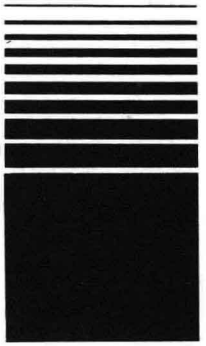
GENERAL, ORGANIC, AND BIOCHEMISTRY

THIRD EDITION

BROWN ROGERS



General, Organic, and Biochemistry

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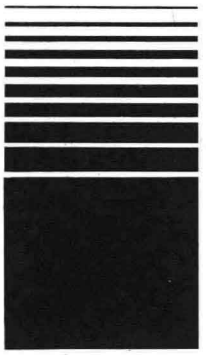

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Preface

This text is written for students of the life sciences, particularly those planning careers in one of the many health professions. While we recognize that these students are not planning to become professional chemists, we also know that they need to understand how living systems depend on chemistry. In this survey of general, organic, and biochemistry, we have tried to reveal this relationship and provide a foundation in chemistry that's necessary for further study.

The category of life and health sciences includes a great variety of academic majors. Although all students in these majors need a knowledge of chemistry, some need to know more about certain areas than do others. An inhalation therapist, for example, needs to know more about the properties of gases than does a physical education major; a radiation technologist requires a greater background in radiochemistry than does a dietician. These diverse needs impose special requirements on a text.

First, in addition to covering basic concepts of chemistry, the text must contain a wide choice of material on which instructors can draw to tailor courses to the needs of their particular students. For this reason, we have included more material than most courses will cover. We leave the decision on topic selection to each instructor.

Second, the organization of the text must be flexible enough to allow selected topics to be presented in an order that is logical for each particular course. We have organized this text in a way that seems logical to us, but we realize that other approaches will work equally well. For this reason, we have divided chapters into many freestanding sections and subsections to give instructors as much latitude as possible in choosing and arranging the material to cover. For example, nuclear chemistry is presented at the end of Chapter 2, but the material is designed so that it might be included just as easily later in the course, or omitted. In the Instructor's Manual we suggest other points of flexibility.

Third, the presentation must be even, neither slighting one topic nor going overboard on another. To this end, we have attempted throughout to bring a high degree of pedagogical, organizational, and stylistic unity to this book.

Text Organization

The chapters of this text can be divided into four parts: general chemistry, organic chemistry, biomolecules, and metabolism.

General Chemistry: Chapters 1–9

The first part of the book presents the fundamental concepts of chemistry. Because quantitative thinking is often a major stumbling block for beginning students, we have given special attention in Chapters 1–9 to calculations and problem solving. Problem solving by unit analysis is introduced in the first chapter with a detailed algorithm that enables students to analyze a problem, identify the data, and arrange the problem in solvable form. We use the same algorithm throughout the book. Chapters 2 and 3 concentrate on atomic structure, including radioactivity and the use of radioisotopes in medicine. Chapter 4 covers compounds, their composition, and their properties, with particular emphasis on bonding and the geometry of molecules and ions. We present chemical reactions and stoichiometry in Chapter 5, the kinetic molecular theory of matter in Chapter 6, the properties of solutions and colloids in Chapter 7, and reaction rates and chemical equilibrium in Chapter 8. This part of the book concludes in Chapter 9 with a detailed discussion of acids, bases, pH, and acid-base buffers.

There are two major changes in this part of the Third Edition. First, we have curtailed the discussion of energy, and second, we have reorganized and expanded the discussion of acids and bases. We now present this material in a new, separate chapter. All other changes are intended to clarify difficult concepts.

Organic Chemistry: Chapters 10–18

The second part of the book begins in Chapter 10 with covalent bonding in organic compounds and an introduction to the concepts of structural and functional group isomerism. This chapter also introduces hybridization of atomic orbitals, and covalent bond formation by the overlap of atomic orbitals. Chapters 11–17 present the chemistry of specific functional groups: saturated hydrocarbons, unsaturated hydrocarbons, alcohols and phenols, amines, aldehydes and ketones, carboxylic acids, and finally, functional derivatives of carboxylic acids. These chapters are similarly organized to include structure, nomenclature, physical properties, and reactions. This part concludes in Chapter 18 with a discussion of chirality, a major theme that connects the study of organic chemistry and biochemistry.

