

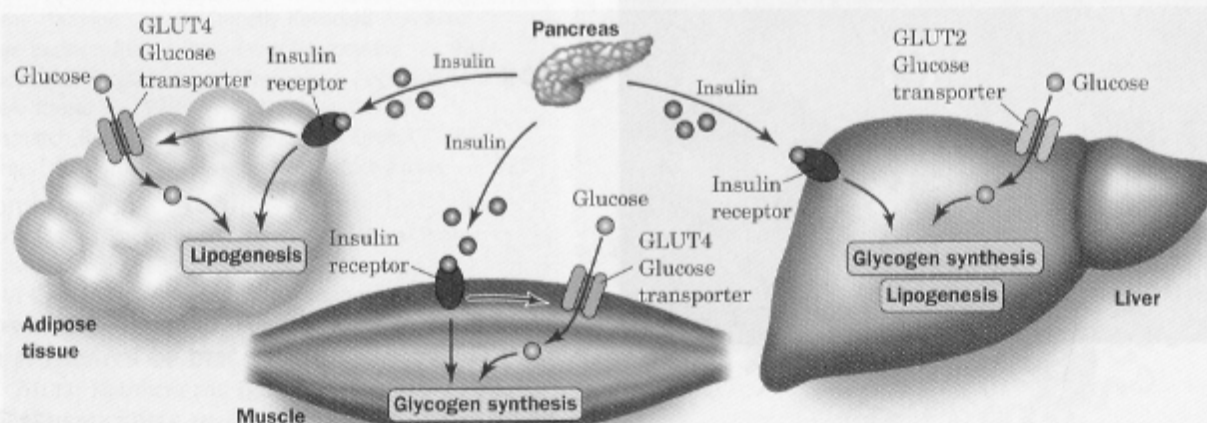
Preface

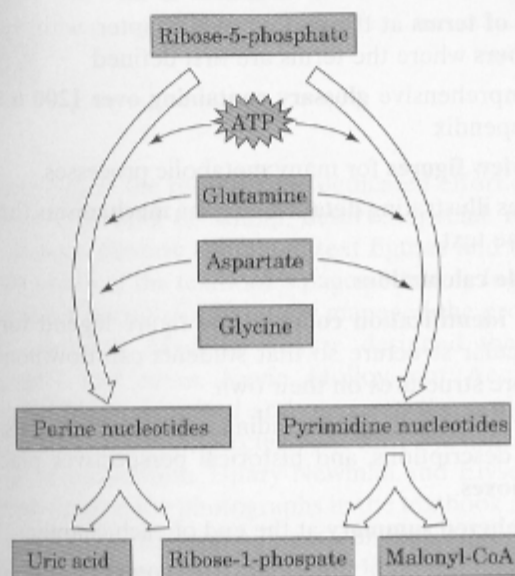
The last several years have seen enormous advances in biochemistry, particularly in the areas of structural biology and bioinformatics. Against this backdrop, we asked *What do students of modern biochemistry really need to know and how can we, as authors, help them in their pursuit of this knowledge?* We concluded that it is more important than ever to provide a solid biochemical foundation, rooted in chemistry, to prepare students for the scientific challenges of the future. With that in mind, we re-examined the contents of *Fundamentals of Biochemistry*, focusing on basic principles and striving to polish the text and improve the pedagogy throughout the book so that it is even more accessible to students. At the same time, we added new material in a way that links it to the existing content, mindful that students assimilate new information only in the proper context. We believe that students are best served by a textbook that is complete, clearly written, and relevant to human health and disease.

New For The Third Edition

The newest edition of *Fundamentals of Biochemistry* includes significant changes and updates to the contents. These changes include:

