Preface

Welcome to the international sixth edition of *Biochemistry: The Molecular Basis of Life*. Although this textbook has been revised and updated to reflect the latest research in biochemistry, our original mission remains unchanged. We continue to believe that the cornerstone of an education in the life sciences is a coherent understanding of the basic principles of biochemistry. Once biochemical concepts have been mastered, students are then prepared to tackle the complexities of their chosen science fields. To that end, we have sought comprehensive coverage of biochemical systems, structures, and reactions, but within the context of the organism. We have thus sought a unique balance between chemistry, biology, and their applications to medicine and human health.

ORGANIZATION AND APPROACH

CHEMICAL AND BIOLOGICAL PRINCIPLES IN BALANCE. As with previous editions, the international sixth edition is designed for both life science students and chemistry majors. We provide thorough coverage of biochemical principles, structures, and reactions, but within a biological context that emphasizes their relevance.

A REVIEW OF BASIC PRINCIPLES. Few assumptions have been made about a student's chemistry and biology background. To ensure that all students are sufficiently prepared for acquiring a meaningful understanding of biochemistry, the first four chapters review the principles of such topics as organic functional groups, noncovalent bonding, thermodynamics, and cell structure. These chapters can either be covered in class or assigned for self-study.

Several topics are introduced in these early chapters and then continued throughout the book. Examples include cell volume changes triggered by metabolic processes that alter osmotic balance across membranes, the self-assembly of biopolymers such as proteins into supermolecular structures, and the nature and function of molecular machines. New in this edition is coverage of proteostasis, the mechanism whereby cells protect their proteins. Other important concepts that are emphasized include the relationship between biomolecular structure and function and the dynamic, unceasing, and self-regulating nature of living processes. Students are also provided with overviews of the major physical and chemical techniques that biochemists have used to explore life at the molecular level.

REAL-WORLD RELEVANCE. Because students who take the one-semester biochemistry course come from a range of backgrounds and have diverse career goals, the international sixth edition consistently demonstrates the fascinating connections between biochemical principles and the worlds of medicine, nutrition, agriculture, bioengineering, and forensics. Features such as the Biochemistry in Perspective essays, as well as dozens of examples integrated into the body of the text, help students see the relevance of biochemistry to their chosen fields of study.

SUPERIOR PROBLEM-SOLVING PROGRAM. Analytical thinking is at the core of the scientific enterprise, and mastery of biochemical principles requires consistent and sustained engagement with a wide range of problems. The international sixth edition continues to present students with a complete problem-solving system. This

includes the effective in-chapter worked problems, which illustrate how quantitative problems are solved, as well as dozens of practice questions throughout, when new concepts and high-interest topics are introduced. There is also a large set of end-of-chapter questions. These include review and thought questions, which will allow students to test their knowledge.

SIMPLE, CLEAR ILLUSTRATIONS. Biochemical concepts often require a high degree of visualization, and we have crafted an art program that brings complex processes to life. There are many newly enhanced for a more vivid presentation in three dimensions and consistent scale and colour of chemical structures.

CURRENCY. The international sixth edition has been updated to present recent developments in the field, while remaining focused on the 'big-picture' principles that are the cornerstone of the one-term biochemistry course. These changes again reflect the goal of balanced and thorough coverage of chemistry within a biological context. A detailed list of updated material follows in the next section.

NEW IN THIS EDITION

As a result of the rapid pace of discovery in the life sciences and our commitment to provide students with the highest-quality learning system available in any biochemistry textbook, we have revised the international sixth edition in the following ways:

