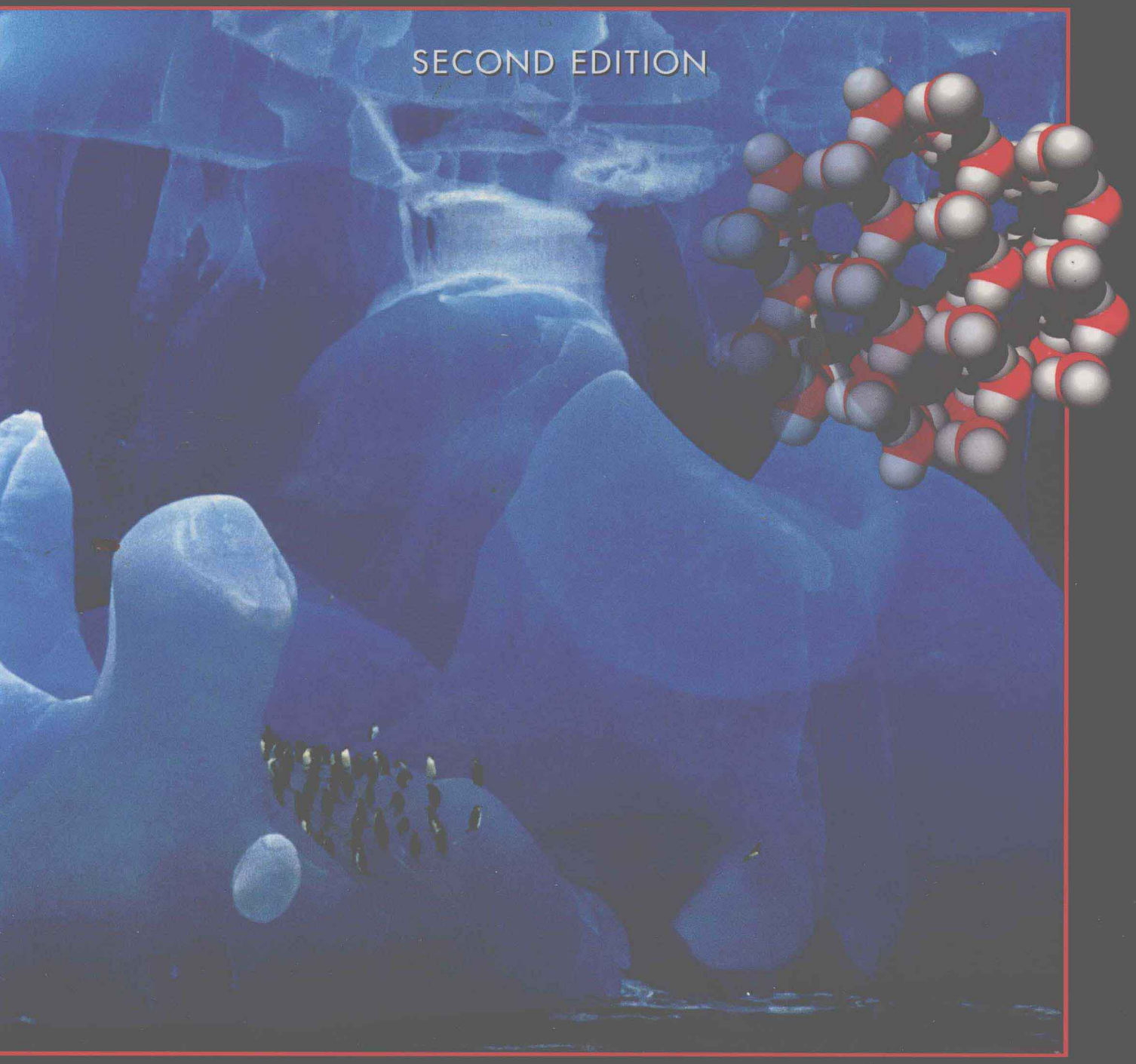
THE CHEMICAL WORLD

CONCEPTS AND APPLICATIONS

SECOND EDITION



MOORE / STANITSKI / WOOD / KOTZ

THE CHEMICAL WORLD

Concepts and Applications

Second Edition

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Second Edition

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THE CHEMICAL WORLD

Concepts and Applications

Second Edition

Elizabeth J. Anderson

Here's what your colleagues are saying about the second edition of *The Chemical World: Concepts and Applications*

"The best feature of the text is the very successful integration of organic chemistry, biochemistry, and environmental topics into the presentation of chemical principles. . . . The authors have managed to do this **without sacrificing the rigor** that has become the trademark of chemistry courses in general."

