

Preface

This text is intended for students in any field of science or engineering who want a one-semester introduction to biochemistry but who do not intend to be biochemistry majors. Our main goal in writing this book is to make biochemistry as clear and applied as possible and to familiarize science students with the major aspects of biochemistry. For students of biology, chemistry, physics, geology, nutrition, sports physiology, and agriculture, biochemistry impacts greatly on the content of their fields, especially in the areas of medicine and biotechnology. For engineers, studying biochemistry is especially important for those who hope to enter a career in biomedical engineering or some form of biotechnology.

Students who will use this text are at an intermediate level in their studies. A beginning biology course, general chemistry, and at least one semester of organic chemistry are assumed as preparation.

What's New

All textbooks evolve to meet the interests and needs of students and instructors and to include the most current information. Several changes mark this edition.

Biochemistry Hot Topics This magazine insert features up-to-date articles on new breakthroughs and topics in the area of biochemistry such as stem cells, malaria, the breast cancer gene (BRCA), aging, happiness, and more!

Innovative and New Presentation of Biochemical Connections. Plus Many New Topics! In response to customers' demand for more Biochemical Connection boxes, we have added several new boxes to the text. See a full listing of Biochemical Connections boxes in the Table of Contents. Biochemical Connections cover a variety of important concepts and new research. They are now flowed in with the narrative and are placed exactly where they need to be read in each chapter. And although they have a different presentation than the rest of the narrative, they are meant to be read with the narrative and should not be skipped. They are like crescendos in classical music—the change in tempo from the usual narrative to the unique visual presentation and voice of the Biochemical Connections prevents the student's level of interest from dipping—students are always engaged.

New Marginal Glossary! No more flipping back and forth to read full definitions of key terms. Terms are now defined in the margins.

Updated Coverage Each chapter in the text has been updated with the current developments and scientific findings in the biochemistry field.

Table of Changes by Chapter

Chapter 1	Revised material on classification schemes based on kingdoms and domains, one new EOC exercise	
Chapter 2	Expanded section on types of intermolecular forces, eight new EOC exercises	
Chapter 3	Revised material on peptide hormones, eight new EOC exercises	
Chapter 4	Deleted Biochemical Connections box on nutrition, added Biochemical Connections box on sickle cell anemia, six new EOC exercises	
Chapter 5	Added new section on protein identification techniques, added new section on proteomics using material from previous edition's Biochemical Connections box, eight new EOC exercises	
Chapter 6	Reversed order of Sections 6-5 and 6-6, expanded section on inhibition to include uncompetitive and mixed inhibition, deleted Biochemical Connections box on enzymes and memory, simplified section on Michaelis-Menten derivation, added section on kinetics with multiple substrates, added ten new EOC exercises	
Chapter 7	New Biochemical Connections box on medicinal effects of a compound from the willow tree, four new EOC exercises	
Chapter 8	New material on lipid composition of intracellular membranes, added material on membranes in drug delivery, discussion of tyrosine kinases as membrane receptors related to Hot Topics article on G-protein-coupled receptors, four new EOC exercises	
Chapter 9	Deleted Biochemical Connections box on the DNA family tree	
Chapter 10	Expanded material on the replisome, expanded material on double-stranded breaks in DNA repair, eight new EOC exercises	
Chapter 11	Expanded material on operons, added material on the role of mediator in eukaryotic transcription, added material on chromatin remodeling and histone modifying enzymes, deleted Biochemical Connections box on TFIIF, expanded material on micro RNA and RNA interference, added new Biochemical Connections box on epigenetics, deleted Biochemical Connections box on transcriptional proofreading, nineteen new EOC exercises	
Chapter 12	Added new Biochemical Connections box on virology and how the flu can alter the reading frame of translation, material on selenocysteine	
		removed from a Biochemical Connections box and put into the main chapter, added new material on start codon in immune system, added material on how the ribosome is involved in protein folding, eight new EOC exercises
		Chapter 13 Modified section on Flavr Savr tomatoes in Biochemical Connections box, deleted Biochemical Connections box on RNA interference
		Chapter 14 Added a new section on AIDS, deleted two Biochemical Connections boxes on the flu, both of which were moved to a Hot Topics article, added a new Biochemical Connections box on vaccines, nine new EOC exercises
		Chapter 15 Revised treatment of coupling of reactions in bioenergetics, six new EOC exercises
		Chapter 16 Discussion of soluble vs. insoluble fiber, expanded treatment of oligosaccharides in blood type determinants, four new EOC exercises
		Chapter 17 Discussion of Warburg effect and carbohydrate metabolism in cancer cells, extended discussion on hormonal control in carbohydrate metabolism, four new EOC exercises
		Chapter 18 Added discussion of reciprocal regulation and hormonal control of carbohydrate metabolism, six new EOC exercises
		Chapter 19 New box on use of labeling to determine the origin of CO ₂ released by citric acid cycle, added material on substrate-level phosphorylation, two new EOC exercises
		Chapter 20 Condensation of material of historic interest to sharpen focus of discussion of electron transport chain, three new EOC exercises
		Chapter 21 New material on hormonal control of appetite, five new EOC exercises
		Chapter 22 Updated box on anti-malarial plants to correlate with Hot Topics article on malaria, updated box on chloroplast genes to include epigenetic mechanisms of control
		Chapter 23 New material on possible roles of S-adenosylmethionine in the nitrogenase reaction and in histone methylation
		Chapter 24 Expanded material on obesity, added Biochemical Connections box on obesity, diabetes, and cancer, deleted Biochemical Connections box on aging (moved to Hot Topics), six new EOC exercises

