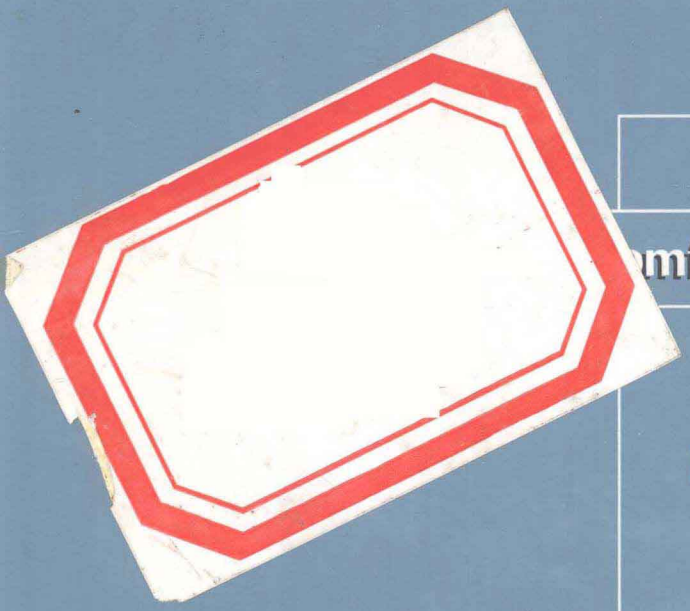
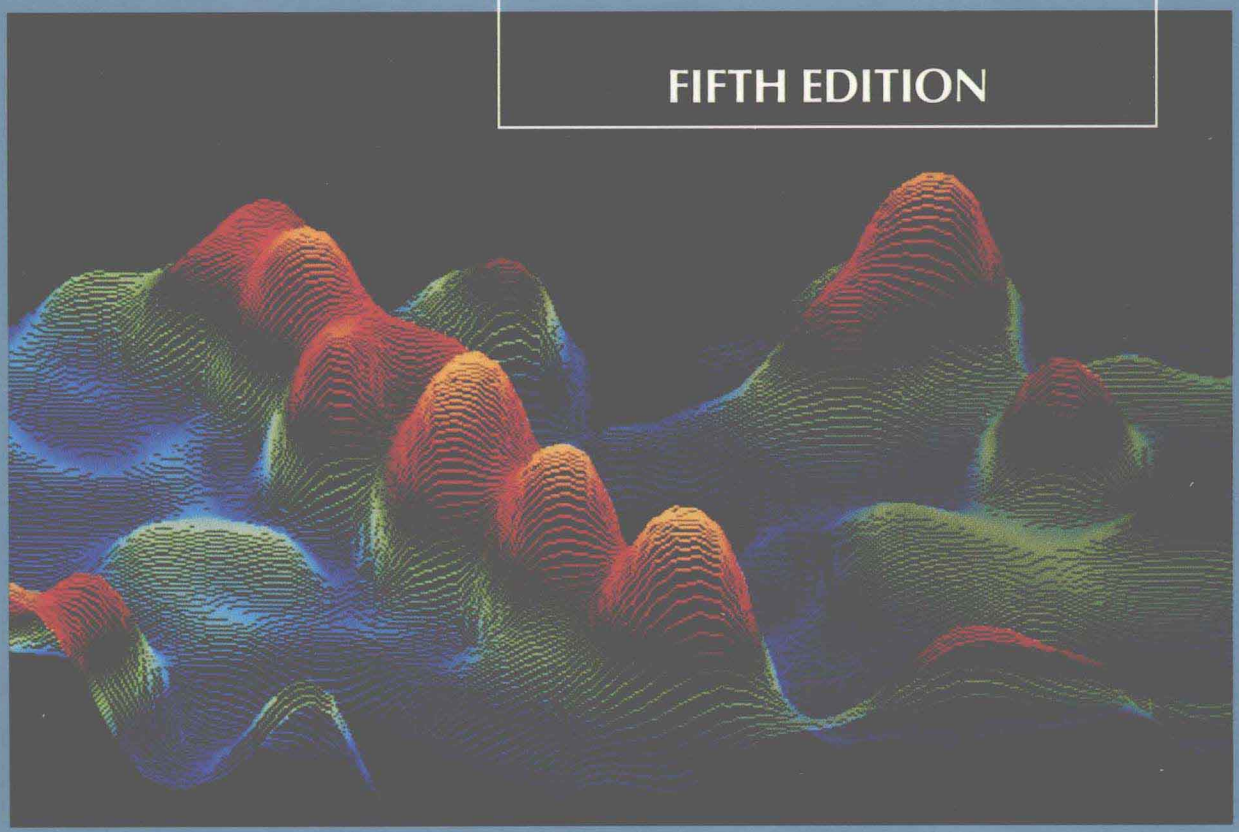