—David Miller
California State University, Northridge

"I was impressed with the implementation of both the emphasis on conceptual understanding and especially the sections that included biochemistry and organic examples. I was particularly impressed with the discussions of free energy and biology and of the production of ATP to store energy."

—Jimmy Reeves
University of North Carolina, Wilmington

"The integration of [illegible] chemistry' and the decreased [illegible] mathematical discussions are particularly attractive."

—Richard Stolzberg
University of Alaska, Fairbanks

"The authors have done a beautiful job of being consistent in the level and style of writing. The coverage is very thorough and **the level of rigor has not been sacrificed** in order to make the material more relevant. . . . The integration of organic, biochemistry, and environmental chemistry goes far beyond what any other text for chemistry majors has done. This is an excellent step toward the integration of relevant topics and chemical principles."

—Miles Koppang, University of South Dakota

"I consider the conceptual exercises to be a major and welcome addition to the new text. These **questions force students to apply the concepts** they have just read about and, consequently, enhance their basic understanding of the material. These are the kinds of questions that I typically ask on homework assignments and on exams."

—Patrick Holt, Bellarmine College

"Integrating organic chemistry, clinical and biochemistry, and environmental chemistry is a welcome change and should be promoted. Clearly this is a bold, much-needed addition to freshman chemistry."

—Joseph Sneddon, McNeese State University

"The conceptual problems in *The Chemical World* will make students stop and think instead of merely punching numbers on their calculators to satisfy a formula."

—Robert Profilet, Texas Tech University

"The development of Principles of Reactivity is excellent, with a particularly good approach to making the origin of the Gibbs free energy more than a just-so story. . . . The chapter on chemical kinetics is excellent—**it is rigorous without being mathematically overwhelming,** and the examples chosen are both clear and pertinent to actual chemical research."

—Ruben Puentedura, Bennington College

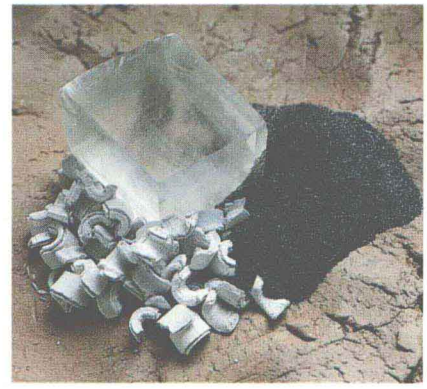
"I am very happy to see so many end-of-chapter questions. They are good ones and are well-linked to the chapter material."

—Donald Williams, Hope College

"The biggest strength of the text is the readability, the historical information, the blending of worked-out examples with the text, and the large number of conceptual problems found within each chapter."

—Sidney Young, University of South Alabama

PREFACE



Why write a general chemistry textbook? Aren't there so many available as to shift the equilibrium toward leaving well enough alone? And isn't it almost impossible to do something new and better? We think not, and this book's first edition was constructed to express clearly the directions we thought general chemistry courses ought to be taking. This second edition reflects the continuing development of the philosophy embodied there.

Our title, *The Chemical World: Concepts and Applications,* indicates that this book is about the facts, theories, and models of chemistry and how they can be applied to understanding the world around us. We have described these concepts and facts in a way that is interesting and accessible to a broad range of students who plan careers in chemistry, other natural sciences, engineering, and related fields. We believe that by integrating applications, facts, and concepts we can motivate students to become actively engaged and involved with the material, thereby enhancing their long-term understanding.

Because the first edition of *The Chemical World* was not a clone of the typical textbook, those who reviewed it and used it paid special attention to the new approaches we took. We appreciate the very useful feedback and suggestions we have received from a variety of sources. This second edition reflects what we have learned from faculty at diverse institutions who are teaching students with a broad range of abilities and motivations. Based on this input and our own observations as we used the book, we have developed further the philosophy that led to and infused the first edition.

Goals of This Book

Our principal goals are to help students develop

- a broad overview of chemistry and chemical reactions,
- an understanding of the most important concepts and models that chemists, and those in chemistry-related fields, use,
- the ability to apply the facts, concepts, and models of chemistry appropriately to new situations in chemistry, other sciences and engineering, and other disciplines,
- knowledge of the many practical applications of chemistry in our society and our environment,

- appreciation of the many ways that chemistry impacts the daily lives of everyone, students included, and
- motivation for studying in ways that help them achieve long-term retention of facts and concepts.