- **New and Updated Applications.** The international sixth edition includes a new Biochemistry in Perspective essay, 'The Artificial Leaf: Biomimetic Photosynthesis', which will capture student interest. In addition, several essays have been updated to reflect recent research. These include 'Myocardial Infarct: Ischaemia and Reperfusion', 'Atherosclerosis', 'Diabetes Mellitus', and 'HIV Infection'.
- **Expanded Problem-Solving Program.** The international sixth edition includes additional questions at the end of the chapters. The expanded problem sets span a range of difficulty, from basic practice problems to more challenging integrative exercises.
- **Brand-New Illustrations.** The international sixth edition incorporates a superior and expanded art program designed to help students develop a strong visual grasp of biochemical processes. Many figures have been enhanced for vivid, clear, and consistent presentation in colour and three dimensions.
- **Important Themes.** We have retained and strengthened the themes of macromolecular crowding and systems biology, introduced in the fourth edition, and introduced a new theme, referred to as proteostasis.
  - Macromolecular crowding, the dense packing of vast numbers of proteins and other molecules within cells, has a profound effect on a wide variety of living processes. The concept of macromolecular crowding provides students with a more realistic view of cell structure and function.
  - The relatively new field of systems biology is an approach to biochemical processes that is based on engineering principles. Developed in response to the overwhelmingly vast amounts of information now available to life scientists, systems biology is the computer-assisted investigation of the complex interactions among biomolecules. Our accessible introduction to systems biological principles provides students with newly revised and expanded insights into the basic patterns of biomolecular processes.

- We offer new coverage of proteostasis, a diverse set of mechanisms whereby cells control the folding of the proteome, which has a crucial impact on cellular processes such as gene expression and signalling pathways. It protects against the toxic effects of protein aggregation.

- **Increased Attention to Reaction Mechanisms.** Catalytic mechanisms provide students with an enhanced understanding of the means by which biochemical reactions occur. Examples include the rubisco and proline residue hydroxylation mechanisms. We have retained a description of the roles of amino acid side chains in the catalytic mechanisms of enzymes and the mechanisms of the nucleic acid polymerases and ribosome-catalysed peptide bond formation. Here, too, we have sought to enhance the text's unique balance between chemistry and biology.

- **Current Topics.** The following is a list of some, but not all, of the updated content that has been introduced in the international sixth edition:

  - **Chapter 1** contains a revision of the section devoted to systems biology. Explanations of the terms *network*, *module*, and *motif* facilitate students' efforts to understand biochemical principles.

  - **Chapter 2** contains an expanded basic themes section. The signal transduction section includes overviews of the role of calcium ions in signalling and the relationship between signalling, metabolism, and gene expression. A new basic theme, proteostasis, provides an introduction to the strategies that cells use to protect the integrity of their proteins. A newly revised discussion of the endomembrane system in eukaryotic cells provides insight into the relationship between cell architecture and biochemical functions such as signalling, protein processing, and gene expression. A revised section concerned with mitochondria includes descriptions of the effects of the ER-mitochondrial interactions on cell signalling and phospholipid synthesis. The Biochemistry in Perspective essay on primary cilia has been updated. The Biochemistry in the Lab reading now includes a brief description of live cell imaging.

  - In **Chapter 5** the section devoted to unstructured proteins has been expanded to include p53, a major tumour suppressor protein with an unstructured domain. The discussion of molecular chaperones, proteins that have a central role in proteostasis, has been expanded and updated. The description of haemoglobin allostery has been revised to improve clarity. The Biochemistry in the Lab reading on protein technology has been expanded to include the use of affinity chromatography in the purification of recombinant proteins and the use of top-down mass spectrometry and NMR spectroscopy in protein structure analysis.

  - The discussion of transition state stabilization in **Chapter 6** has been revised using triose phosphate isomerase as an example.

  - The section in **Chapter 8** devoted to glycolysis regulation has been expanded with a description of glucose-induced gene expression.

  - A revised and updated Biochemistry in Perspective reading in **Chapter 10** describes the biochemical consequences of the reintroduction of oxygen to heart cells damaged by clot-induced inadequate blood flow.

  - In **Chapter 11** the discussion of the plasma membrane protein CFTR has been updated to include a brief overview of the clinical use of molecules that improve folding and/or function of the receptor in cystic fibrosis patients.

