create apps, blogs, and websites on the internet, just as people write books and report the news. In all cases, consumers need to determine whether the person is qualified to provide nutrition information.

This highlight begins by examining the unique potential as well as the problems of relying on the internet and the media for nutrition information. It continues with a discussion of how to identify reliable nutrition information that applies to all resources, including the internet and the news. (The Glossary defines related terms.)

This discussion recognises that identifying nutrition misinformation requires more than simply gathering accurate information, although that is a good start; it requires critical thinking. Critical thinking allows a person who has gathered information to:

- understand the connections between concepts
  - identify and evaluate the pros and cons of an argument
  - detect inconsistencies and errors
  - solve problems
  - identify the relevance of information.
- To that end, the questions at the end of the highlights that follow all chapters are intended to help develop

#### Nutrition on the net

Get a question? The internet has an answer. The internet offers endless opportunities to obtain high-quality information, but it also delivers an abundance of incomplete, misleading or inaccurate information. Simply put, anyone can publish anything. Determining whether information is balanced, accurate, and credible has become increasingly challenging in recent years.<sup>1</sup>

With hundreds of millions of websites, a person searching for valid nutrition information can be overwhelmed with uncertainty. When using the internet, keep in mind that the quality of health-related information available covers a broad range. You must evaluate websites for their accuracy, just like every other source. The 'How to' box that follows provides tips for determining whether a website is reliable.

One of the most trustworthy sites used by scientists and others is the US National Library of Medicine's PubMed, which provides free access to over 30 million research papers published in scientific journals around the world. Many abstracts provide links to websites where full articles are available. Figure H1 introduces this valuable resource.

If you have received an email warning of the health dangers associated with reusing or freezing plastic water bottles, you have been a victim of urban scarelore. When nutrition information arrives in unsolicited emails, be suspicious if:

- the person sending it to you did not write it and you cannot determine who did or if that person is a nutrition expert
- the phrase 'Forward this to everyone you know' appears
- the phrase 'This is not a hoax' appears; chances are that it is
- the news is sensational and you have never heard about it from legitimate sources
- the language is emphatic and the text is sprinkled with capitalised words and exclamation marks
- no references are given or, if present, are of questionable validity when examined.

#### HIGHLIGHT

- 1 S. Bower and N. Alexander. On post-truth, fake news, and trust. *Nutrition Today* 52 (2017): 179–182.
- 2 C. Eversink and co-authors. Titled medical talk shows – What they recommend and the evidence to support their recommendations: A prospective observational study. *British Medical Journal* 349 (2014): doi:10.1136/bmj.g7946.

- 3 M. Adamski and co-authors. Are doctors nutritionists? What is the role of doctors in providing nutrition advice? *Nutrition Bulletin* 43 (2018): 147–152.

# Guide to the online resources

## FOR THE INSTRUCTOR

Cengage is pleased to provide you with a selection of resources that will help you to prepare your lectures and assessments, when you choose this textbook for your course.

Log in or request an account to access instructor resources at [cengage.com.au/instructors](https://cengage.com.au/instructors) for Australia or [cengage.co.nz/instructors](https://cengage.co.nz/instructors) for New Zealand.

### MINDTAP

Premium online teaching and learning tools are available on the *MindTap* platform – the personalised eLearning solution.

*MindTap* is a flexible and easy-to-use platform that helps build student confidence and gives you a clear picture of their progress. We partner with you to ease the transition to digital – we're with you every step of the way.

The *Cengage Mobile App* puts your course directly into students' hands with course materials available on their smartphone or tablet. Students can read on the go, complete practice quizzes or participate in interactive real-time activities.

*MindTap* for Whitney's *Understanding Nutrition* is full of innovative resources to support critical thinking and help your students move from memorisation to mastery! Includes:

- Whitney's *Understanding Nutrition* eBook
- Interactive nutrition calculations, Common sense test, Concept checks, Case activities, Quizzes and more

*MindTap* is a premium purchasable eLearning tool. Contact your Cengage learning consultant to find out how *MindTap* can transform your course.



### INSTRUCTOR'S MANUAL

The **Instructor's Manual** includes:

- Learning objectives
- Lecture presentation outlines and enrichments
- Answers to study questions
- Critical thinking questions with answers
- Worksheets and handouts
- Classroom activities
- New Zealand instructor information

### COGNERO® TEST BANK

A bank of questions has been developed in conjunction with the text for creating quizzes, tests and exams for your students. Create multiple test versions in an instant and deliver tests from your LMS, your classroom, or wherever you want using Cognero. Cognero test generator is a flexible online system that allows you to import, edit, and manipulate content from the text's test bank or elsewhere, including your own favourite test questions.

### POWERPOINT™ PRESENTATIONS

Use the chapter-by-chapter PowerPoint presentations to enhance your lecture presentations and handouts to reinforce the key principles of your subject.

### ARTWORK FROM THE TEXT

Add the digital files of graphs, tables, pictures and flow charts into your course management system, use them in student handouts, or copy them in your lecture presentations.