Audience

The Chemical World: Concepts and Applications is intended for general chemistry courses for students who expect to pursue further study in science or science-related disciplines. Those planning to major in chemistry, biochemistry, biological sciences, engineering, geological sciences, materials science, physics, and many related areas should benefit from this book and its approach. We assume that the students who will use this book have had a basic foundation in mathematics (algebra and geometry) and in general science. Most will also have had a chemistry course before coming to college.

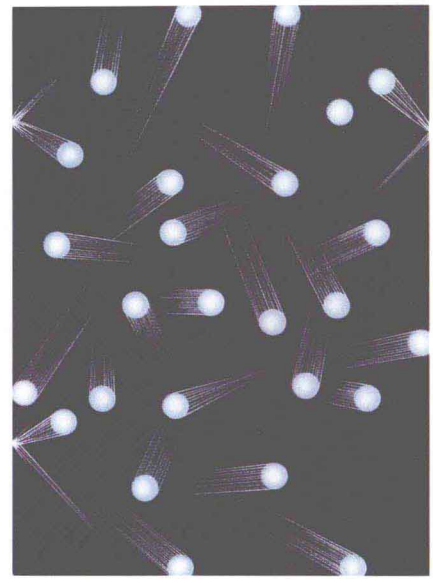
Philosophy, Approach, and Special Features

Our intent is that this book can be used in its entirety in a two-semester course. We provide thorough, concept-rich treatments of those subjects that we (and users of the first edition) have identified as the most important for chemistry students to learn and understand. We have attempted to distill the essence from the encyclopedic liquor that is called general chemistry. And we have used some of the space made available to incorporate new topics and ideas from modern chemistry and related fields. The criterion for including a principle or concept continues to be that it is used later in the book or will be used by a large fraction of students in subsequent studies. By concentrating on the most important ideas and integrating them with applications as well as other concepts, we have aimed for a whole that provides students with much better understanding and longer-term retention of facts and principles than could be achieved by disconnected, individual parts.

Whenever possible we include practical applications, especially those applications that students will revisit when they study other natural science and engineering disciplines. Applications have been integrated where they are relevant, not relegated to separate chapters and separated from the principles and facts on which they are based. We have included **numerous cross references (indicated by ⇐)** that will help students link a concept being developed in the chapter they are reading with an earlier, related principle or fact.

Of particular importance is the **integration of organic chemistry and biochemistry** throughout the book. In many areas, such as stoichiometry and molecular formulas, organic compounds provide excellent examples. To take advantage of this we have incorporated basic organic topics into the text beginning with Chapter 3 and used them wherever they are appropriate. In the discussion of molecules and the properties of molecular compounds, the concepts of structural formulas, functional groups, and isomers are developed naturally and effectively.

Many of the principles that students encounter in general chemistry are directly applicable to biochemistry, and a large fraction of the students in most general chemistry courses are planning careers in biological or medical areas that make constant use of biochemistry. Therefore we have chosen to deal with biochemical topics in juxtaposition with the general chemistry principles that underlie them. For example, elements essential to life and two classes of biomolecules are introduced in Chapter 3 and used in examples involving moles and formulas of molecular compounds. Metabolism and Gibbs free energy are closely coupled in Chapter 7, DNA structure is



discussed in Chapter 10 in conjunction with hydrogen bonding and other noncovalent interactions, proteins are covered in Chapter 11, and enzymes are dealt with in Chapter 12 on kinetics.

Environmental topics are also integrated. Stratospheric ozone depletion provides an excellent reinforcement of the concept of catalysis in Chapter 12 (kinetics), atmospheric chemistry and air pollution are discussed in Chapter 14 (gases), and the chemistry of the aqueous environment is developed naturally in Chapter 16 (solutions). Units are introduced on a need-to-know basis. Celsius temperature is defined in Chapter 1 with the introduction to the properties of matter. Length, mass, and volume units are introduced in Chapter 2 in the context of the sizes of atoms. Energy units are defined in conjunction with energy, work, and heat in Chapter 6 (thermochemistry), and the thermodynamic temperature scale is introduced in Chapter 7 (thermodynamics), where the need for it can be made clear.