- A new chapter, Chapter 13, on Biochemical Signaling covers the role of hormones, receptors, G proteins, second messengers, and other aspects of inter- and intracellular communication. Placing these topics in a single chapter allows more comprehensive coverage of this rapidly changing field, which is critical for understanding such processes as fuel metabolism and cancer growth.
 - Chapter 14 (Introduction to Metabolism) includes a new discussion of vitamins, minerals, and macronutrients, as part of a more wholistic approach to human metabolism. Expanded coverage of DNA chip technology and applications reflects growth in this area. In addition, a section on Systems Biology describes the cutting-edge fields of genomics, transcriptomics, proteomics, and metabolomics, along with some relevant laboratory techniques.
 - P/O ratios have been updated throughout the metabolism chapters (so that each electron pair from NADH corresponds to 2.5 rather than 3 ATP) to match the most recent research findings.
 - Chapter 22 (Mammalian Fuel Metabolism: Integration and Regulation) has been extensively revised to incorporate recent advances in human metabolic studies, with a new section on metabolic homeostasis that includes a discussion of appetite and body weight regulation. New material on AMP-dependent protein kinase and the hormone adiponectin describes some of the newly discovered biochemistry behind metabolic regulation.
 - Other additions to the third edition were prompted by advances in many different fields, for example, new information on the analysis of short tandem repeats for DNA fingerprinting, bacterial biofilms, viral membrane fusion events, structures and functions of ABC transporters such as P-glycoprotein responsible for drug resistance, chromatin structure, elements involved in initiating RNA transcription, and posttranscriptional protein processing.
- We have given significant thought to the pedagogy within the text and have concentrated on fine-tuning and adding





some new elements to promote student learning. These enhancements include the following:

- Numerous macromolecular structures are displayed with newly revealed details, and well over 100 figures have been replaced with state-of-the-art molecular graphics.
- Seven metabolic overview figures have been reworked to better emphasize their physiological relevance.
- Three new Pathways of Discovery Boxes have been added to focus on the scientific contributions of Lynn Margulis (Chapter 1), Rosalyn Yalow (Chapter 13), and Gertrude Elion (Chapter 23). These provide a better sense of history and emphasize that the study of biochemistry is a human endeavor.
- **Learning Objectives** placed at the beginning of each section of a chapter guide students as they read.
- Each section concludes with a set of study questions, entitled **Check Your Understanding**, to provide a quick review of the preceding material.
- Thirty new end-of-chapter problems with complete solutions have been added to provide students with more opportunities to apply their knowledge.
- New **overview figures** summarize multistep metabolic pathways and the interrelationships among them.

Organization

As in the second edition, the text begins with two introductory chapters that discuss the origin of life, evolution, thermodynamics, the properties of water, and acid-base chemistry. Nucleotides and nucleic acids are covered in Chapter 3, since an understanding of the structures and functions of

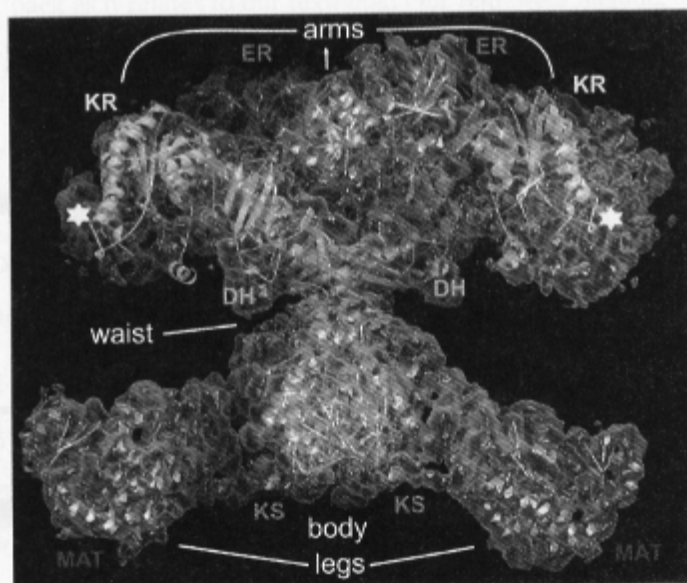
these molecules supports the subsequent study of protein evolution and metabolism.

Four chapters (4 through 7) explore amino acid chemistry, methods for analyzing protein structure and sequence, secondary through quaternary protein structure, protein folding and stability, and structure–function relationships in hemoglobin, muscle proteins, and antibodies. Chapter 8 (Carbohydrates), Chapter 9 (Lipids and Biological Membranes), and Chapter 10 (Membrane Transport) round out the coverage of the basic molecules of life.

The next three chapters examine proteins in action, introducing students first to enzyme mechanisms (Chapter 11), then shepherding them through discussions of enzyme kinetics, the effects of inhibitors, and enzyme regulation (Chapter 12). These themes are continued in Chapter 13, which describes the components of signal transduction pathways.