## FOR THE STUDENT

### MINDTAP

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# PREFACE

Nutrition is a science. The details of a nutrient's chemistry or a cell's biology can be overwhelming and confusing to some, but it needn't be. When the science is explained step by step and the facts are connected one by one, the details become clear and understandable. That has been the goal since this book was first developed and as it has continued to be updated in this fifth edition: to reveal the fascination of science and share the excitement of nutrition with readers. We have learned from the hundreds of university teachers and nutrition professionals and more than a million students who have used previous editions of this book through the years that readers want to *understand* nutrition so that they can make healthy choices in their daily lives.

With its focus on Australia and New Zealand, the text incorporates current nutrition recommendations and public health issues, and food culture relevant to those studying and working in nutrition in this region of the world.

Because nutrition is an active science, staying current is paramount. To that end, this edition incorporates the latest in nutrition research. The connections between diet and disease have become more apparent – and our interest in making smart health choices has followed. More people are living longer and healthier lives. The science of nutrition has grown rapidly, with new research emerging daily. In this edition, as with previous editions, every chapter has been substantially revised to reflect the many changes that have occurred in the field of nutrition and in our daily lives over the years. We hope that this book serves you well.

## THE CHAPTERS


*Understanding Nutrition* presents the core information of an introductory nutrition course. The early chapters introduce the nutrients and their work in the body, and the later chapters apply that information to people's lives – describing the role of foods and nutrients in energy balance and weight control, in physical activity, in the life cycle and in disease prevention, and food safety. At the beginning of each chapter are clearly stated learning objectives to outline the key concept areas to be covered. Each chapter also clearly flags for the reader practical applications of nutritional research and presents the most recent research in the topic area.

## THE HIGHLIGHTS

Every chapter is followed by a highlight that provides readers with an in-depth look at a current, and often controversial, topic that relates to its companion chapter. Each highlight closes with critical thinking questions designed to encourage readers to develop clear, rational, open-minded and informed thoughts based on the evidence presented in the text.

## THE APPENDICES

The appendices are valuable references for a number of purposes. Appendix A summarises background information on the hormonal and nervous systems, complementing Appendices B and C on basic chemistry, the chemical structures of nutrients and major metabolic pathways. Appendix D describes measures of protein quality. Appendix E provides detailed coverage of nutrition assessment with updated infant and child growth charts, and Appendix F presents estimated energy requirements for men and women at various levels of physical activity. Appendix G presents common calculation and conversion tips.



Chillis are part of the capsicum family and a rich source of vitamin C

## THE COVERS

The book's inside covers put commonly used information at your fingertips, including current nutrient recommendations and suggested weight ranges for various heights.

We have taken great care to provide accurate information and have included many references at the end of each chapter. However, to keep the number of references manageable, many statements appear without references. All statements reflect current nutrition knowledge and the authors will supply references upon request. In addition to supporting text statements, the references provide readers with resources for finding a good overview or more details on a subject.

In this new edition, the art and layout have been carefully designed to be inviting while enhancing student learning. For all chapters and highlights, content has been reviewed and updated. Several new figures and tables have been created and others revised to enhance learning. Each chapter also features a true-false 'common sense' test presented at the beginning to allow students to test their core knowledge on practical nutrition concepts related to the topic. Answers to these common-sense questions are revealed throughout the chapter and a brief explanation is given at the end. This new edition has also been revised throughout to include more content and related nutrition issues that are specific to New Zealand. For example, Chapter 2 features the recent updates to the *Eating and Activity Guidelines for New Zealand Adults*. And to acknowledge the growing interest in the gastrointestinal microbiome in health, an expanded section in Chapter 3 has been added with an additional focus on nutrition, the microbiome and mental health as well as a research focus in Chapter 4.

Nutrition is a fascinating subject, and we hope our enthusiasm for it comes through on every page.

**Tim Crowe**  
**Adam Walsh**  
**Ellie Whitney**  
**Sharon Rady Rolfes**

Dragon fruit seeds are an excellent source of Oleic and Linoleic acids which may lower risk of cardiovascular disease



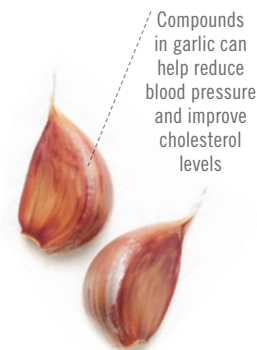
# ABOUT THE AUTHORS

**Eleanor Noss Whitney**, PhD, received her BA in Biology from Radcliffe College in 1960 and her PhD in Biology from Washington University, St Louis, in 1970. Formerly on the faculties at Florida State University and Florida A&M University and a dietitian registered with the American Dietetic Association, Ellie now devotes full time to research, writing and consulting in nutrition, health and environmental issues. Her earlier publications include articles in science, genetics, and other journals. Her textbooks include *Nutrition Concepts and Controversies* 12th edn, *Understanding Nutrition* 12th edn, *Understanding Normal and Clinical Nutrition* 9th edn and *Nutrition and Diet Therapy* 7th edn, all with Cengage Wadsworth. She also recently co-authored *Priceless Florida* (Pineapple Press), a comprehensive text examining the ecosystems in her home state. Her additional interests include energy conservation, solar energy use, alternatively fuelled vehicles and ecosystem restoration.