We continue to believe that a sound conceptual foundation is the best means by which students can approach and solve a wide variety of real-world problems. Three features have been designed to help students test their conceptual understanding: a large number of **Conceptual Exercises (indicated by**) are included within each chapter; a separate section of the end-of-chapter questions, headed **Applying Concepts,** has been developed by Patricia Metz, Texas Tech University; and each chapter has a set of **Conceptual Challenge Problems,** most of them written by H. Graden Kirksey, University of Memphis, that will make individual students think in new ways about the concepts they have learned. The Conceptual Challenge Problems are also suitable for students to work on in cooperative groups.

To support our intent that students develop long-term understanding rather than rote memorization, we have included the many numerical **Exercises** (with answers only available in the back of the book) that characterized the first edition, expanding them with the Conceptual Exercises described previously. We have also developed a new form of example that we call a **Problem-Solving Example.** It consists of four parts: a Question (problem); an Answer, stated briefly; an Explanation that provides significant help for students whose answer did not agree with ours; and additional Problem-Solving Practice that provides similar questions or problems. We encourage students first to work out an answer for the question or problem without looking at either the Answer or the Explanation, then to check their answer, next to repeat their work if their answer did not agree with ours, and only after that to look at the Explanation.

We believe that our approach to problem solving will enable students to learn strategies and techniques that will help them approach and solve real problems they will encounter later in their careers. To help them evaluate how well they have developed such abilities, the **end-of-chapter questions have been revised and expanded** by Patricia Metz, Texas Tech University; Melinda Oliver, Louisiana State University; and Allan Smith, Drexel University. In addition to the Conceptual Challenge Problems and Applying Concepts questions, we have included questions keyed to sections within each chapter. There is also an extensive set of general questions that are not identified with chapter sections and that often draw on several related concepts for their solution. To further emphasize that problem solving is a crucial aspect of learning science, we have keyed a question to the photograph with which each chapter opens. Students answer that question as part of a **Summary Problem** that ends the chapter and ties together many or all of the major concepts discussed in the chapter.

There is considerable evidence in the literature that students learn better when they can see the relationships among macroscopic phenomena, submicroscopic models involving atoms, molecules and/or ions (we call this the nanoscale), and symbolic

A Capstone Experience via the World Wide Web

We believe that it is highly effective for students to end a one-year general chemistry course with a capstone experience that integrates and coordinates the chemistry concepts learned earlier with a variety of other areas and gives students a realistic picture of the broad applicability and importance of our discipline. To this end we provide a modular Chapter 20, "The Chemical World." It consists of three sections, any of which can be used as a case study to wrap up a first-year course. Each section is independent of the other two and deals with an application of chemistry to an area of considerable practical importance that connects chemistry with a variety of related subjects. The three modules are titled

- Metals in Modern Society
- The Atmospheric Environment
- Biochemical Structure and Function

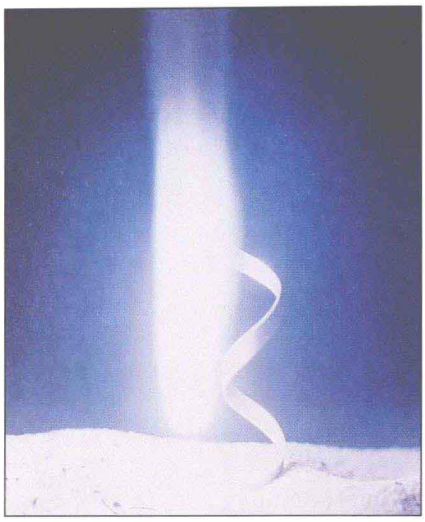
We expect that few if any faculty would use all three of these modules in the same year, but many will use different modules in different years. In addition, it is important that each module be up to date, because both the science and its societal consequences are developing continually. For these reasons we have decided on a highly innovative approach. Chapter 20 does not appear in this textbook, but rather is available to adopters of the book via the Saunders College Publishing World Wide Web site (www.saunderscollege.com). (Printed copies will also be made available if there is a need for them.) In addition to text, color graphics, and the other features of a printed book, the Web version provides animations, videos, and links to other relevant Web sites. It can be used directly on the Web or printed for more extended examination and study. We strongly encourage adopters of this book to utilize this Web site and to provide us with collective knowledge that will enhance both its content and presentation.

Organization

The most important change in organization from the first edition to this one is integration of biochemistry, organic chemistry, environmental chemistry, and applications of chemistry with the principles and concepts that are the essence of a general chemistry course.