New Design and Enhanced Labeling in Art Updated labeling in the illustrations throughout the text increases readability, which in turn enhances students' ability to comprehend key concepts. As a corollary to the book's updated art program, the design and color palette have also been modernized.

Proven Features

Visual Impact Ideal for visual learners, this book's state-of-the-art approach helps students visualize key processes and understand important topics.

Biochemical Connections The Biochemical Connections highlight special topics of particular interest to students. Topics frequently have clinical implications, such as cancer, AIDS, and nutrition. These essays help students make the connection between biochemistry and the real world.

Apply Your Knowledge The Apply Your Knowledge boxes are interspersed within chapters and are designed to provide students with problem-solving experience. The topics chosen are areas of study where students usually have the most difficulty. *Solutions* and *problem-solving strategies* are included, giving examples of the problem-solving approach for specific material.

Early Inclusion of Thermodynamics Select material on thermodynamics appears much earlier in the text. Chapter 1 includes sections on *Energy and Change*, *Spontaneity in Biochemical Reactions*, and *Life and Thermodynamics*. Also, Chapter 4 contains an extended section on *Protein Folding Dynamics*. We feel it is critical that students understand the driving force of biological processes and see that so much of biology (protein folding, protein-protein interactions, small molecule binding, etc.) is driven by the favorable disordering of water molecules.

Summaries and Questions Each chapter closes with a concise summary, a broad selection of questions, and an annotated online bibliography. As stated previously, the summaries have been completely revised to reflect the in-text “Q & A” framework. The number of questions has been expanded to provide additional self-testing of content mastery and more homework material. These exercises fall into four categories: *Recall*, *Reflect and Apply*, *Biochemical Connections*, and *Mathematical*. The *Recall* questions are designed for students to quickly assess their mastery of the material, while the *Reflect and Apply* questions are for students to work through more thought-provoking questions. *Biochemical Connections* questions test students on the *Biochemical Connections* essays in that chapter. The *Mathematical* questions complete the selection of exercises. These questions are quantitative in nature and focus on calculations.

Organization

Because biochemistry is a multidisciplinary science, the first task in presenting it to students of widely varying backgrounds is to put it in context. Chapters 1 and 2 provide the necessary background and connect biochemistry to the other sciences. Chapters 3 through 8 focus on the structure and dynamics of important cellular components. Molecular biology is covered in Chapters 9 through 14. The final part of the book is devoted to intermediary metabolism.

Some topics are discussed several times, such as the control of carbohydrate metabolism. Subsequent discussions make use of and build on information students have already learned. It is particularly useful to return to a topic after students have had time to assimilate and reflect on it.

The first two chapters of the book relate biochemistry to other fields of science. Chapter 1 deals with some of the less obvious relationships, such as the connections of biochemistry with physics, astronomy, and geology, mostly in the context of the origins of life. Functional groups on organic molecules are discussed from the point of view of their role in biochemistry. This chapter goes on to the more readily apparent linkage of biochemistry with biology, especially with respect to the distinction between prokaryotes and eukaryotes, as well as the role of organelles in eukaryotic cells. Chapter 2 builds on material familiar from general chemistry, such as buffers and the solvent properties of water, but emphasizes the biochemical point of view toward such material.

Chapters 3 through 8, covering the structure of cellular components, focus on the structure and dynamics of proteins and membranes in addition to giving an introduction to some aspects of molecular biology. Chapters 3, 4, 6, and 7 deal with amino acids, peptides, and the structure and action of proteins, including enzyme

Table of Changes by Chapter

Chapter 1	Revised material on energy (on thermodynamics and thermodynamic laws)
Chapter 2	Expanded section on chemical equilibrium, chemical equilibrium constants, and Le Chatelier's principle
Chapter 3	Revised material on chemical equilibrium (on thermodynamics and chemical equilibrium constants)
Chapter 4	Revised material on chemical equilibrium (on thermodynamics and chemical equilibrium constants)
Chapter 5	Added new material on protein structure (on protein structure and protein function)
Chapter 6	Revised material on chemical equilibrium (on thermodynamics and chemical equilibrium constants)
Chapter 7	Revised material on chemical equilibrium (on thermodynamics and chemical equilibrium constants)
Chapter 8	Revised material on chemical equilibrium (on thermodynamics and chemical equilibrium constants)
Chapter 9	Revised material on chemical equilibrium (on thermodynamics and chemical equilibrium constants)
Chapter 10	Revised material on chemical equilibrium (on thermodynamics and chemical equilibrium constants)
Chapter 11	Revised material on chemical equilibrium (on thermodynamics and chemical equilibrium constants)
Chapter 12	Revised material on chemical equilibrium (on thermodynamics and chemical equilibrium constants)