**Sharon Rady Rolfes** received her MS in nutrition and food science from Florida State University. She is a founding member of Nutrition and Health Associates, an information resource centre that maintains a research database on over 1000 nutrition-related topics. Sharon's publications include the college textbooks *Understanding Nutrition* 12th edn and *Nutrition for Health and Health Care* 4th edn. In addition to writing and research, she occasionally teaches at Florida State University and serves as a consultant for various educational projects. Her volunteer work includes serving on the board of Working Well, a community initiative dedicated to creating a healthy workforce.

**Dr Tim Crowe** is an Advanced Accredited Practising Dietitian who has spent most of his career in the world of university nutrition teaching and research. He now works chiefly as a health and medical writer and scientific consultant and speaks on many health topics to the public through both the media, social media and writing for consumer publications.

**Dr Adam Walsh** is a Senior Lecturer in Nutrition and Dietetics in the School of Behavioural and Health Sciences at Australian Catholic University in Melbourne, and an Advanced Accredited Practising Dietitian. He teaches in the undergraduate and postgraduate nutrition and dietetics programs in the areas of clinical dietetics, nutritional physiology, and paediatric health. Adam's area of research is the influence of fathers on young children's nutrition and physical activity behaviours.



Compounds in garlic can help reduce blood pressure and improve cholesterol levels



# ACKNOWLEDGEMENTS

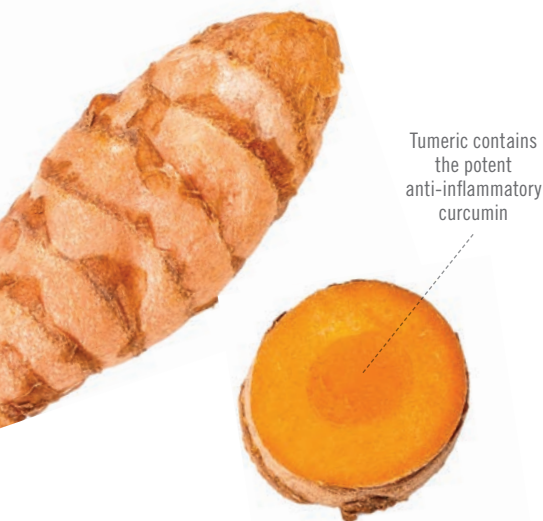
The adaptation and updating of this textbook has been a team effort with us all focused on improving a book that has been well-received throughout nutrition courses in Australia and New Zealand. Many thanks must go to the team of external reviewers who gave valuable feedback and advice on each of the chapters in order to improve the relevance of the text to the teaching of nutrition in Australia and New Zealand. The team at Cengage have been instrumental in guiding us through the entire process and have been a pleasure to work with through all stages of development. It is rewarding to see the text now in print after all our hard work.

**From Tim Crowe:** Many thanks go to my nutrition and dietetic friends and colleagues who have been down the publication path before and assured me that the late nights and long weekends of writing and proofing would be time well spent in producing a piece of work to be proud of. They were right.

**From Adam Walsh:** Thanks to my two wonderful boys for keeping me grounded and reminding me what life is all about. They have, on more than one occasion, reminded me that even though I'm the dietitian in the house, I'm still just Dad to them.

The authors and Cengage Learning would like to thank our reviewers who provided incisive and helpful feedback:

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- Chris Irwin – Griffith University, Gold Coast
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- Sophie Scott – Fitness Institute Australia.



# AN OVERVIEW OF NUTRITION

## Nutrition in your life

Believe it or not, you have probably eaten at least 20 000 meals in your life. Without any conscious effort on your part, your body uses the nutrients from those meals to make all its components, fuel all its activities and defend itself against diseases. How successfully your body handles these tasks depends, in part, on your food choices. Nutritious food choices support healthy bodies.

### PUTTING COMMON SENSE TO THE TEST


Circle your answer

- T** **F** For good health, it is best to avoid all processed foods.
- T** **F** Fat has twice the number of kilojoules as carbohydrates or protein.
- T** **F** All published research should be treated with some level of critical appraisal.
- T** **F** A Recommended Dietary Intake for a nutrient is the amount that everyone needs to consume each day.
- T** **F** Changing our diet will do little to reduce the risk of many chronic diseases.