Chapter 1, "The Nature of Chemistry," is an overview of science, its methods, and its practitioners that uses as an example the chemistry behind the hole in the ozone layer and the recent winners of the Nobel Prize who discovered much of that science. The chapter also introduces qualitatively the kinetic-molecular theory and describes mixtures, compounds, elements, and separation and purification processes. Chapter 2, "Elements and Atoms," deals with the atomic theory, atomic structure and atomic weight, the mole, and a brief introduction to the periodic table. "Chemical Compounds" (Chapter 3) describes properties and nomenclature of molecular compounds and ionic compounds; it introduces carbohydrates, fats, and oils; and it revisits the mole. "Chemical Reactions" (Chapter 4) introduces chemical equations and categories of chemical reactions, providing a firm base of descriptive chemistry on which subsequent chapters can build. In Chapter 5, "Relating Quantities of Reactants and Products," stoichiometry is applied to reactions among pure substances and in solution.

The next two chapters begin to develop the principles on which chemical reactivity is based. We have split thermodynamics from thermochemistry, treating energy,



enthalpy, calorimetry, and fuels in Chapter 6, "Energy Transfer and Chemical Reactions." Entropy and Gibbs free energy are discussed in Chapter 7, "Directionality of Chemical Reactions," which could easily be taught in the second semester, long after Chapter 6. Chapter 7 also applies thermodynamic ideas to (free) energy resources, conservation of (free) energy, coupling of reactions, and metabolism and biochemical energetics.

The next three chapters, "Electron Configurations, Periodicity, and Properties of Elements" (Chapter 8), "Covalent Bonding" (Chapter 9), and "Molecular Structures" (Chapter 10), develop the electronic structure of atoms, chemical bonding, molecular structure including hybrid orbitals, isomerism, and the consequences of noncovalent interactions between molecules. The ideas developed here are applied to spectroscopy of atoms and molecules (and MRI as well), descriptive chemistry of elements in the second row of the periodic table, chiral drugs, and the structure of DNA. Chapter 11, "Energy, Organic Chemicals, and Polymers" continues to apply the ideas of bonding and structure to fossil fuels, alcohols, carboxylic acids, organic polymers, plastics and recycling, and proteins.

Chapter 12, "Chemical Kinetics," and Chapter 13, "Chemical Equilibrium," develop further the principles that underlie chemical reactivity and apply them to biological and industrial catalysts, environmental systems such as stratospheric ozone where catalysis is important, and the control of chemical reactions to obtain the substances we want. "Gases and the Atmosphere" (Chapter 14) and "The Liquid State, the Solid State, and Modern Materials" (Chapter 15) deal with the three major states of matter and changes among them. The chemistry developed in Chapter 14 is applied to obtaining chemicals from the atmosphere, gas-phase reactions in the environment, and air pollution. In Chapter 15 semiconductors, superconductors, and ceramics exemplify the importance of materials science and its relation to chemistry.

The next three chapters are devoted largely to chemistry in aqueous solutions. Chapter 16, "Water and Solution Chemistry," develops the fundamentals of solubility and applies them to hard water, water pollution, and water purification. Chapter 17, "Acids and Bases," describes aqueous equilibria involving acids and bases, and applies these ideas to household chemicals and acid rain. Chapter 18, "Electrochemistry and Its Applications," does what its title implies. The many practical applications of both voltaic cells and electrolysis are emphasized.

"Nuclear Chemistry" is the subject of Chapter 19—one that is constantly in the news. Chapter 20, "The Chemical World," is our innovative Web-based set of three modules: Metals in Modern Society; The Atmospheric Environment; and Biochemical Structure and Function. Any one of these provides a capstone experience for students in a first-year college course, bringing to bear many of the principles, concepts, models, and facts learned in previous chapters.

New to This Edition

Many of the book's features have already been mentioned to illustrate how we have implemented our philosophy. New features in this edition are

- Chapter-opening photograph and question keyed to the Summary Problem at the chapter's end
- Computer-generated art that relates the nanoscale of atoms, molecules, and ions, the macroscale of the laboratory, and the symbolic formulas and equations of chemistry
- Conceptual Exercises, which are indicated by the symbol

- Connections among related concepts and applications, which are indicated by the ⇐ symbol
- Summary Problem at the end of each chapter to consolidate and reinforce concepts
- Chapter-end Conceptual Challenge Problems that require considerable thought and are suitable for cooperative group work
- Expanded and revised chapter-end problems, including a new section, Applying Concepts
- Key terms list at the end of each chapter
- Complete glossary of key terms at the end of the book
- Large number of Problem-Solving Examples with answers, explanations, and Problem-Solving Practice questions—structured to avoid rote problem solving
- An applications-based Web site (*see p. xiii*)

