the science of nutrition

Canadian Edition

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PEARSON
Toronto
Dedication

This book is dedicated to my amazing family, friends, and colleagues—you provide constant support, encouragement, and unconditional love. It is also dedicated to my students—you continue to inspire me, challenge me, and teach me. — JLT

This book is dedicated to my wonderful colleagues, friends, and family—your guidance, support, and understanding have allowed this book to happen. — MMM

This book is dedicated to my strong circle of family, friends, and colleagues. Year after year, your support and encouragement sustain me. — LAV

This book is dedicated to my family—it would never have been completed without your support and patience. — KGP

This book is dedicated to my family—your encouragement and support have motivated me to complete the project. — DM
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Janice Thompson earned a doctorate in exercise physiology and nutrition at Arizona State University. She is currently Professor of Public Health Nutrition at the University of Bristol in the Department of Exercise and Health Sciences and is also an adjunct faculty member at the University of New Mexico Health Sciences Center. Her research focuses on designing and assessing the impact of nutrition and physical activity interventions to reduce the risks for obesity, cardiovascular disease, and type 2 diabetes in high-risk populations. She also teaches nutrition and research methods courses and mentors graduate research students.

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Janice loves hiking, yoga, travelling, and cooking and eating delicious food. She likes almost every vegetable except fennel and believes chocolate should be listed as a food group.

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Melinda Manore earned a doctorate in human nutrition with a minor in exercise physiology at Oregon State University (OSU). She is the past chair of the Department of Nutrition and Food Management at OSU and is currently a professor in the Department of Nutrition and Exercise Sciences. Prior to her tenure at OSU, she taught at Arizona State University for 17 years. Melinda’s area of expertise is nutrition and exercise, especially the role of diet and exercise in health and prevention of chronic disease, exercise performance, weight control, and micronutrient needs. She has a special focus on the energy and nutritional needs of active women and girls across the life cycle.

Melinda is an active member of the Academy of Nutrition and Dietetics and the American College of Sports Medicine (ACSM). She is the past chair of the ADA Research Committee and the Research Dietetic Practice Group and
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Melinda is also a member of the American Society of Nutrition (ASN) and The Obesity Society and serves as chair of the USDA Nutrition and Health Committee for Program Guidance and Planning. Melinda writes the nutrition column and is an associate editor for the ACSM’s *Health and Fitness Journal*, serves on editorial boards of numerous research journals, and has won awards for excellence in research and teaching. She has also coauthored the Benjamin Cummings textbooks *Nutrition: An Applied Approach* and *Nutrition for Life* with Janice Thompson.

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Linda enjoys swimming, cycling, and baking bread in her free time.

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Preface

Nutrition is a dynamic, evolving, and exciting science. Learning about the scientific fundamentals of nutrition—the essential components of food and their functions in biological processes—can be challenging. Accordingly, we have designed this text’s organization and pedagogy to make the material accessible, and to engage nutrition and other health science majors.

Maintaining health and preventing chronic disease is a main theme of this text. By organizing the text’s contents around the functions of vitamins and minerals and their effects on the body we aim to help students appreciate that groups of micronutrients have crucial interconnected roles. In our teaching, we have found that this functional approach enhances understanding and discourages the simple rote memorization of lists of nutrients.

Students must be able to use scientific knowledge to assess diets, to evaluate research, and to appraise nutrition information. But to achieve these goals, they must learn about current scientific knowledge and how to evaluate future findings. Accordingly, the text emphasizes an evidence-informed approach to practice and promotes active learning through critical thinking. Each chapter incorporates Case Studies and Evidence-Informed Decision Making discussions to promote the development of these skills.

The Canadian Edition

Our primary goal in writing the Canadian edition of The Science of Nutrition was to create a reliable, accessible nutrition resource for Canadian students and instructors. Throughout the book you will find current Canadian material, including the following:

- Material from Eating Well with Canada’s Food Guide
- Canadian food regulations
- Canadian research and innovations
- Nutrition issues unique to Canadian populations
- Canadian data
- Canadian references
- Links to Canadian websites

Organization

The book is divided into 19 chapters plus 7 appendices (4 of which are in the printed book and 3 of which are available online).

In Chapter 1 we provide an introductory overview of how nutrition contributes to good health. After briefly describing the essential nutrients, we discuss current nutrition recommendations and how they are used in dietary assessment. We conclude the chapter with an overview of the scientific method where students are challenged to think critically about the nutrition information and advice provided by the media and on the internet.

In Chapter 2 we outline the key components of a healthy diet and introduce students to Eating Well with Canada’s Food Guide and to nutrition labelling rules and regulations.

In Chapter 3 we begin with a discussion about why we eat the foods that we do. Then we present an overview of the processes of digestion, absorption, and elimination of food and nutrients.
In Chapters 4, 5, and 6 we describe the macronutrients in detail. Each chapter includes a discussion of the important roles these nutrients play in the human body and a more detailed description of how they are digested, absorbed, and metabolized. Here we also discuss important food sources and the health-related disorders associated with particular nutrients.