### LEARNING OBJECTIVES


- |  |   |
|--|---|
| <p>1.1 Describe how various factors influence personal food choices.</p> <p>1.2 Name six major classes of nutrients and identify which are organic and which yield energy.</p> <p>1.3 Explain the scientific method and how scientists use various types of research studies and methods to acquire nutritional information.</p> | <p>1.4 Define the four categories of the Nutrient Reference Values (NRVs) and explain their purpose.</p> <p>1.5 Explain how the four nutrition assessment methods for an individual are used to detect energy and nutrient deficiencies and excesses.</p> <p>1.6 Identify several risk factors for chronic disease and explain their relationship.</p> <p>1.7 Recognise misinformation and describe how to identify reliable nutrition information.</p> |
|--|---|

Onions contain antioxidants and compounds that fight inflammation, decrease triglycerides and reduce cholesterol levels

 In general, a chronic disease progresses slowly or with little change and lasts a long time. By comparison, an acute disease develops quickly, produces sharp symptoms and runs a short course.

- *chronos* = time
- *acute* = sharp

Welcome to the world of **nutrition**. Although you may not always have been aware of it, nutrition has played a significant role in your life. And it will continue to affect you in major ways, depending on the **foods** you select.

Every day, several times a day, you make food choices that influence your body's health for better or worse. Each day's choices may benefit or harm your health only a little, but when these choices are repeated over years and decades, the rewards or consequences become major. That being the case, paying close attention to good eating habits now can bring health benefits later. Conversely, carelessness about food choices can contribute to many chronic diseases  prevalent in later life, including heart disease and cancer. Of course, some people will become ill or die young no matter what choices they make, and others will live long lives despite making poor choices. For most of us, however, the food choices we make each and every day will benefit or impair our health in proportion to the wisdom of those choices.

Although most people realise that their food habits affect their health, they often choose foods for other reasons. After all, foods bring to the table a variety of pleasures, traditions and associations as well as nourishment. The challenge, then, is to combine favourite foods and fun times with a nutritionally balanced **diet**.

## 1.1 Food choices

People decide what to eat, when to eat and even whether to eat in highly personal ways, often based on behavioural or social motives rather than on an awareness of nutrition's importance to health.

### Personal preference

As you might expect, the primary reason people choose foods is taste – they like certain flavours. Two widely shared preferences are for the sweetness of sugar and for the savouriness of salt. Liking high-fat foods also appears to be a universally common preference. Other preferences might be for the hot chilli common in Mexican cooking or the curry spices of Indian cuisine. Some research suggests that genetics may influence people's food preferences.<sup>1</sup>

### Hunger and satiety

People eat for a variety of reasons, but clearly hunger is a key driver of seeking food. Hunger is a physiological response to a need for food triggered by chemical messengers originating and acting in the brain. After a meal, the feeling of satiety suppresses hunger and allows a person to not feel the need to eat for a while. The complex interplay between hunger, hormones and the feeling of fullness are covered in greater depth in Section 8.2 of Chapter 8 which explores energy balance and body composition.

### Habit

People sometimes select foods out of habit. They eat cereal every morning, for example, simply because they have always eaten cereal for breakfast. Eating a familiar food and not having to make any decisions can be comforting. Similarly, people may find certain foods and beverages most appropriate at certain times of day – orange juice in the morning, for example.

### Ethnic heritage or tradition

Among the strongest influences on food choices are ethnic heritage and tradition. People eat the foods they grew up eating. Every country – and, in fact, every region of a country – has its own typical foods and ways of combining them into meals. The 'Australian diet' includes many

ethnic foods from various countries, such as Greece, Italy, Thailand and China, all adding **variety** to the diet. The New Zealand diet has been influenced by British, Pacific and, more recently, Asian migrants. Recent trends in the New Zealand diet include a reduction in beef, lamb and potatoes and an increase in poultry, pasta and rice, which reflects international food trends, food prices and ease of preparation.<sup>2</sup>

## Social interactions

Most people enjoy companionship while eating. It's fun to go out with friends for pizza or Thai. Meals are social events, and sharing food is part of hospitality. Social customs invite people to accept food or drink offered by a host or shared by a group regardless of hunger signals. Such social interactions can be a challenge for people trying to limit their food intake; Chapter 9 describes how people tend to eat more food when socialising with others. People also tend to eat the kinds of foods eaten by those in their social circles, thus helping to explain why obesity seems to spread in social networks and weight loss is easier with a partner.

## Marketing

The food industry competes for our food dollars, persuading consumers to eat more – more food, more often. These marketing efforts pay off well, generating billions of dollars in new sales each year. In addition to building brand loyalty, food companies attract busy consumers with their promises of convenience.

## Availability, convenience and economy

People eat foods that are accessible, quick and easy to prepare, and within their financial means. Today's consumers value convenience and are willing to spend more than half of their food budget on meals that require little, if any, further preparation. Consumers' food choices and behaviours shifted when the COVID-19 pandemic forced restaurants to close and trips to the supermarket were infrequent. But what was seen during this time was part of a long-growing trend where people would frequently eat out, bring home ready-to-eat meals or have food delivered. Even when they venture into the kitchen, they want to prepare a meal in 15 to 20 minutes, using fewer than half a dozen ingredients – and those 'ingredients' are often semi-prepared foods, such as canned soups. This emphasis on convenience limits food choices to the selections offered on menus and products designed for quick preparation. Whether decisions based on convenience meet a person's nutrition needs depends on the choices made. Eating a banana or a chocolate bar may be equally convenient, but the fruit offers more **vitamins** and **minerals** and less sugar and fat.