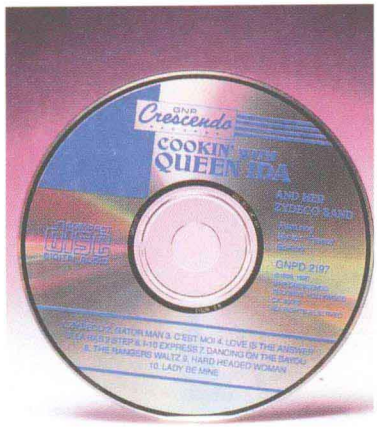
Integrated Material

Integrated organic chemistry, biochemistry, environmental chemistry, and applications include

- Introduction to organic chemistry, fats, carbohydrates, and dietary essential elements (Chapter 3)
- Patterns of chemical reactions related to environmental applications and industrial products (Chapter 4)
- Stoichiometry applied to industrial chemical processes (Chapter 5)
- Bond energies linked to fossil fuels and hydrogen use (Chapter 6)
- Gibbs free energy in relation to fuel resources and to energy transfer in biological systems—ADP/ATP, photosynthesis (Chapter 7)
- Application of nuclear magnetic resonance to medical magnetic resonance imaging (MRI) (Chapter 8)
- Isomerism in hydrocarbons; coordination compounds and life (Chapter 9)
- Organic molecules and biomolecules as examples of molecular structure, and their structural determination using uv-visible and infrared spectroscopy (Chapters 9 and 10)
- Overview of DNA structure and function with molecular structure and noncovalent forces (Chapter 10)
- Petroleum refining, additional organic chemistry, and polymers (Chapter 11)
- Enzymes and stratospheric ozone depletion with kinetics (Chapter 12)
- Applications of equilibrium principles to geological and atmospheric processes (Chapter 13)
- Atmospheric chemistry and air pollution with gases (Chapter 14)
- Ceramics and composite materials with solid state (Chapter 15)
- Chemistry of the aqueous environment with solutions (Chapter 16)
- Household chemicals with acids and bases (Chapter 17)
- Newly developed batteries (Chapter 18)

Features Retained from the First Edition

- Introductory paragraph giving an overview of each chapter and providing practical reasons to study the material
- Numerous Exercises that encourage students to study actively, not just read; answers are provided in an appendix
- A Chemistry You Can Do take-home or dorm-room experiment in every chapter



- A Portrait of a Scientist box in every chapter to show the human side of science and scientists
- A Chemistry in the News box in every chapter to relate the chemistry being studied to recently breaking news and to emphasize the applicability of chemistry to everyday life
- Plentiful margin notes that highlight important points and steer students around potential pitfalls
- In Closing section at the end of each chapter to list important points students should have mastered and to link them to sections in the chapter
- Numerous Questions for Review and Thought (some illustrated with photographs or nanoscale art) at the end of each chapter, with answers to boldface-numbered questions in an appendix
- Appendices on problem solving, mathematical operations, units and conversion factors, physical constants, nomenclature, ionization constants for acids and bases, solubility product constants, reduction potentials, thermodynamic data, answers to problem-solving practices and exercises, and answers to selected chapter-end questions

Supporting Materials

Written Materials for the Student and Instructor

The **Student Study Guide** by Dean Nelson of the University of Wisconsin-Eau Claire has been designed around the key objectives of the book. Each chapter of the study guide includes study hints, true/false questions, a list of symbols presented in the chapter, a list of terminology, concept maps of the chapter topics, a concept test, a discussion of how the chapter material relates to other chapters, crossword puzzles, and supplementary reading of current interest.

The **Student Solutions Manual** by Paul Kelter and James Carr of the University of Nebraska-Lincoln gives detailed solutions to designated end-of-chapter questions. The manual also contains strategies for problem solving.

The **Instructor's Resource Manual** by Patricia A. Metz of Texas Tech University focuses on four main areas: conceptual understanding and how to help students develop it; pedagogical approaches and learning strategies; cooperative learning and suggested group activities; and technology-based enhancement of learning. In addition, there is background information regarding the Chemistry You Can Do experiments, suggestions for chemical demonstrations that illustrate important points, and answers for the Summary Problems and Conceptual Challenge Problems. Solutions in the Instructor's Manual are contributed by Paul Kelter and James Carr of the University of Nebraska, Gary Michels of Creighton University, and by Therese Michels of Dana College.

