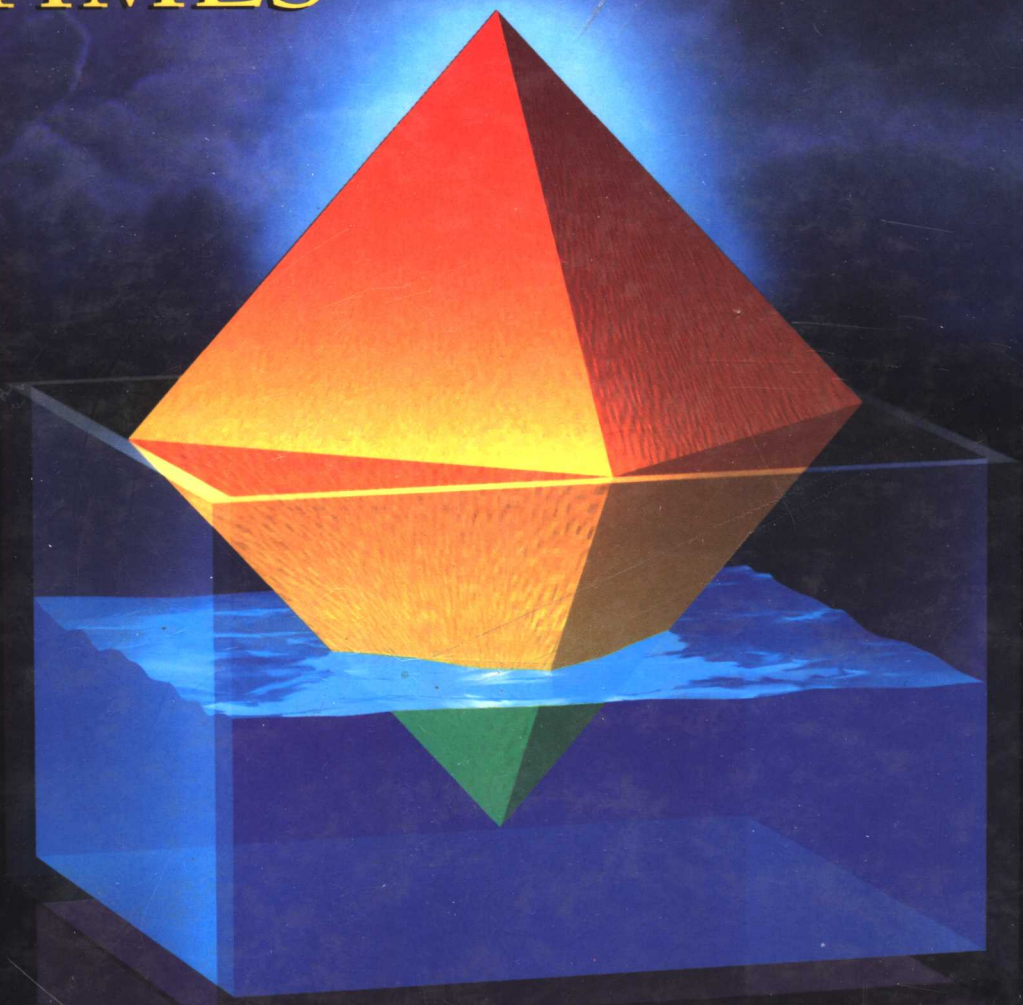
CHEMISTRY FOR CHANGING TIMES

Seventh Edition



John W. Hill Doris K. Kolb

Chemistry for Changing Times

Seventh Edition

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Chemistry for Changing Times

Preface

Chemistry for Changing Times is now in its seventh edition, and times have indeed changed since the first edition appeared in 1972. The book has changed accordingly—perhaps a bit more than usual with this edition because a co-author has been added. The fact that there now are two of us shouldn't really make much difference, though, because we share the same philosophy when it comes to teaching chemistry.

We believe that a chemistry course for students who are not majoring in science should be quite different from the course we offer our science majors. It should present basic chemical concepts with intellectual honesty, but it should not focus on esoteric theories or rigorous mathematics. It should include lots of modern everyday applications. The textbook should be appealing to look at, easy to understand, and interesting to read.

Three-fourths of the legislation considered by the United States Congress involves questions having to do with science or technology, yet only rarely does a scientist or engineer enter the field of politics. Most of the people who make important decisions regarding our health and our environment are not trained in science, but it is critical that these decision makers have some measure of scientific literacy. A chemistry course for students who are not science majors should emphasize practical applications of chemistry to problems involving such things as environmental pollution, radioactivity, energy sources, and human health. The students who take our liberal arts chemistry courses include future teachers, lawyers, accountants, journalists, and judges. There are probably some future legislators, too.