Given the abundance of convenient food options, fewer adults are learning the cooking skills needed to prepare meals at home, which has its downside. They are more likely to eat out where the choice is often low-cost fast-food outlets. People who are competent in their cooking skills eat more of their meals at home and tend to make healthier food choices.

## Positive and negative associations

People tend to like particular foods associated with happy occasions – such as meat pies at football games or cake at birthday parties. By the same token, people can develop aversions and dislike foods that they ate when they felt sick or that were forced on them.<sup>3</sup> Similarly, children learn to like and dislike certain foods when their parents use foods as rewards or punishments. Negative experiences can have long-lasting influences on food preferences.



An enjoyable way to learn about other cultures is to taste their ethnic foods.



To enhance your health, keep nutrition in mind when selecting foods.

## Emotions

Emotions are another factor that guide food choices and eating behaviours. Some people cannot eat when they are emotionally upset. Others may eat in response to a variety of emotional stimuli; such as, to relieve boredom or depression, or to calm anxiety. A lonely person may choose to eat rather than to call a friend. A person who has returned home from an exciting evening out may unwind with a late-night snack. These people may find emotional comfort, in part because foods can influence the brain's chemistry and the mind's response. Eating in response to emotions can easily lead to overeating and obesity, but it may be appropriate at times. For example, sharing food at times of grief serves both the giver's need to provide comfort and the receiver's need to be cared for and to interact with others, as well as to take nourishment.

## Values

Food choices may reflect people's religious beliefs, political views or environmental concerns. For example, many Christians forgo meat during Lent (the period prior to Easter), Jewish law includes an extensive set of dietary rules that govern the use of foods derived from animals, and Muslims fast between sunrise and sunset during Ramadan (the ninth month of the Islamic calendar). A concerned consumer may boycott fruit picked by migrant workers who have been exploited. People may buy vegetables from local farmers to save the fuel and environmental costs of foods shipped in from far away. They may also select foods packaged in containers that can be reused or recycled. Some consumers accept or reject foods that have been irradiated or genetically modified, depending on their approval of these processes (see Chapter 19 and Highlight 19 for a complete discussion).

## Body weight and health

Sometimes people select certain foods and supplements that they believe will improve their body weight, health or allergies and avoid those they believe might be detrimental. Such decisions can be beneficial when based on nutrition science, but decisions based on fads or carried to extremes undermine good health, as pointed out in later discussions of eating disorders (Highlight 8) and dietary supplements commonly used by athletes (Highlight 14).

## Nutrition and health benefits

Finally, of course, many consumers make food choices that will benefit their health. Making healthy food choices 100 years ago was rather easy; the list of options was relatively short, and markets sold mostly fresh, **whole foods**. Examples of whole foods include vegetables, legumes, fruits, seafood, meats, poultry, eggs, nuts, seeds, milk and whole grains. Today, tens of thousands of food items fill the shelves of super-grocery stores and most of those items are **processed foods**. Whether a processed food is a healthy choice depends, in part, on how extensively the food was processed. When changes are minimal, processing can provide an abundant, safe, convenient, affordable and nutritious product. Examples of minimally processed foods include frozen vegetables, fruit juices, smoked salmon, cheeses, and breads. The nutritional value diminishes, however, when changes are extensive, creating

### PUTTING COMMON SENSE TO THE TEST

For good health, it is best to avoid all processed foods.

**FALSE**

**ultra-processed foods.** Ultra-processed foods no longer resemble whole foods. They are made from substances that are typically used in food preparation but not consumed as foods themselves (e.g. oils, fats, flours, refined starches and sugars). These substances undergo further processing by adding little, if any, processed foods, salt and other preservatives, and additives such as flavours and colours. Examples of ultra-processed foods include soft drinks, corn chips, confectionery, chicken nuggets and pastries. Notably, these foods cannot be made in a home kitchen using common grocery ingredients. Dominating the global foods market, ultra-processed foods tend to be attractive, tasty and cheap – as well as high in fat and sugar. Consumers who want to make healthy food choices will select fewer ultra-processed foods and more whole foods and minimally processed foods.<sup>4</sup>

### CURRENT RESEARCH IN NUTRITION

#### The perils of highly processed foods

Do you believe the key to good health is to just cut out processed foods? The term ‘processed food’ may seem like a dietary demon that we need to avoid, but it is a concept that has little meaning and is unhelpful in informing food choices. Almost everything you eat is processed to an extent. Even cooking food is a form of food processing. A much more helpful concept is to divide food into categories based on their degree of processing. So, on the positive side think more of food that has been minimally processed and is still close to its natural state in appearance and nutritional quality. Here it is all about fruits vegetables, fruits, wholegrains, nuts, milk, fresh meats and legumes. And against that, we have the foods we should be most concerned about – ultra-processed foods.