In Chapter 7 we examine the metabolism of the macronutrients and their important role in energy production. We also include a discussion on the metabolic responses to feeding and fasting and the hormonal regulation of metabolism.

In Chapter 8 we present a brief introduction to the micronutrients, phytochemicals, and functional foods. This chapter sets the stage for a more detailed discussion of these nutrients in Chapters 9, 10, 11, 12, and 13. We have used a functional approach for the discussion of the essential micronutrients. In Chapter 9 we examine the nutrients involved in energy metabolism. In Chapter 10 we explore the various nutrients involved in fluid and electrolyte balance. Then, in Chapter 11, we move into a discussion of the nutrients involved in antioxidant function. Chapter 12 follows with a consideration of the nutrients involved in bone health. Chapter 13 closes this group of chapters with a discussion of the nutrients involved in blood health and immunity.

In Chapters 14 and 15 we explore the concepts of energy balance and weight control and the role of physical activity in achieving health. We discuss the various methods used to evaluate body weight and composition and the factors that contribute to excess body weight. We also consider strategies that can be used to achieve and maintain a healthy weight through diet and exercise.

In Chapters 16 through 18 we concentrate on nutrition issues through the lifecycle. We explore the role that food and nutrients play in the promotion of health from preconception to older adulthood, and we discuss nutrients and nutrition-related concerns in the various life stages.

In Chapter 19 we discuss the issues related to food security and insecurity in Canada and around the world. We look at the populations most affected by food insecurity and possible ways to address the problem.

**Special Features of This Canadian Edition**

Students learn effectively when they are interested, enthusiastic, and actively engaged. We have taken care to incorporate features that facilitate teaching and learning the science of nutrition.

- Each chapter opens with a brief quiz entitled **Test Yourself**. These true–false questions pique interest in the topics to be covered in the chapter by raising and dispelling some common misconceptions about nutrition. Answers to these questions are provided at the end of each chapter.

- **Chapter Objectives** follow the chapter-opening quiz and outline the knowledge and skills to be learned. By providing a roadmap at the beginning of each chapter, the Objectives will help students to read and understand the material more efficiently and more effectively.

- **Key Terms** are boldfaced in the body of the text where they are defined. They are also restated with their definitions in the margin. For convenience, they are also collected in a **Glossary** near the end of the book.

- **Did You Know?** boxes bring attention to important Canadian research and issues.

- **Highlight** boxes provide additional information about a particular topic.

- **Nutrition Label Activities** guide students in how to critically assess the information given in particular Canadian food labels.

- **Nutrition Myth or Fact?** boxes dispel common misconceptions and encourage students to critically evaluate information from advertising, mass media, and their peers.
• You Do the Math boxes provide examples and opportunities to work out quantitative calculations.

• A Case Study (with a set of Critical Thinking Questions) in each chapter presents a scenario that encourages students to apply the material they have learned in the chapter. All the Case Studies in the book are listed immediately following the Table of Contents.

• A See for Yourself box immediately preceding the Chapter Review offers brief, targeted activities that encourage active learning. This self-assessment feature provides students with the opportunity to learn about their own nutrition and health habits.

• A Chapter Review appears at the end of each chapter, and consists of the following elements:
  • Test Yourself Answers consisting of answers to the chapter-opening quiz.
  • A Summary that briefly reviews the key concepts of the chapter.
  • Review Questions that consist of multiple-choice and short-essay questions. Answers to all the Review Questions may be found near the end of the book.
  • Annotated Weblinks that help students start to explore particular topics in more detail.

• A robust Evidence-Informed Decision Making feature at the end of each chapter focuses on an important current issue. Here students are encouraged to think critically about the issue and to answer the Using the Evidence questions. All the Evidence-Informed Decision Making sections are listed immediately following the Table of Contents.

• For convenience, various Tables of Dietary Reference Intakes are given on the inside of the front and back covers.

Instructor Supplements

Instructor’s Resource CD-ROM

We have carefully prepared an Instructor’s Resource CD-ROM (ISBN: 978-0321-83711-0) to aid in presenting engaging lectures, providing additional activities, assessing students’ answers to all the questions in the book, and preparing tests and exams. It includes the following items:

• Instructor’s Manual that includes additional activities as well as answers to all the questions in the book (except for the answers to the Review Questions, which are given in the book itself).

• A Testbank available either in Word (called a Test Item File) or in a computerized format (called Pearson TestGen). Pearson TestGen is a powerful program that enables instructors to view and edit existing questions, create new questions, and generate quizzes, tests, exams, or homework. With Pearson TestGen instructors can also administer tests on a local area network, have the tests graded electronically, and have the results prepared in electronic or printed reports.

• PowerPoint Slides that can be used to help create lectures.

• An Image Library consisting of electronic files of all the figures and tables in the textbook.

CourseSmart eTextbook

The CourseSmart eTextbook (978-0321-62474-1) version of this book represents a new way for instructors and students to access textbooks online, anytime, from anywhere. With thousands of titles across hundreds of courses, CourseSmart helps instructors choose the best textbook for
their class and give their students a new option for buying the assigned textbook as an eTextbook at a lower cost. For more information, visit www.coursesmart.com.