Objectives

Our main objectives in a chemistry course for students who are not majoring in science are these:

- To attract as many students as possible. If they are not enrolled in the course, we cannot teach them.
- To use topics of current interest to illustrate chemical principles. We want students to appreciate the importance of chemistry in the real world.
- To relate chemical problems to the everyday lives of our students. Chemical problems seem more significant to students if they can see a personal connection.
- To instill in students an appreciation for chemistry as an open-ended learning experience. We hope that they will want to continue learning throughout their lives.

- To acquaint students with scientific methods. We want them to be able to read about science and technology with some degree of critical judgment.
- To impart to students a sense of scientific literacy. We want our students to develop such a comfortable knowledge of science that they find news articles relating to science interesting rather than intimidating.

Major Changes in This Revision

The text has been updated and many topics have been expanded. New material includes recent developments regarding energy sources, global warming, acid rain, the ozone hole, cigarette smoke, alcohol, waste disposal, water treatment, air pollution, and health and fitness. There are new diagrams, tables, and photographs.

In order to keep the size of the book as small and easy to handle as possible, we have cut the number of chapters from 25 to 20 by combining chapters. Thus, no major omissions from the sixth edition were necessary. Hydrocarbons are now discussed in Chapter 9, "Organic Chemistry"; Chapter 14, "Energy," now includes future energy sources; farm chemistry is included in Chapter 16, "Food"; cosmetics are considered in Chapter 17, "Household Chemicals"; and chemical therapy is included in Chapter 19, "Drugs."

A summary has been added at the end of every chapter, along with a list of Key Terms, in order to help students understand what they are expected to know from each chapter.

Use of Color

New color photographs and diagrams have been added. Visual material adds greatly to the general appeal of a textbook. Color diagrams can also be highly instructive, and colorful photographs relating to descriptive chemistry do much to enhance the learning process.

Readability

Over the years students have told us that they have found this textbook easy to read. The language is simple, and the style is conversational. Explanations are clear and easy to understand. We trust that the friendly tone of the book has been maintained in this seventh edition.

Units of Measurement

The United States continues to cling to the traditional English system for many kinds of measurement even though the metric system has long been used internationally. A modern version of the metric system, the Système International (SI), is now widely used, especially by scientists. So what units should be used in a text for liberal arts students? In presenting chemical principles, we use SI units for the most part. In other parts of the book we use whatever units the students are most likely to come across elsewhere in that same context.

Chemical Structures

The structures of many complicated molecules are given in the text, especially in the later chapters. They are presented mainly to emphasize that these structures are actually known and to illustrate the fact that substances with similar properties often have similar structures. Students should not feel that they must learn these structures, but they should take the time to look at them. We hope that they will come to recognize familiar features in these molecules.

Glossary

The glossary in Appendix E gives definitions for terms that appear in **boldface** throughout the text. These include all the Key Terms listed at the end of each chapter.

Questions and Problems

The end-of-chapter exercises include review questions, problems, and suggested projects. Answers to many review questions and to all the odd-numbered problems are given in Appendix F. Problems are given within some of the chapters, with worked out examples followed by similar exercises. Answers to all the in-chapter exercises are also given in Appendix F.

References and Suggested Readings

An updated list of recommended books and articles appears at the end of each chapter. A student whose interest has been sparked by a particular topic can delve more deeply into the subject in the library. Instructors might also find the lists useful.

Supplementary Materials

The most important learning aid in any course is the teacher. In order to make the instructor's job easier and to enrich the education of students, we have provided a variety of supplementary materials.

Study Guide by Diane Bunce, Catholic University of America.

Instructor's Resource Manual by Doris K. Kolb.

Chemical Investigations for Changing Times, seventh edition (laboratory manual), by Alton Hassell and Paula Marshall, Baylor University, with Instructor's Guide by Alton Hassell.

Test Item File by John S. Phillips, Wilkes University.

Prentice Hall Test Manager, Version 2.0 (Macintosh and IBM), a computerized version of Test Item File.

Color Transparencies

The New York Times Themes of the Times Program, a compilation of current articles from *The New York Times* illustrating issues pertaining to chemistry in the world around us..

ABC News/Prentice Hall Video Library, video segments selected from ABC's documentary and news coverage.