Ultra-processed foods are industrial formulations of food-derived substances that contain little if any whole food. Ultra-processed foods often include ingredients not commonly used in home cooking such as flavourings, colourings, emulsifiers and other additives. A key feature of ultra-processed foods is that they are usually appetising and pleasing to the taste buds, convenient, sold in large packages and highly marketed.

Ultra-processed foods are the types of foods that are over-represented in the list of discretionary food choices. Such foods are not an essential part of a nutritious diet. Now nutritional researchers are linking these foods as a major driver of overweight and obesity, while also contributing to non-communicable diseases, such as heart disease, **type 2 diabetes** and certain cancers.

A recent systematic review and meta-analysis looked at the links between ultra-processed foods and chronic disease.<sup>5</sup> From 21 cross-sectional and 19 prospective studies, increasing consumption of ultra-processed foods was linked to a greater risk of overweight or obesity; metabolic syndrome; depression; cardiometabolic diseases, such as heart disease or diabetes; frailty; irritable bowel syndrome; cancer and all-cause mortality.

Most of the food we eat is processed to some degree. But it is only the foods considered to be ultra-processed that we should aim to eat less of. Eating food as close to its natural state as possible, making food from original ingredients and choosing a wide variety of mostly plant-based foods are the keys to eating a healthy diet.



A person selects foods for a variety of reasons. Whatever those reasons may be, food choices influence health. Individual food selections neither make nor break a diet's healthfulness, but the balance of foods selected over time can make an important difference to health. For this reason, people are wise to think 'nutrition' when making their food choices.



## 1.2 Nutrients

Biologically speaking, people eat to receive nourishment. Do you ever think of yourself as a biological being made of carefully arranged atoms, molecules, **cells**, tissues and organs? Are you aware of the activity going on within your body even as you sit still? The atoms, molecules and cells of your body continually move and change, even though the structures of your tissues

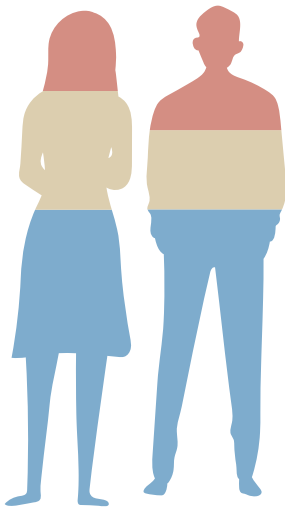


Shutterstock.com/Maridav

As Chapter 5 explains, most lipids are fats.

of the solid materials are **carbohydrates**, lipids and proteins. If you could remove these materials, you would find a tiny residue of vitamins, minerals and other compounds. Water, carbohydrates, lipids, proteins, vitamins and some of the minerals found in foods are nutrients – substances the body uses for the growth, maintenance and repair of its tissues.

**FIGURE 1.1** Body composition of healthy-weight men and women The human body is made of compounds similar to those found in foods – mostly water (60%) and some fat (13–21% for young men, 23–36% for young women who are of a healthy weight), with carbohydrate, protein, vitamins, minerals and other minor constituents making up the remainder. (Chapter 8 describes the health hazards of too little or too much body fat.)

**Key:**

- % Carbohydrates, proteins, vitamins, minerals in the body
- % Fat in the body
- % Water in the body

and organs and your external appearance remain relatively constant. To maintain your 'self', you must continually replenish, from foods, the **energy** and the **nutrients** you deplete as your body maintains itself.

## Nutrients in foods and in the body

Amazingly, our bodies can derive all the energy, structural materials and regulating agents we need from the foods we eat. This section introduces the nutrients that foods deliver and shows how they participate in the dynamic processes that keep people alive and well.

### Nutrient composition of foods

Chemical analysis of a food such as a tomato shows that it is composed primarily of water (95%). Most

This book focuses mostly on nutrients; however, foods contain other compounds as well, such as fibre, phytochemicals, pigments, additives, alcohols and others. Some are beneficial, some are neutral and a few are harmful. Later sections of the book touch on these compounds and their significance.

### Nutrient composition of the body

A complete chemical analysis of your body would show that it is made of materials similar to those found in foods (see Figure 1.1). A healthy 70 kilograms body contains about 41 kilograms of water and about 9 to 21 kilograms of fat. The remaining kilograms are mostly protein, carbohydrate and the major minerals of the bones. Vitamins, other minerals and incidental extras constitute a fraction of a kilogram.

### Chemical composition of nutrients

The simplest of the nutrients are the minerals. Each mineral is a chemical element; its atoms are all alike. As a result, its identity never changes; for example, iron may have different electrical charges, but individual iron atoms remain the same when they are in a food, when a person eats the food, when the iron becomes part of a red blood cell, when the cell is broken down and when the iron is lost from the body by excretion. The next simplest nutrient is water, a compound made of two elements – hydrogen and oxygen. Minerals and water are **inorganic** nutrients, which means they do not contain carbon.