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When we decided to take on the task of writing the Canadian edition of this text, we really had no idea how much work this would entail. There are a myriad of little details that needed to be attended to in addition to the gathering of information related to Canadian nutrition research and practice. We would like to thank our student assistant, Sarah Nabuurs, for helping us check all of those details and for asking us questions from a student’s point of view, which has made this book more student-centred. We would also like to thank the students in our introductory nutrition classes who have helped us test out some of our ideas and provided us with valuable feedback. We would like to thank all of the wonderful staff at Pearson for their dedication and commitment to this book. They are an incredibly professional group of individuals and we are extremely grateful to them for their patience and guidance. In particular, our developmental editor, Maurice Esses, provided us with invaluable support and encouragement throughout the writing process. His attention to detail and critical eye kept us on track and helped us to make improvements along the way. Finally, we would like to thank our colleagues, friends, and family members who have motivated us to keep going. This really has been a team effort.

Kathy Gottschall-Pass
Debbie L. MacLellan
MasteringNutrition®

MasteringNutrition (www.masteringnutrition.pearson.com) is a course management system that makes it easy to organize your class, personalize your students’ educational experience, and push their learning to the next level.

Designed to help you maximize class time, MasteringNutrition offers customizable, easy-to-assign and automatically graded assessments and pedagogical tools that motivate students to learn outside of class, and arrive prepared for lecture.

Developed by science educators for science students and professors, the Mastering platform has over one million active users, and a proven history with over 9 years of student use in 30 countries.

Assignable Content

With MasteringNutrition, you can assign publisher-created pre-built assignments—pre-lecture tests, NutriCase Studies, and testbank questions—to get started quickly. You can import your own questions, and edit any of our questions or answers to match the precise language that you use.

The system automatically grades every assignment that features machine-graded questions (multiple choice and fill-in-the-blank), and students’ results appear in the gradebook. Note that instructor-graded questions (short answer and essay questions) must be graded by the professor.

NutriTools

Students can experiment with 21 NutriTools—Build-a-Salad, Build-a-Pizza, Build-a-Meal, and more—to combine different food options, and thereby learn how to create healthier meals. NutriTools activities offer assignable questions.

Build a Sandwich
Animations

Pre-Lecture Quiz
Ensure that students come to lectures prepared by assigning a Pre-Lecture Quiz featuring multiple choice, fill-in-the-blank, and short answer questions based on chapter content.

Pearson Science of Nutrition eText

- **Highlight** function allows students to highlight whatever they want to remember.
- **Google®-based search function.**
- **Zoom** lets students zoom in and out for better viewing.
- **Hyperlinks** link to quizzes, activities, and animations.
- **Notes** give you, the educator, the opportunity to push out any content that you highlight and notes to your class.
- **Annotation** function provides students with the opportunity to take notes.
NutriCase Studies
These audio case studies walk listeners through a real life nutrition challenge, and pose compelling questions that apply the chapter concepts to the case study. NutriCase Studies feature assignable multiple choice and true-false questions.

Study Area
The Study Area of MasteringNutrition offers a plethora of resources that allow students to assess their knowledge of the material, and their progress.

Prep Materials
Students have access to Get Ready for Nutrition, which features extra math and chemistry content related to nutrition.

Cumulative Exam
Students can assemble their own practice cumulative exam by selecting the chapters they want to test their knowledge, and the number of questions per chapter. The system then draws on a variety of questions. Note that these questions are different than the ones offered in the test bank to which you have access. MasteringNutrition automatically grades answers, so students can get feedback and check their understanding right away.

Gradebook
Get easy-to-interpret insights into students performance using the gradebook. MasteringNutrition automatically grades every assignment that features machine-grade questions. At a glance, you can see vulnerable students and challenging assignments.

The gradebook’s diagnostics provide unique insight into the class, and student performance. Charts summarize the most difficult problems, students-at-risk, grade distribution, and score improvement over the duration of the course.

Instructor Resources

Study on the Go
Students will find a unique QR code featured at the end of each chapter that provides access to Study on the Go, an unprecedented mobile integration between text and online content. Students link to Pearson’s unique Study on the Go content directly from their smartphones, allowing them to study whenever and wherever they wish! Go to one of the sites below to see how to download an app to your smartphone for free. Once the app is installed, the phone will scan the code and link to a website containing Pearson’s Study on the Go content, including the popular study tools Glossary Flashcards, Animations, and Quizzes, which can be accessed anytime.

ScanLife
http://get.scanlife.com/
NeoReader
http://get.neoreader.com/
QuickMark
http://www.quickmark.com.tw/
MyDietAnalysis

Accessible via MasteringNutrition, MyDietAnalysis offers an accurate, reliable, easy-to-use program that helps students assess their lifestyles. Featuring a database of nearly 20,000 foods, the program assists in the tracking of diet and activity levels. Students can generate and submit reports electronically.
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