Acknowledgments

The seventh edition has benefited greatly from the critical input of these most helpful reviewers who have taught from the sixth edition.

Benjamin H. Bruckner, University of Maryland, Baltimore County
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Cynthia S. Hill prepared much of the original material on biochemistry, food, and health and fitness. Her special contributions are acknowledged on the title page.

Four of the verses that appear in this volume were first published in the *Journal of Chemical Education* (1978, pp. 47 and 732; and 1979, pp. 53 and 469). We acknowledge with thanks the permission to reprint them here.

We also want to thank our colleagues at the University of Wisconsin–River Falls and Bradley University for all their help and support.

We have been blessed with a team of careful and considerate editors. We especially appreciate all the help we have received from Paul F. Corey and from our outstanding production supervisor, Elisabeth H. Belfer.

We owe a very special kind of thanks to our wonderful spouses, Ina and Ken. Ina has done typing, library research, and so many other things. Ken has done chapter reviews, made countless suggestions, and given invaluable help with this seventh edition. Most of all, we are grateful to both of them for their enduring love and their boundless patience.

We thank all those many students whose enthusiasm has made teaching such a joy. It is gratifying to have students learn what you are trying to teach them, but it is a supreme pleasure to find that they want to learn even more.

Finally, we want to thank all of you who have made so many helpful suggestions. We welcome and appreciate all your comments, corrections, and criticisms.

J. W. H.
D. K. K.

To the Student

Welcome to Our Chemical World!

Chemistry is fun. Through this book, we would like to share with you some of the excitement of chemistry and some of the joy in learning about it. We hope to convince you that chemistry does not need to be excluded from your learning experiences. Learning chemistry will enrich your life—now and long after this course is over—through a better understanding of the natural world, the technological questions now confronting us, and the choices we must face as citizens within a scientific and technological society.

Chemistry Directly Affects Our Lives

How does the human body work? How does aspirin cure our headaches? Do steroids enhance athletic ability? Is table salt poisonous? Can scientists cure genetic diseases? Why do most weight loss diets seem to work in the short run but fail in the long run? Does fasting "cleanse" the body? Why do our moods swing from happy to sad? Can a chemical test on urine predict possible suicide attempts? How does penicillin kill bacteria without harming our healthy body cells? Chemists have found answers to questions like these and continue to seek the knowledge that will unlock still other secrets of our universe. As these mysteries are resolved, the direction of our lives often changes—sometimes dramatically.

We live in a chemical world—a world of drugs, biocides, food additives, fertilizers, detergents, cosmetics, and plastics. We live in a world with toxic wastes, polluted air and water, and dwindling petroleum reserves. Knowledge of chemistry will help you to better understand the benefits and hazards of this world and enable you to make intelligent decisions in the future.

Chemical Dependency

We are all chemically dependent. Even in the womb, we depend on a constant supply of oxygen, water, glucose, and a multitude of other chemicals.

Our bodies are intricate chemical factories. They are durable but delicate systems. A myriad of chemical reactions are constantly taking place within us that allow our bodies to function properly. Thinking, learning, exercising, feeling happy or sad, putting on too much weight or not gaining enough, and virtually all life processes are made possible by these chemical reactions. Everything that we ingest is part of a complex process that determines whether our bodies work effectively or not. The consumption of some substances can initiate chemical reactions that will stop body functions altogether. Other substances, if consumed, can cause permanent handicaps, and others

can make living less comfortable. A proper balance of the right foods provides the chemicals and generates the reactions we need in order to function at our best. The knowledge of chemistry that you will soon be gaining will help you to better understand how your body works so that you will be able to take proper care of it.

Changing Times

We live in a world of increasingly rapid change. It has been said that the only constant is change itself. At present, we are facing some of the greatest problems that humans have ever encountered, and the dilemmas with which we are now confronted seem to have no perfect solutions. We are sometimes forced to make a best choice among only bad alternatives, and our decisions often provide only temporary solutions to our problems. Nevertheless, if we are to choose properly, we must understand what our choices are. Mistakes can be costly, and they cannot always be rectified. It is easy to pollute, but cleaning up pollution once it is there is enormously expensive. We can best avoid mistakes by collecting as much information as possible before making critical decisions. Science is a means of gathering and evaluating information, and chemistry is central to all the sciences.

Chemistry and the Human Condition

Above all else, our hope is that you will learn that chemistry need not be dull and difficult. Rather, it can enrich your life in so many ways—through a better understanding of your body, your mind, your environment, and the world in which you live. After all, the search to understand the universe is an essential part of what it means to be human.

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