

Several years ago, we set out to write a short biochemistry textbook that combined succinct, clear chapters with extensive problem sets. We believed that students would benefit from a modern approach involving broad but not overwhelming coverage of biochemical facts, focusing on the chemistry behind biology, and providing students with practical knowledge and problem-solving opportunities. Our experience in the classroom continues to remind us that effective learning also requires students to become as fully engaged with the material as possible. To that end, we have embraced a strategy of posing questions and suggesting study activities throughout each chapter, so that students will not simply read and memorize but will explore and discover on their own—a truer reflection of how biochemists approach their work in the laboratory or clinic.

As always, we view our textbook as a guidebook for students, providing a solid foundation in biochemistry, presenting complete, up-to-date information, and showing the practical aspects of biochemistry as it applies to human health, nutrition, and disease. We hope that students will develop a sense of familiarity and comfort as they encounter new material, explore it, and test their understanding through problem solving.

New to Global Edition

Many details in the text and illustration program have been updated, with virtually no section left untouched. Some significant changes are worth mentioning: Chapter 3 includes an updated discussion of genomics and a completely new presentation of DNA sequencing technologies and the use of CRISPR-Cas to edit genes. Other new items include a discussion of archaeal lipids, details on the GLUT membrane transport protein, a box on exosomes, new illustrations of respiratory cilia and bacterial peptidoglycan, new molecular graphics of mitochondrial respiratory complexes, an updated presentation of the ribonucleotide reductase mechanism, and more information on the microbiome, cancer, and obesity. Descriptions of DNA replication and transcription have been extensively modified, with numerous new diagrams to present a more realistic picture of these processes. The histone code and readers, writers, and erasers are explained. New details on RNA splicing and protein translocation round out the revised text.

Eight health-related topics that were previously confined to short boxes have been updated and expanded to **Clinical Connection** sections to give them the appropriate attention: 2.5 Acid-Base Balance in Humans, 4.5 Protein Misfolding and Disease, 5.2 Hemoglobin Variants, 6.5 Blood Coagulation, 7.4 Drug Development, 13.5 Disorders of Carbohydrate Metabolism, 19.4 Cancer Metabolism, and 20.4 Cancer as a Genetic Disease.

With the same goal of making it easy for students to navigate complex topics, some material within sections has been

reorganized, and several new sections of text now focus on key content areas: 14.3 Thermodynamics of the Citric Acid Cycle, 17.1 Lipid Transport, 18.5 Nucleotide Metabolism, 20.5 DNA Packaging, 21.1 Initiating Transcription, and 22.1 tRNA and the Genetic Code.

Above all, the focus of the global edition is ease of use, particularly for students and instructors taking advantage of new ways to assess student understanding. The **end-of-chapter problem sets** have been refreshed, with a total of 1,489 problems (averaging 68 per chapter). Problems are grouped by section and offered in pairs, with the answers to odd-numbered problems provided in an appendix.

Traditional Pedagogical Strengths

- **“Do You Remember?” review questions** start each chapter, to help students tie new topics to what they have already studied.
- **Key Concepts** at the beginning of each section prompt students to recognize the important takeaways or concepts in each section, providing the scaffolding for understanding by better defining these important points.
- **Concept Check** questions appear at the end of every section and are designed for students to check their mastery of the section’s key concepts.
- **Figure Questions** that accompany key tables and figures prompt students to inspect information more closely.
- **Key Sentences** summarizing main points are printed in italics to assist with quick visual identification.
- **Tools and Techniques Sections** appear at the end of Chapters 2, 3, and 4, to showcase practical aspects of biochemistry and provide an overview of experimental techniques that students will encounter in their reading or laboratory experience.
- **Metabolism Overview Figures** introduced in Chapter 12 and revisited in subsequent chapters help students place individual metabolic pathways into a broader context.
- **Chapter Summaries**, organized by major section headings, highlight important concepts to guide students to the most important points within each section.
- **Key Terms** are in boldface. Their definitions are also included in the **Glossary**.
- An annotated list of **Selected Readings** for each chapter includes recent short papers, mostly reviews, that students are likely to find useful as sources of additional information.

Organization

We have chosen to focus on aspects of biochemistry that tend to receive little coverage in other courses or present a challenge to many students. Thus, in this textbook, we devote proportionately more space to topics such as acid-base chemistry, enzyme mechanisms, enzyme kinetics, oxidation-reduction reactions, oxidative phosphorylation, photosynthesis, and the enzymology of DNA replication, transcription, and translation. At the same time, we appreciate that students can become overwhelmed with information. To counteract this tendency, we have intentionally left out some details, particularly in the chapters on metabolic pathways, in order to emphasize some general themes, such as the stepwise nature of pathways, their evolution, and their regulation.

