

# Chemistry

*for Changing Times*



Eighth Edition

John W. Hill • Doris K. Kolb

# Chemistry *for Changing Times*

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**Eighth Edition**

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# Preface

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*Chemistry for Changing Times* is now in its eighth edition. Times have indeed changed since the first edition appeared in 1972, and the book has changed accordingly. Our knowledge base has expanded enormously in the quarter century that has passed since that first edition, yet we have resisted the pressure to increase the size of the book. This has forced us to make some tough choices in deciding what to include and what to leave out. We live in what has been called the “information age.” Our main focus, therefore, is not so much on providing information as it is on helping students evaluate that information.

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.

## I Objectives

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

- To attract as many students as possible. If students 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 our students will want to continue learning throughout their lives.
- To acquaint students with scientific methods. We want students 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.

## I Changes in the Eighth Edition

All the text has been thoroughly updated to reflect the latest scientific knowledge. In addition, we have responded to suggestions from users and reviewers of the seventh edition and have used our own writing and teaching experience to make the following changes:

- For this eighth edition, we have added critical thinking exercises in each chapter. These exercises are introduced in Chapter 1, where we have included worked-out examples. We have found that students initially need guidance and practice in working through critical thinking exercises, but with some experience they can do quite well on their own.
- At the request of several users and reviewers, we have added a new section (Section 6.9) on gas laws. This addition includes four new figures and four additional examples and exercises. At the end of the chapter, 10 new review questions and 14 new problems have been added.
- A new section (Section 8.7, Explosive Reactions) has been added to Chapter 8.
- Several applications have been moved from later to earlier chapters. For example, some of the discussion of acid rain has been moved from Chapter 12 to Chapter 7, and the reactions of salicylic acid and some of the material on salicylates is now discussed in Chapter 9 rather than in Chapter 19. We also make extensive cross references to later applications of principles that are introduced in early chapters.
- There are several new applications boxes. One entitled “Why Doesn’t ‘Stomach Acid’ Dissolve the Stomach?” appears in Chapter 7. Others include one on fake fats in Chapter 16 and one on nitric oxide and the learning process in Chapter 19. New box features in Chapter 20 include “What Kills You? What Makes You Sick?” and “How Cigarette Smoking Causes Cancer.”
- We have chosen several new photographs and produced new diagrams to improve the pedagogy and the visual appeal of the book. Several of the new illustrations are computer-generated molecular graphics.

## I 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.

## I 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 edition.

## I 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.

## I Chemical Structures

The structures of many complicated molecules are presented in the text, especially in the later chapters. These structures are presented mainly to emphasize that they 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 all 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.

## I Glossary

The glossary (Appendix E) gives definitions of terms that appear in **boldface** throughout the text. These terms include all the key terms listed at the ends of the chapters.

## I 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.

## I 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 topic can delve more deeply into the subject in the library. Instructors might also find these lists useful.

## I Supplementary Materials

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

*New York Times* Themes of the Times. This newspaper-format off-print uses current chemistry-related articles to emphasize the importance and relevance of chemistry in our lives. (Free in quantity to qualified adopters.)

*Chemistry for Changing Times* World Wide Web Center (<http://www.prenhall.com/~chem>). Through current news articles, this user-friendly site emphasizes

that chemistry is an open-ended learning experience, and gives real examples of how it affects our daily lives. The site also offers interactive quizzes where they receive guided instruction, get graded results, and can mail their results electronically to their professor.

*Student Study Guide* by John W. Hill of University of Wisconsin–River Falls and Richard Jones of the Sinclair Community College. This useful guide contains learning objectives, chapter outlines, key terms, and additional problems along with self-tests and answers.

*Test Item File* by David R. Gano, Minot State University, contains over 1600 multiple choice questions that are referenced to the text.

*Computerized PH Custom Test*. This computerized test generator is available in Windows and Macintosh.

*Transparencies*. This set contains 150 four-color acetates.

*Instructor's Resource Manual* by Paul Karr of Wayne State College includes lecture outlines, answers and solutions to all questions and problems which are not answered by the authors in the answer appendix, suggested in-class demonstrations recommended by Doris Kolb, and other suggested resources. The lecture outline is also available in an electronic format.

*Chemical Investigations for Changing Times, Eighth Edition*, by Alton C. Hassell and Paula Marshall contains forty-one laboratory experiments and is specifically referenced to *Chemistry for Changing Times*. An *Instructor's Manual* prepared by Paula Marshall is also available.