- In **Chapter 12** the section devoted to lipolysis in adipocytes has been revised to reflect recent discoveries concerning the roles of perilipin A and several enzymes. The Biochemistry in Perspective reading on atherosclerosis now includes a description of the consequences of AGE formation in endothelial cells.
- In **Chapter 13** a new Biochemistry in Perspective reading, 'The Artificial Leaf', describes the attempts of researchers to imitate natural photosynthesis for fuel synthesis.
- The discussion of nitrogen fixation in **Chapter 14** has been revised to reflect recent discoveries. The transamination reaction mechanism figure has been modified to improve clarity.
- In **Chapter 15** the section devoted to the ubiquitin proteasomal system has been revised to increase clarity.
- The section devoted to cell surface receptor function in **Chapter 16** has been revised and expanded. The Biochemistry in Perspective reading on diabetes mellitus has been updated.
- In **Chapter 17** the section devoted to histones and chromatin structure has been revised to improve clarity and expanded to include recent research. Descriptions of noncoding DNA in the human genome have been updated. In the Biochemistry in the Lab reading devoted to nucleic acid methods, descriptions of Illumina and ion torrent DNA sequencing have been added. The description of ncRNAs has been revised. The Biochemistry in Perspective on HIV infection has been updated.
- In the Biochemistry in the Lab on genomic methods in **Chapter 18**, the description of genome projects has been updated with an introduction to ENCODE (the Encyclopedia of DNA Elements). The discussion of eukaryotic RNA polymerase II now includes a brief description of transcription factories in the nucleus. The section devoted to eukaryotic transcription and posttranscriptional processing has been revised and expanded to reflect recent discoveries.
- A new section of **Chapter 19** describes the proteostasis network, which protects the integrity of proteins from their synthesis through folding, transport, and degradation when they are damaged or obsolete. The discussion includes brief descriptions of the heat shock response and the role of the proteostasis network in several human diseases.

LEARNING PACKAGE

We have created a comprehensive set of additional resources to accompany the international sixth edition. These are designed to help students master the subject matter and to assist instructors in meeting this objective. Instructors have access to lecture notes, PowerPoint slides, and test bank questions through the Online Resource Centre (www.oxfordtextbooks.co.uk/orc/mckee6e). Students and instructors both have access to the new International Sixth Edition website (www.oup.com/mckee-xse), where students may take web quizzes and view interactive 3-D illustrations of molecules.

For Students

STUDENT SOLUTIONS MANUAL. Written by the textbook authors, this manual provides the solutions to all of the exercises from the text that are not included in the book itself. Each solution has been independently checked for accuracy by a panel of expert reviewers.

ACKNOWLEDGMENTS

We wish to express our appreciation for the efforts of the dedicated individuals who provided detailed content and accuracy reviews of the text and the supplemental materials of the international sixth edition:

Erika L. Abel—Baylor University
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Sandra L. Barnes—Alcorn State University
Ruth Birch—Saint Louis University
Karl Bishop—Husson University
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Kyle Murphy—Rutgers University
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We would also like to thank the individuals who reviewed the previous editions of this text:

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Laura S. Zapanta—University of Pittsburgh

We also wish to express our appreciation to Jason Noe, senior editor; Lauren Mine, developmental editor; Andrew Heaton, assistant editor; David Jurman, marketing manager; Frank Mortimer, director of marketing; Patrick Lynch, editorial director; and John Challice, vice president and publisher. The excellent efforts of the Oxford University Press production team are gratefully acknowledged. We are especially appreciative of the efforts of David Bradley, senior production editor; Lisa Grzan, production manager; and Michele Laseau, art director. We give a very special thank you to Susan Brown, whose consistent diligence on this project has ensured the accuracy of the text.

We wish to extend our deep appreciation to those individuals who have encouraged us and made this project possible: Ira and Jean Cantor and Josephine Rabinowitz. Finally we thank our son, James Adrian McKee, for his patience and encouragement.

Trudy McKee
James R. McKee