A **Test Bank** by Ronald Clark of Florida State University provides hundreds of conceptual and numerical problems for use by the instructor. It is available in written, Macintosh, IBM, and Windows versions.

Overhead Transparencies of 150 figures from the book are available to adopters of the book. In addition, these transparencies as well as those from all other Saunders College Publishing chemistry textbooks are available on the Shakhashiri Chemical Demonstrations videodisc mentioned on p. xiv. Both the transparencies and the videodisc are available at no charge to the adopters of this book.

Laboratory Manuals

Saunders offers many excellent general chemistry laboratory manuals, all of which can be used in conjunction with *The Chemical World.* An instructor's manual is available for each title. In the event that none of these laboratory manuals meets your needs individually, selected experiments can be custom published as a separate laboratory manual, in accordance with Saunders' custom publishing policy. Please contact your local sales representative for more information on custom publishing.

Laboratory Experiments for General Chemistry (1998) by Joe March of the University of Wisconsin–Madison and David Shaw of Madison Area Technical College, evolved in conjunction with the NSF-supported New Traditions Project. This guided-inquiry approach has more than 25 experiments.

Chemical Principles in the Laboratory, sixth edition (1996), by Emil J. Slowinski and Wayne Wolsey of Macalaster College and William J. Masterton of the University of Connecticut provides detailed directions and advance study assignments. These thoroughly class-tested experiments were chosen with regard to cost and safety. The manual includes 43 experiments. An Alternate Version containing Qualitative Analysis (1996) is also available.

Standard and Microscale Experiments in General Chemistry, third edition, by Carl B. Bishop and Muriel B. Bishop, both of Clemson University, contains descriptive, quantitative, and instrumental experiments. This manual provides detailed instructions and incorporates helpful notes into the experiments to help students gain confidence. Alternate procedures have been added for several experiments, providing the instructor with a choice between macro and **microscale** uses. Approximately 30% of the experiments are available in microscale.

Laboratory Experiments for General Chemistry, third edition (1998, available July 1997), by Harold R. Hunt and Toby F. Block of Georgia Institute of Technology contains experiments that are designed to minimize waste of materials and stress safety. Pre-lab exercises and post-lab questions are included. The manual includes 42 experiments.

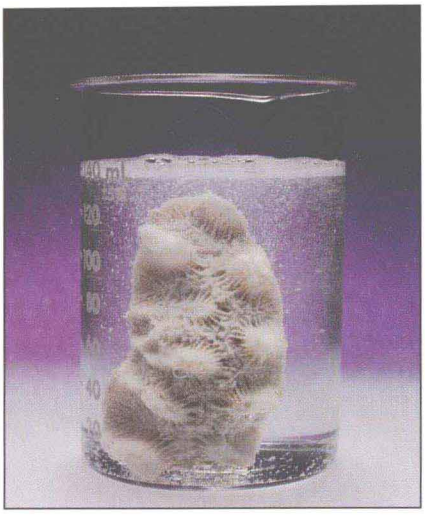
Experiments in General Chemistry, (1991) by Frank Milio and Nordulf Debye of Towson State University and Clyde Metz of the College of Charleston, is the result of many years of collaboration on the development of laboratory-tested experiments in which attention has been given to cost and safety. This manual contains 44 experiments.

Saunders Chemistry Web Resource Center

Based on feedback from hundreds of chemistry educators and students, Saunders has created a unique Web site that encourages students to probe and question. An **algorithmic problem-solving program** allows students to improve their skills and prepare for exams with new sets of problems every time they log on. The variety of problems, including multiple choice and numeric input, is unmatched by other Web sites. (See www.saunderscollege.com.)

Multimedia Materials

Saunders Interactive General Chemistry CD-ROM is a revolutionary interactive tool. This multimedia presentation serves as a companion to the text. Divided into chapters, the CD-ROM presents ideas and concepts with which the user can interact in several different ways, for example, by watching a reaction in progress, changing a variable in an experiment and observing the results, and listening to tips and suggestions for understanding concepts or solving problems. Students navigate through



the CD-ROM using original animation and graphics, interactive tools, pop-up definitions, over 100 video clips of chemical experiments, which are enhanced by sound effects and narration, and over 100 molecular models and animations.

Chemistry 1998 MediaActive contains imagery from various Saunders texts in general and organic chemistry in a presentation CD-ROM that can be used in conjunction with commercial presentation packages, such as Power-Point™, Persuasion™, and Podium™. Available for both Windows and Macintosh platforms.