The other four classes of nutrients – carbohydrates, lipids, proteins and vitamins – are more complex. In addition to hydrogen and oxygen, they all contain carbon, an element

found in all living things. They are therefore called **organic** compounds (meaning, literally, *alive*). Protein and some vitamins also contain nitrogen and may contain other elements as well (see Table 1.1). The use of the term ‘organic’ when describing the chemistry of substances should not be confused with the use of this term in the farming and produce sense to describe how food is grown under a certification system, as Chapter 19 explains.

**TABLE 1.1** Elements in the six classes of nutrients

Notice that organic nutrients contain carbon.

	CARBON	HYDROGEN	OXYGEN	NITROGEN	MINERALS
<b>Inorganic nutrients</b>					
Minerals					✓
Water		✓	✓		
<b>Organic nutrients</b>					
Carbohydrates	✓	✓	✓		
Lipids (fats)	✓	✓	✓		
Proteins <sup>a</sup>	✓	✓	✓	✓	
Vitamins <sup>b</sup>	✓	✓	✓		

<sup>a</sup> Some proteins also contain the mineral sulphur.

<sup>b</sup> Some vitamins contain nitrogen; some contain minerals.

## Essential nutrients

The body can make some nutrients, but it cannot make all of them. Also, it makes some in insufficient quantities to meet its needs and, therefore, must obtain these nutrients from foods. The nutrients that foods must supply are **essential nutrients**. When used to refer to nutrients, the word *essential* means more than just ‘necessary’; it means ‘needed from outside the body’ – normally from foods.

## Energy-yielding nutrients: carbohydrate, fat and protein

In the body, three organic nutrients can be used to provide energy: carbohydrate, fat and protein. In contrast to these **energy-yielding nutrients**, vitamins, minerals and water do not yield energy in the human body.

Carbohydrate, fat, and protein are sometimes called *macronutrients* because the body requires them in relatively large amounts (many grams daily). In contrast, vitamins and minerals are *micronutrients*, required only in small amounts (milligrams or micrograms daily).

Table 1.2 summarises some of the ways the six classes of nutrients can be described.

**TABLE 1.2** The six classes of nutrients

NUTRIENT	ORGANIC	INORGANIC	ENERGY-YIELDING	MACRONUTRIENT	MICRONUTRIENT
Carbohydrates	✓		✓	✓	
Lipids (fats)	✓		✓	✓	
Proteins	✓		✓	✓	
Vitamins	✓				✓
Minerals		✓			✓
Water		✓			



✿ The international unit for measuring food energy is the joule, a measure of work energy. The energy in food is normally expressed in kilojoules. To convert kilocalories to kilojoules, multiply by 4.2; to convert kilojoules to kilocalories, multiply by 0.24.

#### PUTTING COMMON SENSE TO THE TEST

Fat has twice the number of kilojoules as carbohydrates or protein.

**TRUE**

✿ The processes by which nutrients are broken down to yield energy or used to make body structures are known as *metabolism*, which is defined and described further in Chapter 7.

## Energy measured in kilojoules

The energy released from carbohydrates, fats and proteins can be measured in **joules**. ✿ In some countries (particularly the US), 'calorie' is still the preferred measure of food energy, though in this context it is actually kilocalories (or kcalories) that is the implied unit of energy measure for food and the prefix 'kilo' is normally dropped in everyday speaking. When you read in popular books or magazines that an apple provides '100 calories', it actually means 100 kcalories, which is the same as 420 kilojoules. This book uses the term kilojoules and its abbreviation kJ throughout.

## Energy from foods

The amount of energy a food provides depends on how much carbohydrate, fat and protein it contains. When completely broken down in the body, a gram of carbohydrate yields about 17 kilojoules (4 kcals) of energy, a gram of protein also yields 17 kilojoules (4 kcals) and a gram of fat yields 37 kilojoules (9 kcals) (see **Table 1.3**). Fat, therefore, has a greater **energy density** than either carbohydrate or protein. The energy yield from carbohydrate of 17 kilojoules per gram (kJ/g) is considered an average figure as monosaccharides (e.g. glucose), disaccharides (e.g. sucrose) and starch all yield slightly different amounts of energy per gram. The upcoming 'How to' box explains how to calculate the energy available from foods.

**TABLE 1.3** Kilojoule and kcalorie values of energy nutrients

Notice that organic nutrients contain carbon.

NUTRIENTS	ENERGY kJ/g	ENERGY kcal/g
Carbohydrate	17	4
Protein	17	4
Fat	37	9

Note: Alcohol contributes 29 kilojoules per gram that can be used for energy, but it is not considered a nutrient because it interferes with the body's growth, maintenance and repair.

