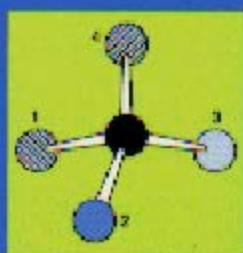
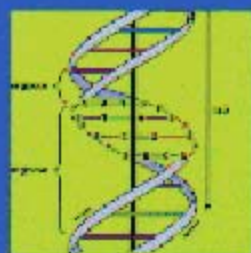


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# Harper's Illustrated Biochemistry



Robert K. Murray  
Daryl K. Granner  
Peter A. Mayes  
Victor W. Rodwell

twenty-  
sixth  
edition

a LANGE medical book

# Harper's Illustrated Biochemistry

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twenty-sixth edition

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University of Toronto  
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# Preface

The authors and publisher are pleased to present the twenty-sixth edition of *Harper's Illustrated Biochemistry*. *Review of Physiological Chemistry* was first published in 1939 and revised in 1944, and it quickly gained a wide readership. In 1951, the third edition appeared with Harold A. Harper, University of California School of Medicine at San Francisco, as author. Dr. Harper remained the sole author until the ninth edition and co-authored eight subsequent editions. Peter Mayes and Victor Rodwell have been authors since the tenth edition, Daryl Granner since the twentieth edition, and Rob Murray since the twenty-first edition. Because of the increasing complexity of biochemical knowledge, they have added co-authors in recent editions.

Fred Keeley and Margaret Rand have each co-authored one chapter with Rob Murray for this and previous editions. Peter Kennelly joined as a co-author in the twenty-fifth edition, and in the present edition has co-authored with Victor Rodwell all of the chapters dealing with the structure and function of proteins and enzymes. The following additional co-authors are very warmly welcomed in this edition: Kathleen Botham has co-authored, with Peter Mayes, the chapters on bioenergetics, biologic oxidation, oxidative phosphorylation, and lipid metabolism. David Bender has co-authored, also with Peter Mayes, the chapters dealing with carbohydrate metabolism, nutrition, digestion, and vitamins and minerals. P. Anthony Weil has co-authored chapters dealing with various aspects of DNA, of RNA, and of gene expression with Daryl Granner. We are all very grateful to our co-authors for bringing their expertise and fresh perspectives to the text.

## CHANGES IN THE TWENTY-SIXTH EDITION

A major goal of the authors continues to be to provide both medical and other students of the health sciences with a book that both describes the basics of biochemistry and is user-friendly and interesting. A second major ongoing goal is to reflect the most significant advances in biochemistry that are important to medicine. However, a third major goal of this edition was to achieve a substantial reduction in size, as feedback indicated that many readers prefer shorter texts.

To achieve this goal, all of the chapters were rigorously edited, involving their amalgamation, division, or deletion, and many were reduced to approximately one-half to two-thirds of their previous size. This has been effected without loss of crucial information but with gain in conciseness and clarity.

Despite the reduction in size, there are many new features in the twenty-sixth edition. These include:

- A new chapter on amino acids and peptides, which emphasizes the manner in which the properties of biologic peptides derive from the individual amino acids of which they are comprised.
- A new chapter on the primary structure of proteins, which provides coverage of both classic and newly emerging "proteomic" and "genomic" methods for identifying proteins. A new section on the application of mass spectrometry to the analysis of protein structure has been added, including comments on the identification of covalent modifications.
- The chapter on the mechanisms of action of enzymes has been revised to provide a comprehensive description of the various physical mechanisms by which enzymes carry out their catalytic functions.
- The chapters on integration of metabolism, nutrition, digestion and absorption, and vitamins and minerals have been completely re-written.
- Among important additions to the various chapters on metabolism are the following: update of the information on oxidative phosphorylation, including a description of the rotary ATP synthase; new insights into the role of GTP in gluconeogenesis; additional information on the regulation of acetyl-CoA carboxylase; new information on receptors involved in lipoprotein metabolism and reverse cholesterol transport; discussion of the role of leptin in fat storage; and new information on bile acid regulation, including the role of the farnesoid X receptor (FXR).
- The chapter on membrane biochemistry in the previous edition has been split into two, yielding two new chapters on the structure and function of membranes and intracellular traffic and sorting of proteins.
- Considerable new material has been added on RNA synthesis, protein synthesis, gene regulation, and various aspects of molecular genetics.
- Much of the material on individual endocrine glands present in the twenty-fifth edition has been replaced with new chapters dealing with the diversity of the endocrine system, with molecular mechanisms of hormone action, and with signal transduction.

- The chapter on plasma proteins, immunoglobulins, and blood coagulation in the previous edition has been split into two new chapters on plasma proteins and immunoglobulins and on hemostasis and thrombosis.
- New information has been added in appropriate chapters on lipid rafts and caveolae, aquaporins, connexins, disorders due to mutations in genes encoding proteins involved in intracellular membrane transport, absorption of iron, and conformational diseases and pharmacogenomics.
- A new and final chapter on “The Human Genome Project” (HGP) has been added, which builds on the material covered in Chapters 35 through 40. Because of the impact of the results of the HGP on the future of biology and medicine, it appeared appropriate to conclude the text with a summary of its major findings and their implications for future work.
- As initiated in the previous edition, references to useful Web sites have been included in a brief Appendix at the end of the text.

## ORGANIZATION OF THE BOOK

The text is divided into two introductory chapters (“Biochemistry & Medicine” and “Water & pH”) followed by six main sections.

**Section I** deals with the structures and functions of proteins and enzymes, the workhorses of the body. Because almost all of the reactions in cells are catalyzed by enzymes, it is vital to understand the properties of enzymes before considering other topics.

**Section II** explains how various cellular reactions either utilize or release energy, and it traces the pathways by which carbohydrates and lipids are synthesized and degraded. It also describes the many functions of these two classes of molecules.

**Section III** deals with the amino acids and their many fates and also describes certain key features of protein catabolism.

**Section IV** describes the structures and functions of the nucleotides and nucleic acids, and covers many major topics such as DNA replication and repair, RNA synthesis and modification, and protein synthesis. It also discusses new findings on how genes are regulated and presents the principles of recombinant DNA technology.

**Section V** deals with aspects of extracellular and intracellular communication. Topics covered include membrane structure and function, the molecular bases of the actions of hormones, and the key field of signal transduction.

**Section VI** consists of discussions of eleven special topics: nutrition, digestion, and absorption; vitamins and minerals; intracellular traffic and sorting of proteins; glycoproteins; the extracellular matrix; muscle and the cytoskeleton; plasma proteins and immunoglobulins; hemostasis and thrombosis; red and white blood cells; the metabolism of xenobiotics; and the Human Genome Project.

## ACKNOWLEDGMENTS

The authors thank Janet Foltin for her thoroughly professional approach. Her constant interest and input have had a significant impact on the final structure of this text. We are again immensely grateful to Jim Ransom for his excellent editorial work; it has been a pleasure to work with an individual who constantly offered wise and informed alternatives to the sometimes primitive text transmitted by the authors. The superb editorial skills of Janene Matragrano Oransky and Harriet Lebowitz are warmly acknowledged, as is the excellent artwork of Charissa Baker and her colleagues. The authors are very grateful to Kathy Pitcoff for her thoughtful and meticulous work in preparing the Index. Suggestions from students and colleagues around the world have been most helpful in the formulation of this edition. We look forward to receiving similar input in the future.

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