The 22 chapters of *Essential Biochemistry* are relatively short, so that students can spend less time reading and more time extending their learning through active problem-solving. Most of the problems require some analysis rather than simple recall of facts. Many problems based on research data provide students a glimpse of the “real world” of science and medicine.

Although each chapter of *Essential Biochemistry, Global Edition* is designed to be self-contained so that it can be covered at any point in the syllabus, the 22 chapters are organized into four parts that span the major themes of biochemistry, including some chemistry background, structure-function relationships, the transformation of matter and energy, and how genetic information is stored and made accessible.

Part 1 of the textbook includes an introductory chapter and a chapter on water. Students with extensive exposure to chemistry can use this material for review. For students with little previous experience, these two chapters provide the chemistry background they will need to appreciate the molecular structures and metabolic reactions they will encounter later.

Part 2 begins with a chapter on the genetic basis of macromolecular structure and function (Chapter 3). This is followed by chapters on structure of proteins (Chapter 4) and function of proteins (Chapter 5), with coverage of myoglobin and hemoglobin, and cytoskeletal and motor proteins. An explanation of how enzymes work (Chapter 6) precedes a discussion of enzyme kinetics (Chapter 7), an arrangement that allows students to grasp the importance of enzymes and to focus on the chemistry of enzyme-catalyzed reactions before delving into the more quantitative aspects of enzyme kinetics. A chapter on lipid chemistry (Chapter 8, Lipids and Biological Membranes) is followed by two chapters that discuss critical biological functions of membranes (Chapter 9, Transport through Membrane, and Chapter 10, Biochemical Signaling). The section ends with a chapter on carbohydrate chemistry (Chapter 11), completing the survey of molecular structure and function.

Part 3 begins with an introduction to metabolism that provides an overview of fuel acquisition, storage, and mobilization as well as the thermodynamics of metabolic reactions (Chapter 12). This is followed, in traditional fashion, by chapters on glucose and glycogen metabolism (Chapter 13); the citric acid cycle (Chapter 14); electron transport and oxidative phosphorylation (Chapter 15); the light and dark reactions of

photosynthesis (Chapter 16); lipid catabolism and biosynthesis (Chapter 17); and pathways involving nitrogen-containing compounds, including the synthesis and degradation of amino acids, the synthesis and degradation of nucleotides, and the nitrogen cycle (Chapter 18). The final chapter of Part 2 explores the integration of mammalian metabolism, with extensive discussions of hormonal control of metabolic pathways, disorders of fuel metabolism, and cancer (Chapter 19).

Part 4, the management of genetic information, includes three chapters, covering DNA replication and repair (Chapter 20), transcription and RNA (Chapter 21), and synthesis of proteins (Chapter 22). Because these topics are typically also covered in other courses, Chapters 20–22 emphasize the relevant biochemical details, such as topoisomerase action, nucleosome structure, mechanisms of polymerases and other enzymes, structures of accessory proteins, proofreading strategies, and chaperone-assisted protein folding.

Flow of Genetic Information

The book's companion site (<http://www.wiley.com/college/pratt>) contains an extensive set of resources for enhancing student understanding of biochemistry.

Student Resources

Bioinformatics Projects A set of newly updated exercises by Paul Craig, Rochester Institute of Technology, covering the contents and uses of databases related to nucleic acids, protein sequences, protein structures, enzyme inhibition, and other topics. The exercises use real data sets, pose specific questions, and prompt students to obtain information from online databases and to access the software tools for analyzing such data.

Instructor Resources

Image PowerPoint Slides contain all images and tables in the text, optimized for viewing onscreen.

Digital Image Library with images from the text, also available in JPEG format, can be used to customize presentations and provide additional visual support for quizzes and exams.

Lecture Power Points by Mary Peek, Georgia Tech University, contain lecture outlines, Key Concepts, and relevant figures from the text.

Test Bank by Scott Lefler, Arizona State University, contains over 1100 questions, with each multiple choice question keyed to the relevant section in the text and rated by difficulty level. A computerized version of the Test Bank is also available.

Classroom Response Questions (“Clicker Questions”) by Gail Grabner, University of Texas at Austin, consist of interactive questions for classroom response systems to facilitate classroom participation and discussion. These questions can also be used by instructors as prelecture

questions that help gauge students’ knowledge of overall concepts, while addressing common misconceptions.

Solutions to all problems are available.
Instructor resources are password protected.

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