One other substance contributes energy – alcohol. Alcohol is not considered a nutrient because it interferes with the growth, maintenance and repair of the body, but it does yield energy (29 kJ or 7 kcal per gram) when metabolised in the body. (Highlight 7 and Chapter 18 present the potential harms and possible benefits of alcohol consumption.)

Most foods contain all three energy-yielding nutrients as well as water, vitamins, minerals and other substances. For example, meat contains water, fat, vitamins and minerals as well as protein. Bread contains water, a trace of fat, a little protein and some vitamins and minerals in addition to its carbohydrate. Only a few foods are exceptions to this rule, the common ones being sugar (pure carbohydrate) and oil (essentially pure fat).

## Energy in the body

The body uses the energy-yielding nutrients to fuel all its activities. When the body uses carbohydrate, fat or protein for energy, the bonds between the nutrient's atoms break. As the bonds break, they release energy. ✿ Some of this energy is released as heat, but some is used to send electrical impulses through the brain and nerves, to synthesise body compounds and to move muscles. Thus the energy from food supports every activity, from quiet thought to vigorous sports.

If the body does not use these nutrients to fuel its current activities, it rearranges them into storage compounds (e.g. body fat), to be used between meals and overnight when fresh energy supplies run low. If more energy is consumed than expended, the result is an increase in energy stores and weight gain. Similarly, if less energy is consumed than expended, the result is a decrease in energy stores and weight loss.

When consumed in excess of energy needs, alcohol, too, can be converted to body fat and stored. When alcohol contributes a substantial portion of the energy in a person's diet, the

harm it does far exceeds the problems of excess body fat. (Highlight 7 describes the effects of alcohol on health and nutrition.)

### Other roles of energy-yielding nutrients

In addition to providing energy, carbohydrates, fats and proteins provide the raw materials for building the body's tissues and regulating its many activities. In fact, protein's role as a fuel source is relatively minor compared with the other two nutrients and its other roles. Proteins are found in structures such as the muscles and skin and help to regulate activities such as digestion and energy metabolism.

#### HOW TO: CALCULATE THE ENERGY AVAILABLE FROM FOODS

Practise calculating the energy available from foods.

- |  |  |
|--|--|
| <p>1. To calculate the energy available from a food, multiply the number of grams of carbohydrate, protein and fat by 17, 17 and 37, respectively. Then add the results together – e.g. 1 slice of bread with 1 tablespoon of peanut butter on it contains 16 grams carbohydrate, 7 grams protein and 9 grams fat.</p> | $16 \text{ g carbohydrate} \times 17 \text{ kJ/g} = 272 \text{ kJ}$<br>$7 \text{ g protein} \times 17 \text{ kJ/g} = 119 \text{ kJ}$<br>$9 \text{ g fat} \times 37 \text{ kJ/g} = 333 \text{ kJ}$<br><b>Total = 724 kJ</b> |
|--|--|

From the information you calculated in step 1, you can determine the percentage of kilojoules each of the energy nutrients contributes to the total.

- |   |   |
|---|---|
| <p>2. To determine the percentage of kilojoules from fat, for example, divide the 333 fat kilojoules by the total 724 kilojoules.</p> <p>3. Then multiply by 100 to get the percentage.</p> | $333 \text{ fat kJ} \div 724 \text{ total kJ} = 0.46$<br>$0.46 \times 100 = 46\%$ |
|---|---|

Dietary recommendations that urge people to limit fat intake to 20 to 35 per cent of kilojoules refer to the day's total energy intake, not to individual foods. Still, if the proportion of fat in each food choice throughout a day exceeds 35 per cent of kilojoules, then the day's total surely will, too. Knowing that this snack provides 46 per cent of its kilojoules from fat alerts a person to the need to make lower-fat selections at other times that day.



## Vitamins

**Vitamins** are organic but they do not provide energy. Instead, they facilitate the release of energy from carbohydrate, fat and protein and participate in numerous other activities throughout the body.

Each of the 13 different vitamins has its own special role to play. ☼ One vitamin enables the eyes to see in dim light, another helps produce functional red blood cells, and still another helps make the sex hormones – among other things. When you cut yourself, one vitamin helps stop the bleeding and another helps repair the skin. Vitamins busily help replace old red blood cells and the lining of the digestive tract. Almost every action in the body requires the assistance of vitamins.

Vitamins can function only if they are intact, but because they are complex organic molecules, they are vulnerable to destruction by heat, light and chemical agents. This is why the body handles them carefully, and why nutrition-wise cooks do, too. The strategies of cooking vegetables at moderate temperatures for short times and using small amounts of water help to preserve the vitamins.

☼ The water-soluble vitamins are vitamin C and the eight B vitamins: thiamin, riboflavin, niacin, vitamins B<sub>6</sub> and B<sub>12</sub>, folate, biotin and pantothenic acid. The fat-soluble vitamins are vitamins A, D, E and K. The water-soluble vitamins are the subject of Chapter 10, and the fat-soluble vitamins are discussed in Chapter 11.