Our goal in revising the organic chapters has been to tighten them as much as possible, and to make them flow smoothly and directly into the sections on biomolecules and metabolism. Further, there are two major revisions in chapter organization. We moved the chapter on amines forward to Chapter 14 so that the discussion of these molecules follows immediately the discussion of alcohols, ethers, and phenols in Chapter 13. Also, we moved the

discussion of chirality to the end of the organic chemistry section where it now serves as a transition from organic molecules to biomolecules.

Biomolecules: Chapters 19–23

We introduce the major classes of biomolecules in Chapters 19–23. In Chapter 19 we discuss the chemistry of carbohydrates, and in Chapter 20, the chemistry of lipids. In Chapter 21 we present amino acids and proteins, and in Chapter 22, enzymes. The discussion of biomolecules concludes in Chapter 23 with the structure and function of nucleic acids.

Among the major revisions in this part are addition of Michaelis-Menton kinetics and a more quantitative treatment of enzyme kinetics, an expanded discussion of allosteric regulation of enzyme activity, and new material on using enzymes in the health sciences.

Metabolism: Chapters 24–27

In Chapter 24 we introduce metabolism and bioenergetics, and clearly delineate the several stages in oxidation of foodstuffs and generation of ATP. Discussion of the metabolism of carbohydrates, fatty acids, and amino acids follows in Chapters 25–27. Throughout these chapters we point out that the metabolism of these foodstuff molecules is interrelated and precisely regulated.

Features

Several features of this edition make it an especially effective teaching tool.

Example Problems with step-by-step solutions appear in each chapter and are followed by similar problems for students to solve. Students can find the answers to all in-chapter problems in the back of the book.

End-of-Chapter Problems are grouped according to chapter section. This feature ensures a balanced and representative group of problems for each section of the text.

Key Terms and Concepts are listed at the end of each chapter. The section reference following each term or concept directs the student to the place in the text where it is defined and used.

Sixteen Mini-Essays are included. Two of them, "Alkaloids," and "Biogenic Amines and Emotions," are new to this edition. The mini-essays have several purposes: they bridge the gap between the study of chemistry and the projected vocational areas of life science students; they demonstrate some of the creativity and excitement inherent in chemistry; and they offer a glimpse of the human involvement in research and development.

Extensive use of graphics, all of it newly designed and redrawn for this edition, enhances the visual appeal and pedagogical effectiveness of the text.

Supplements

The following supplemental materials that we have prepared are available for use with the text.

Student Study Guide Contains complete solutions to all end-of-chapter problems. It makes use of a detailed step-by-step learning approach centered around the important concepts and terms used in the text.

Laboratory Manual Includes 35 experiments keyed to specific chapters.

Instructor's Manual Contains suggestions for course organization and scheduling.

Overhead Transparency Masters More than 60 important figures and tables used in the text have been prepared as masters. Using these masters, instructors can produce overhead transparencies for use as lecture aids or in quizzes.

Acknowledgments

We would like to acknowledge the help we have received from Bruce Thrasher of Willard Grant Press on previous editions and from Sue Ewing of Brooks/Cole on this edition. And we thank the very capable staff of Brooks/Cole, coordinated by Phyllis Larimore, for leading us through the intricacies of design, copyediting, and production. Certainly we thank users of the first and second editions, and the following reviewers for their valuable contributions: William Bull, University of Tennessee at Knoxville; Allen Clark, Old Dominion University; James Golen, Southeastern Massachusetts University; Robert Klein, East Carolina University; Jon Robertus, University of Texas; Louis Perlgut, California State University–Long Beach; and James Takacs, University of Utah. Most of all we acknowledge with profound thanks the patience and understanding of our spouses, Hazel S. Brown and Robert W. Rogers, and our children, all of whom we fear were sometimes given short shrift as deadlines came and went.

William H. Brown

Elizabeth P. Rogers

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