## I Acknowledgments

Through the last quarter century we have benefited so much from hundreds of helpful reviews. It would take far too many pages to list all of those reviewers here. Many of you have contributed to the flavor of the book and helped us minimize our errors. Please know that your contributions are deeply appreciated. For this edition, we are grateful for challenging reviews from:

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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*. We acknowledge with thanks the permission to reprint them here. Those verses plus all of the others, including the chapter openers, were written by Doris Kolb.

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 Ben Roberts and from our outstanding production editor, Andrea Fincke.

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 suggestions, and given invaluable help with this eighth 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

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## I 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 of 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.

## I 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 such as 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 better understand the benefits and hazards of this world and enable you to make intelligent decisions in the future.

## I 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 that allow our bodies to function properly are constantly taking place within us. 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 still 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 better understand how your body works so that you will be able to take proper care of it.

## **I 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.

## **I Chemistry and the Human Condition**

Above all else, our hope is that you will learn that the study of 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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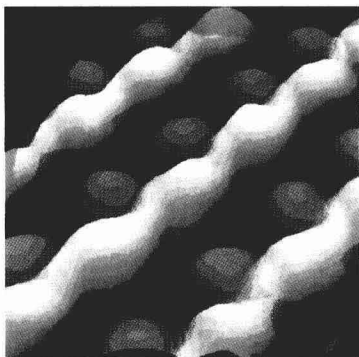
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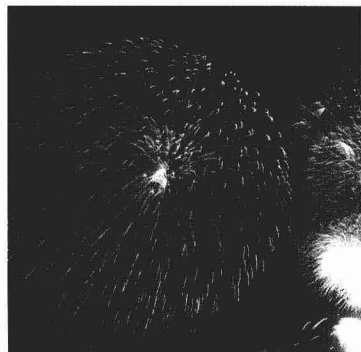
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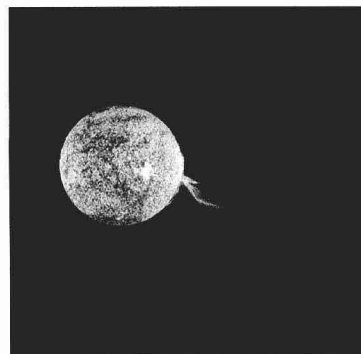
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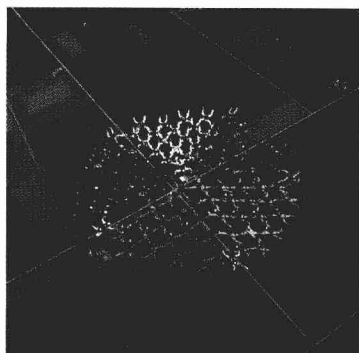


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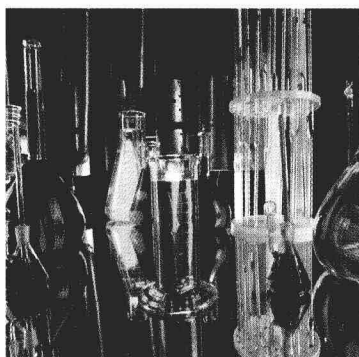
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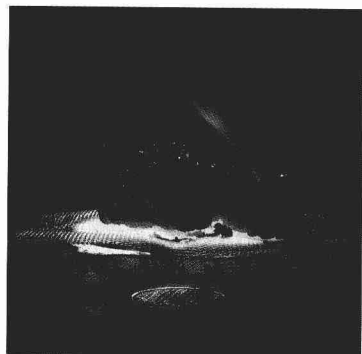
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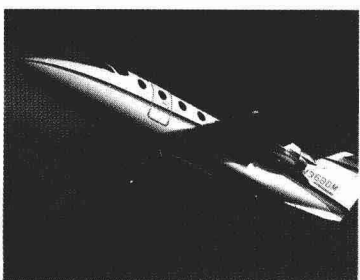
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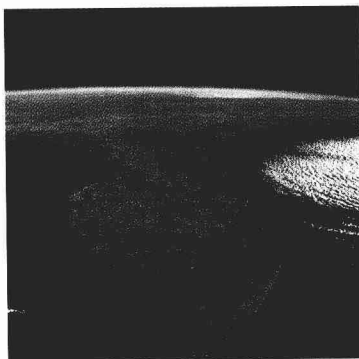
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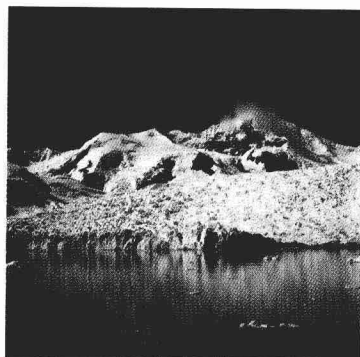
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