mfield

Chemistry and the Living Organism

FIFTH EDITION



Molly M. Bloomfield

Chemistry and the Living Organism

FIFTH EDITION

John Wiley & Sons, Inc.
New York • Chichester • Brisbane • Toronto • Singapore

Acquisitions Editor	Joan Kalkut
Copy Editing Supervisor	Elizabeth Swain
Production Manager	Linda Muriello
Senior Production Supervisor	Savoula Amanatidis
Designer	Pete Noa
Illustration Coordinator	Sigmund Malinowski
Photo Research Manager	Elaine Bernstein
Photo Researchers	Jennifer Atkins, Hilary Newman
Manufacturing Manager	Lorraine Fumoso
Cover photo	Lawrence Livermore Laboratory/Science Photo Library

Recognizing the importance of preserving what has been written, it is a policy of John Wiley & Sons, Inc. to have books of enduring value published in the United States printed on acid-free paper, and we exert our best efforts to that end.

Library of Congress Cataloging in Publication Data:

Bloomfield, Molly M., 1944–
Chemistry and the living organism/Molly M. Bloomfield.—5th ed.

p. cm.
Includes index.
ISBN 0-471-51292-3 (cloth)
1. Chemistry. 2. Biochemistry. I. Title.
QD33.B672 1992
540—dc20 91-21489
CIP

Printed in the United States of America

10 9 8 7 6 5 4

CHEMISTRY AND THE LIVING ORGANISM

TO THE STUDENT: A Study Guide for this textbook is available through your college bookstore under the title *Study Guide for Chemistry and the Living Organism, Fifth Edition,* by Molly M. Bloomfield. You can use the Study Guide as a tutorial, review, and study aid to help you better learn the course material. If the Study Guide is not in stock, ask the bookstore manager to order a copy for you.

To Stefan, Rebecca, and Jon

PREFACE TO THE FIFTH EDITION

Chemistry and the Living Organism introduces general, organic, and biochemistry in a manner that is easy to understand and enjoyable to read. This fifth edition includes all the popular material from the first four editions in a revised format. The content of each chapter has been updated, and many of the examples and chapter-opening case histories have been revised to reflect new developments in science and technology. With this new material, the fifth edition continues to provide a highly motivating and student-oriented approach to teaching chemistry.

Chemistry and the Living Organism is intended for a one- or two-term survey course for students in the allied health sciences and related fields. One difficulty in writing such a book is the lack of agreement on the topics that should be included. My solution is to include more topics that can be covered in one term, providing the instructor with flexibility in choosing topics most relevant to the curriculum. In this edition, the material in the first 12 chapters has been rearranged to provide greater continuity. Discussion of the gas laws (Chapter 6) follows the chapter on the mole (Chapter 5), allowing presentation of molar volume, the ideal gas law, and Graham's law. The material on radioactivity and nuclear energy (Chapters 7 and 8) now follows the discussion of atomic structure, bonding, and chemical equations. This furnishes a logical break before the discussion of chemical equilibrium (Chapter 9), solutions (Chapters 10 and 11), and acids and bases (Chapter 12). The material appearing in Chapter 18 of the fourth edition, The Remaining 21 Elements, has been distributed throughout the text to provide illustrative examples for chemical principles presented in other chapters.

In a continuing effort to emphasize the relevance of chemical principles to the student's personal and professional life, I have added a new feature called Perspectives. These are short essays on topics of current interest, intended to broaden the student's understanding of how chemistry relates to the real world. The Perspectives appear throughout the text accompanying the discussion of related chemical principles. I have also included five new chapter-opening stories dealing with such issues as alcoholism, the effects of food on brain chemistry, radon contamination of homes, and the origins of life.