Metabolism is covered in a set of chapters, beginning with an introductory chapter (Chapter 14) that provides an overview of metabolic pathways, the thermodynamics of “high-energy” compounds, and redox chemistry. Central metabolic pathways are presented in detail (e.g., glycolysis, glycogen metabolism, and the citric acid cycle in Chapters 15–17) so that students can appreciate how individual enzymes catalyze reactions and work in concert to perform complicated biochemical tasks. Chapters 18 (Electron Transport and Oxidative Phosphorylation) and 19 (Photosynthesis) complete a sequence that emphasizes energy-producing pathways. Not all pathways are covered in full detail, particularly those related to lipids (Chapter 20), amino acids (Chapter 21), and nucleotides (Chapter 23). Instead, key enzymatic reactions are highlighted for their interesting chemistry or regulatory importance. Chapter 22, on the integration of metabolism, discusses organ specialization and metabolic regulation in mammals.

Five chapters describe the biochemistry of nucleic acids, beginning with Chapter 24, which discusses the structure of

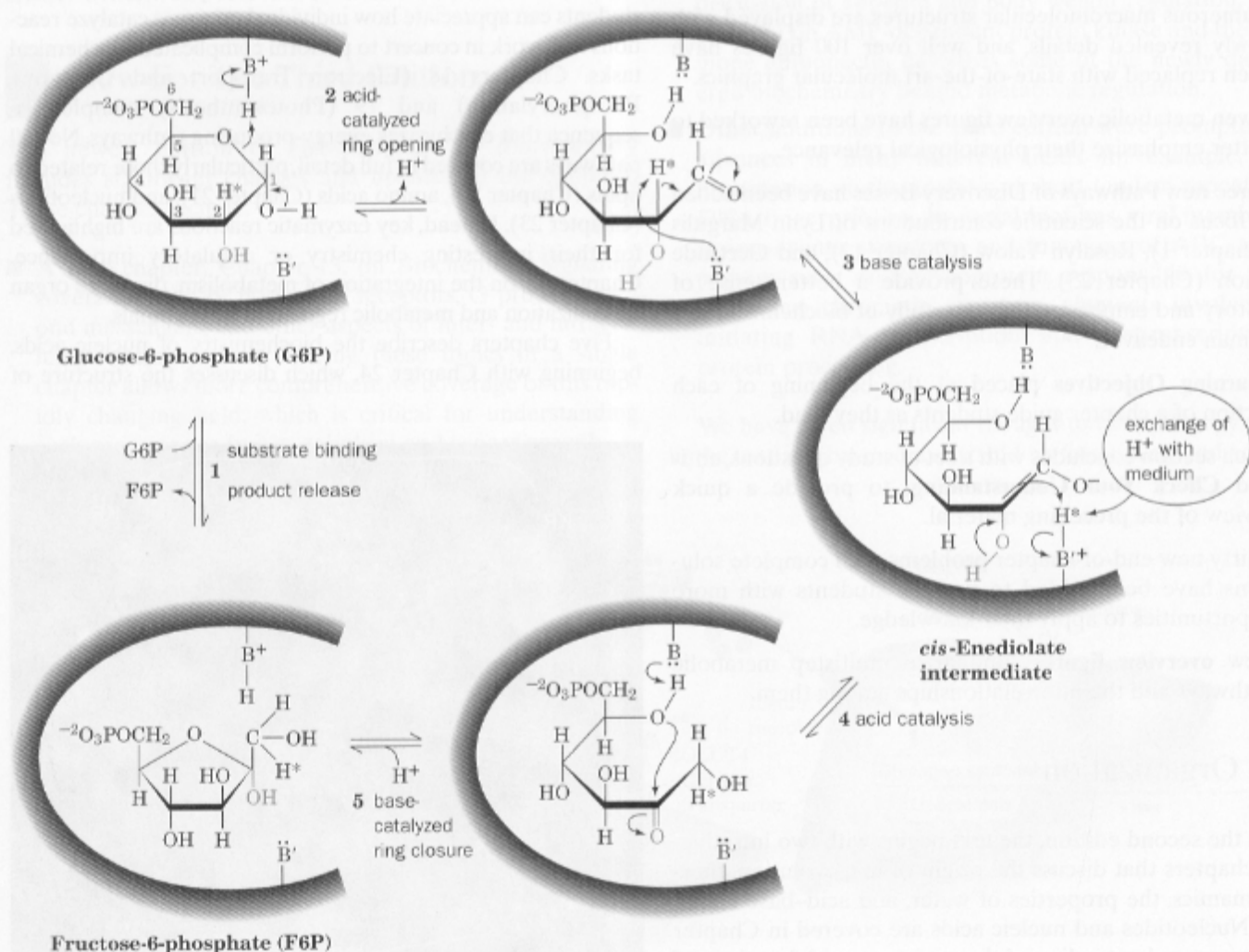


DNA and its interactions with proteins. Chapters 25–27 cover the processes of replication, transcription, and translation, highlighting the functions of the RNA and protein molecules that carry out these processes. Chapter 28 deals with a variety of mechanisms for regulating gene expression, including the histone code and the roles of transcription factors and their relevance to cancer and development.