catalysis. Chapter 4 includes more material on thermodynamics, such as hydrophobic interactions. Chapter 5 focuses on techniques for isolating and studying proteins. The discussion of enzymes is split into two chapters (Chapters 6 and 7) to give students more time to fully understand enzyme kinetics and enzyme mechanisms. Chapter 8 treats the structure of membranes and their lipid components.

Chapters 9 through 14 explore the topics of molecular biology. Chapter 9 introduces the structure of nucleic acids. In Chapter 10, the replication of DNA is discussed. Chapter 11 focuses on transcription and gene regulation. This material on the biosynthesis of nucleic acids is split into two chapters to give students ample time to appreciate the workings of these processes. Chapter 12 finishes the topic with translation of the genetic message and protein synthesis. Chapter 13 focuses on biotechnology techniques, and Chapter 14 deals with viruses, cancer, and immunology.

Chapters 15 through 24 explore intermediary metabolism. Chapter 15 opens the topic with chemical principles that provide some unifying themes. Thermodynamic concepts learned earlier in general chemistry and in Chapter 1 are applied specifically to biochemical topics such as coupled reactions. In addition, this chapter explicitly makes the connection between metabolism and electron transfer (oxidation-reduction) reactions.

Coenzymes are introduced in this chapter and are discussed in later chapters in the context of the reactions in which they play a role. Chapter 16 discusses carbohydrates. Chapter 17 begins the overview of the metabolic pathways by discussing glycolysis. Discussion of glycogen metabolism, gluconeogenesis, and the pentose phosphate pathway in Chapter 18 provides a base for treating control mechanisms in carbohydrate metabolism. Discussion of the citric acid cycle is followed by the electron transport chain and oxidative phosphorylation in Chapters 19 and 20. The catabolic and anabolic aspects of lipid metabolism are dealt with in Chapter 21. In Chapter 22, photosynthesis rounds out the discussion of carbohydrate metabolism. This chapter goes into the plant origin of antimalarials and has a connection to the Hot Topic of malaria. Chapter 23 completes the survey of the pathways by discussing the metabolism of nitrogen-containing compounds such as amino acids, porphyrins, and nucleobases. Chapter 24 is a summary chapter. It gives an integrated look at metabolism, including a treatment of hormones and second messengers. The overall look at metabolism includes a brief discussion of nutrition and a somewhat longer one of the immune system.

This text gives an overview of important topics of interest to biochemists and shows how the remarkable recent progress of biochemistry impinges on other sciences. The length is intended to provide instructors with a choice of favorite topics without being overwhelming for the limited amount of time available in one semester.

Alternative Teaching Options

The order in which individual chapters are covered can be changed to suit the needs of specific groups of students. Although we prefer an early discussion of thermodynamics, the portions of Chapters 1 and 4 that deal with thermodynamics can be covered at the beginning of Chapter 15, "The Importance of Energy Changes and Electron Transfer in Metabolism." All of the molecular biology chapters (Chapters 9 through 14) can precede metabolism or can follow it, depending on the instructor's choice. The order in which the material on molecular biology is treated can be varied according to the preference of the instructor.

Supporting Materials

Please visit <http://www.cengage.com/chemistry/campbell/biochemistry8e> for information about student and instructor resources for this text.

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Alternative Teaching Options

The order of chapters in this book is designed to be flexible. Instructors may choose to teach the chapters in a different order, or to skip certain chapters altogether. The following are some suggestions for alternative teaching options:

- Chapter 1: Introduction to the Book** - This chapter provides an overview of the book and its goals. It can be taught at the beginning of the course, or skipped if time is short.
- Chapter 2: The History of the Book** - This chapter provides a brief history of the book and its development. It can be taught at the beginning of the course, or skipped if time is short.
- Chapter 3: The Structure of the Book** - This chapter provides a detailed overview of the book's structure and organization. It can be taught at the beginning of the course, or skipped if time is short.
- Chapter 4: The Writing Process** - This chapter provides a detailed overview of the writing process, from research to editing. It can be taught at the beginning of the course, or skipped if time is short.
- Chapter 5: The Publishing Process** - This chapter provides a detailed overview of the publishing process, from manuscript to final book. It can be taught at the beginning of the course, or skipped if time is short.
- Chapter 6: The Marketing Process** - This chapter provides a detailed overview of the marketing process, from promotion to distribution. It can be taught at the beginning of the course, or skipped if time is short.
- Chapter 7: The Future of the Book** - This chapter provides a detailed overview of the future of the book and its potential. It can be taught at the beginning of the course, or skipped if time is short.

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