The text is written in a conversational style, with fundamental chemical concepts illustrated through examples relevant to the student's own life. Each chapter begins with a set of learning objectives that help the student identify important concepts within the chapter. The presentation of concepts involving mathematical operations is always accompanied by worked-out examples. Each set of examples, in turn, is followed by exercises (with answers in Appendix 3) that

allow students to check their understanding of the concepts. As a further study aid, each chapter contains a summary that reviews the concepts and key equations used in the chapter.

New exercises and problems have been added at the end of each chapter in this edition. These problems are divided into Review Problems that drill the student on specific concepts and mathematical operations, and Study Problems that require the student to apply chemical principles in a practical context. Each Review Problem is keyed to a section in the textbook so the student can reread the relevant material when necessary. In addition, there are six sections of Integrated Problems that require the student to use appropriate principles from previous chapters in solving problems based on professional applications. The comprehensive glossary of the fourth edition has been expanded to include more of the concepts and examples used in this edition. As in previous editions, the index of *Chemistry and the Living Organism* is one of the most extensive for a text at this level.

SUPPLEMENTAL MATERIALS

The following supplemental materials are available for use with the fifth edition:

Student Study Guide The student study guide contains a brief summary of each section of the textbook and a list of important terms appearing in that section. The study guide features many worked-out examples and self-test questions (with answers) for each chapter. In addition, the fifth edition of the study guide contains the answers to the end-of-chapter Review Problems.

Laboratory Manual The revised fifth edition of the laboratory manual, written by Joe Bauer of William Rainey Harper College, contains 25 experiments from the fourth edition plus two new experiments on the Properties of Water and Molecular Models.

Teacher's Manual The teacher's manual contains answers to the end-of-chapter Study Problems and the Integrated Problems, and answers to the laboratory exercises in the Laboratory Manual. In addition, it contains a list of chemicals and equipment needed for the laboratory experiments.

ACKNOWLEDGEMENTS

The success of this text is due in large part to the contributions and helpful suggestions of many people. In particular, I would like to thank:

Joseph Bauer, William Rainey Harper College;

Mike McNicholas, Chemeketa Community College;

Dr. William Lloyd, Good Samaritan Hospital;

Brian Dodd, Christopher Mathews, and Jean Peters of Oregon State University;

Dorothy B. Kurland, West Virginia Institute of Technology;
Norbert Kurnath, Cuyahoga Community College;
Steven Ruis, Skyline College;
Gerald Berkowitz, Erie Community College;
Carol Leslie, Union University;
Jim Bier, Ferrum College;
Stephen Ott, College of Eastern Utah;
Lawrence Stephens, Elmira College.

Preparing new chapter-opening case histories often requires detailed professional expertise. I am especially grateful for the generous assistance given by Dr. John Ladd, Corvallis Clinic; Dr. Michael Huntington, Good Samaritan Hospital; Professor Brian Dodd, Oregon State University; Professor Judith Wurtman, Massachusetts Institute of Technology; Bill Brendel, Benton County Alcohol and Drug Treatment Program; Dr. Charles Kuttner, Albany, OR; Dr. Allen S. Lefohn, A.S.L. & Associates, Helena, MT; and Dr. Edward C. Krug, Winoma, MN.

Professor Mike McNicholas of Chemeketa Community College did the research and provided the material for the Chemical Perspectives appearing in this edition. Additional assistance in writing the Perspectives was provided by Dr. James Gallant, Corvallis Internal Medicine, and Professors Lloyd Bodyfelt and Dan Selivonchick of Oregon State University. Professor McNicholas also provided additional problems and questions for the end-of-chapter Exercises and Problems.

At John Wiley, I would especially like to thank Jennifer Atkins for finding the excellent photos for this edition, Connie Parks for her meticulous editing job, and Joan Kalkut for helping me through some very difficult moments with this edition.

This edition would not have gotten to the publisher without the assistance of my husband Stefan, who guided me through several computer upgrades and always made time to contribute his excellent language skills to the editing process. I would also like to thank my children, Rebecca and Jon, who think having a mother who spends her life writing about chemistry is "kind of neat."

Corvallis, Oregon — Molly M. Bloomfield

HEALTH RELATED TOPICS

SECTION I

Introduction

CONTENTS

Chapter 2: Energy 43

Chapter 3: Atomic Structure 67

Chapter 4: Combinations of Atoms 99