Traditional Pedagogical Strengths

Successful pedagogical elements from the first and second editions of *Fundamentals of Biochemistry* have been retained. Among these are:

- the division of chapters into **numbered sections** for easy navigation
- **key sentences** printed in italic to assist with quick visual identification
- boldfaced **key terms**
- a **list of terms** at the end of each chapter, with the **page numbers** where the terms are first defined
- a comprehensive **glossary containing over 1200 terms** in an appendix
- **overview figures** for many metabolic processes
- figures illustrating **detailed enzyme mechanisms** throughout the text
- **sample calculations**
- **PDB identification codes** in the figure legend for each molecular structure so that students can download and explore structures on their own.
- Enrichment material, including clinical correlations, technical descriptions, and historical perspectives placed in **text boxes**.
- a **numbered summary** at the end of each chapter
- an expanded set of **problems** (with **complete solutions** in an appendix)
- a list of references for each chapter, selected for their relevance and user-friendliness.



Acknowledgments

This textbook is the result of the dedicated effort of many individuals, several of whom deserve special mention: Laura Ierardi cleverly combined text figures and tables in designing each of the textbook's pages. Suzanne Ingrao, our Production Coordinator, skillfully managed the production of the textbook. Madelyn Lesure designed the book's typography and cover. Kevin Molloy, our Acquisitions Editor, skillfully organized and managed the project until his departure, and Petra Recter, Associate Publisher, saw us through to publication. Hilary Newman and Elyse Rieder acquired many of the photographs in the textbook and kept track of all of them. Connie Parks, our copy editor, put the final polish on the manuscript and eliminated large numbers of grammatical and typographical errors. Sandra Dumas was our in-house Production Editor at Wiley. Sigmund Malinowski coordinated the illustration program, with contributions from Joan Kalkut and artist Elizabeth Morales. Amanda Wainer spearheaded the marketing campaign. Special thanks to Geraldine Osnato and Aly Rentrop, Project Editors, who coordinated and managed an exceptional supplements package, and to Tom Kulesa, Media Editor, who substantially improved and developed the media resources, website, and WileyPLUS program. Thanks go also to Ann Shinnar for her careful review of the Test Bank.

The atomic coordinates of many of the proteins and nucleic acids that we have drawn for use in this textbook were obtained from the Research Collaboratory for Structural Bioinformatics Protein Data Bank. We created these drawings using the molecular graphics programs RIBBONS by Mike Carson; GRASP by Anthony Nicholls, Kim Sharp, and Barry Honig; and PyMOL by Warren DeLano.

The interactive computer graphics diagrams that are presented on the website that accompanies this textbook are either Jmol images or Kinemages. Jmol is a free, open source, interactive, web browser applet for manipulating molecules in three dimensions. It is based on the program RasMol by Roger Sayle, which was generously made publicly available. The Jmol images in the Interactive Exercises were generated by Stephen Rouse. Kinemages are displayed by the program KiNG, which was written and generously provided by David C. Richardson who also wrote and provided the program PREKIN, which DV and JGV used to help generate the Kinemages. KiNG (Kinemage, Next Generation) is an interactive system for three-dimensional vector graphics that runs on Windows, Mac OS X, and Linux/Unix systems.

The Internet Resources and Student Printed Resources were prepared by the following individuals. Bioinformatics Exercises: Paul Craig, Rochester Institute of Technology, Rochester, New York; Online Homework Exercises and Classroom Response Questions: Rachel Milner and Adrienne Wright, University of Alberta, Edmonton, Alberta, Canada; Online Self-Study Quizzes: Steven Vik, Southern Methodist University, Dallas, Texas; Case Studies: Kathleen Cornely, Providence College, Providence, Rhode Island; Student Companion: Akif Uzman, University of Houston-Downtown, Houston, Texas; Test Bank: Marilee Benore-Parsons, University of Michigan-Dearborn, Dearborn, Michigan and Robert Kane, Baylor University, Waco, Texas.

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