Shakhashiri Chemical Demonstration Videotapes contain a unique set of 50 three- to five-minute chemical experiments performed by Bassam Shakhashiri. These videos bring the drama of chemistry into the classroom. An instructor's manual describes each experiment and includes questions for discussion. The videotapes are available free to adopters of the text. **Saunders General Chemistry Videodisc** contains most of the Shakhashiri demonstrations. In addition to this live-action footage, almost 3000 still images taken from eight of Saunders' general chemistry textbooks, including *The Chemical World,* are included on the two-disc set. This videodisc is free upon adoption of any Saunders general chemistry text.

The **World of Chemistry Videotapes** are based on the television series and telecourse, "The World of Chemistry," with Roald Hoffmann as host. These 26 tapes are each about 30 minutes long and provide introductory material on the principles and applications of chemistry. The tapes may be ordered through the Annenberg Foundation at 1-800-LEARNER ($350).

The following items may be purchased from the *Journal of Chemical Education: Software* at JCE: Software, Department of Chemistry, University of Wisconsin-Madison, 1101 University Ave., Madison, WI 53706, (800) 991-5534.

The Periodic Table Live! CD provides on one CD-ROM for Macintosh and Windows PCs a broad range of textual, numeric, and visual information about the chemical elements. Essentially all of the video material from the Periodic Table Videodisc is on the CD and can be accessed easily via a periodic-table-based interface. In addition there is information about macroscale and nanoscale physical properties, solid-state structures, and discovery and applications of each element.

The JCE: Software General Chemistry Collection is a CD-ROM for Macintosh and Windows. Intended for use by students, it includes nearly 40 software programs that correlate with subjects described in this book.

Inorganic Molecules: A Visual Database by Charles Ophardt is a Macintosh-only CD-ROM that contains images of a broad range of molecules specifically designed for classroom presentation by a teacher. Ball-and-stick and space-filling models, Lewis diagrams, VSEPR geometries, orbital hybridization, molecular orbitals, and dipole moments are illustrated.

The Periodic Table Videodisc: Reactions of the Elements (second edition) by Alton J. Banks is a *visual* database; it shows still and motion images of the elements, their uses, and their reactions with air, water, acids, and bases. It is a particularly useful way to demonstrate chemical reactions in a large lecture room. The videodisc can be operated from a videodisc player by a hand-controlled keypad, a barcode reader, or an interfaced computer.

ChemDemos I and II by John W. Moore *et al.* are two videodiscs that contain a broad range of chemical demonstrations roughly correlated with the order of presentation of chemistry content in this and other texts. They are particularly useful for demonstration of chemical reactions in a large lecture room. The videodiscs can be operated from a videodisc player by a hand-controlled keypad, a barcode reader, or an interfaced computer.

The World of Chemistry: Selected Demonstrations and Animations I and II are two videodiscs that show demonstrations together with animated sequences that give a nanoscale interpretation of the demonstrations, both selected from the "World of Chemistry" television series and telecourse.

HIV-1 Protease: An Enzyme at Work by Erica Bode Jacobsen *et al.* is a VHS videotape in NTSC format that uses a very timely example (protease inhibitor treatment of AIDS) and state-of-the-art molecular modeling to show enzyme action. It includes class-tested teaching materials designed to help students learn about enzyme catalysis and inhibition.

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Troy, MO 63379

The New Traditions Project

The philosophy and approach taken in this book and many of the specific implementations of that philosophy are congruent with those of the systemic curriculum project Establishing New Traditions: Revitalizing the Curriculum, and this book will be an excellent resource for those who adopt and adapt the New Traditions approach. The New Traditions project is funded by the National Science Foundation, Directorate for Education and Human Resources, Division of Undergraduate Education, grant DUE-9455928.

REVIEWERS

Reviewers play a vitally important role in the preparation of a textbook. Our reviewers have risen to the challenge of evaluating a text that aims to find new ways to generate interest and excitement about chemistry for our students while maintaining rigor and appropriate content coverage. We deeply appreciate the effort they put into their tasks, and we have paid close attention to every comment.

The individuals listed below have played a significant role in shaping this book, and we thank them for their efforts. John DeKorte, Glendale Community College, Arizona, gets our special thanks for taking great care to check every word of the final draft for accuracy, and doing so quickly and cheerfully. Rob Profilet, Texas Tech University and Texaco, checked selected end-of-chapter questions promptly and enthusiastically.

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The following reviewers based their comments on the first edition of *The Chemical World:*

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The following professors added helpful comments in a survey about the first edition:

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