

From the first edition, my aim has been to write a general chemistry text that provides a firm foundation in chemical concepts and principles and to instill in students an appreciation of the vital part chemistry plays in our daily life. It is the responsibility of the textbook author to assist both teachers and their students in their pursuit of this objective by presenting a broad range of topics in a logical manner. I have tried to strike a balance between theory and application and to illustrate basic principles with everyday examples whenever possible.

In this eleventh edition, as in previous editions, my goal is to create a text that is clear in explaining abstract concepts, concise so that it does not overburden students with unnecessary extraneous information, yet comprehensive enough so that it prepares students to move on to the next level of learning. The encouraging feedback I have received from teachers and students has convinced me that this approach is effective.

What's New in This Edition?

Ken Goldsby, Florida State University, has joined Raymond Chang as an author on the eleventh edition of *Chemistry*. Ken's background in inorganic chemistry has added insight into content and problems, and his extensive work with undergraduate students, reinforces Raymond's long tradition of understanding and respecting the student's and teacher's view of the material.

New organization with the chapters in the latter part of the text reorganized as follows:

- Chapter 17: Entropy, Free Energy, and Equilibrium
- Chapter 18: Electrochemistry
- Chapter 19: Nuclear Chemistry
- Chapter 20: Chemistry in the Atmosphere
- Chapter 21: Metallurgy and the Chemistry of Metals
- Chapter 22: Nonmetallic Elements and Their Compounds
- Chapter 23: Transition Metals Chemistry and Coordination Compounds
- Chapter 24: Organic Chemistry
- Chapter 25: Synthetic and Natural Organic Polymers
- AP Correlated Chapter Introductions for every chapter

Reorganization of these chapters enables those who teach nuclear chemistry to introduce this material right after the coverage of electrochemistry. In addition to recognizing the growing importance of nuclear medicine and the ongoing debate about the role nuclear power will play in addressing future energy needs, the placement of nuclear chemistry before atmospheric chemistry aids the discussion of radon pollution.

Numerous new end-of-chapter problems have been added to this new edition. A number of these problems test the student's ability to interpret graphical data and explain concepts. A new type of problems, called **Interpreting, Modeling & Estimating**, has been added to this edition. These problems are designed to teach the students to solve real-world problems, and they require the art of estimation based on appropriate assumptions, finding the necessary information, and formulating a plan for obtaining ballpark answers in many cases. In Section 1.10, the new problem type is described and a worked example is provided.

New is the creation and versatility of our **Connect[®] Chemistry** system. McGraw-Hill has initiated a rigorous process to ensure high-quality electronic homework. Through careful observation of real students and active instructors we have been able to evolve the online homework tool to an online learning and engagement tool. The goal of Connect is to usher in a new era of meaningful online learning that balances the conceptual and calculated aspect of this most vital discipline.

McGraw-Hill is offering students and instructors an enhanced digital homework experience using **Connect Chemistry**. Each problem within Connect Chemistry carries the text problem-solving methodology and is tailored with specific hints, as well as answer-specific feedback for common incorrect answers. Each question has been accuracy checked by two or more chemistry professors. Several rounds of editorial and chemical accuracy checking, in addition to numerous instructor and student tests of all problems, ensure the accuracy of all content.

In addition to the specific hints and feedback provided for all questions, many questions allow students a chemical drawing experience that can be assessed directly inside of their homework.

New **Review of Concepts** sections have been added to most chapters. This is a quick knowledge test for the

student to gauge his or her understanding of the concept just presented. The answers to the Review of Concepts are available in the Student Solutions Manual and on the companion website in Connect.

New **Chemistry in Action** boxed essays are added to Chapter 7 (Quantum Dots), Chapter 12 (Dialysis), and Chapter 13 (Pharmacokinetics). We have also updated Chemistry in Action boxed essays on White Fat Cells, Brown Fat Cells, and Cure for Obesity in Chapter 6, Buckyballs and Graphene in Chapter 10, and the Shroud of Turin in Chapter 13.

Many **chapters** and **sections** have new and revised content based on the comments from reviewers and users. Some examples include:

- Chapter 1—new Section 1.10 on Real-World Problem Solving: Information, Assumptions, and Simplifications including new Example 1.9.
- Chapter 3—revised Section 3.9 Limiting Reagents including new Example 3.16 showing how synthetic chemists often have to adjust excess reagents to compensate for side reactions.
- Chapter 4—new Example 4.4 on writing molecular, ionic, and net ionic equations involving weak diprotic and triprotic acids.
- Chapter 6—new is the change of the symbol E to U for internal energy to be consistent with accepted usage.
- Chapter 7—new Example 7.6 on quantum mechanics.
- Chapter 9—Example 9.11 provides insight into drawing Lewis structures for compounds containing elements in the third period and beyond, and addresses the controversy in drawing these structures.
- Chapter 13—new section on pseudo first-order reactions.
- Chapter 19—expanded and updated coverage of medical application of carbon-14 dating and new content on the island of stability.

Problem Solving

The development of problem-solving skills has always been a major objective of this text. The two major categories of learning are shown next.

- **Worked examples** follow a proven step-by-step strategy and solution.
- **Problem statement** is the reporting of the facts needed to solve the problem based on the question posed.
- **Strategy** is a carefully thought-out plan or method to serve as an important function of learning.
- **Solution** is the process of solving a problem given in a stepwise manner.

- **Check** enables the student to compare and verify with the source information to make sure the answer is reasonable.
- **Practice Exercise** provides the opportunity to solve a similar problem in order to become proficient in this problem type. The Practice Exercises are available in the Connect electronic homework system. The marginal notes list additional similar problems to work in the end-of-chapter problem section.

End-of-Chapter Problems are organized in various ways. Each section under a topic heading begins with Review Questions followed by Problems. The Additional Problems section provides more problems not organized by section, followed by the new problem type of Interpreting, Modeling & Estimating.

Many of the examples and end-of-chapter problems present extra tidbits of knowledge and enable the student to solve a chemical problem that a chemist would solve. The examples and problems show students the real world of chemistry and applications to everyday life situations.

Visualization

Graphs and Flow Charts are important in science. In *Chemistry*, flow charts show the thought process of a concept and graphs present data to comprehend the concept. A significant number of Problems and Reviews of Concepts, including many new to this edition, include graphical data.

Molecular art appears in various formats to serve different needs. Molecular models help to visualize the three-dimensional arrangement of atoms in a molecule. Electrostatic potential maps illustrate the electron density distribution in molecules. Finally, there is the macroscopic to microscopic art helping students understand processes at the molecular level.

Photos are used to help students become familiar with chemicals and understand how chemical reactions appear in reality.

Figures of apparatus enable the student to visualize the practical arrangement in a chemistry laboratory.

Study Aids

Setting the Stage for the AP Student

Each chapter highlights the connections to the new AP Chemistry Curriculum Framework.

Chapter Contents enables the student to see at a glance what will be covered and how it connects to the Big Ideas in Chemistry.

Introduction provides students with an overview of the content with the correlations to the AP Exam framework also highlighted.

Tools to Use for Studying

Useful aids for studying are plentiful in *Chemistry* and should be used constantly to reinforce the comprehension of chemical concepts.

Marginal Notes are used to provide hints and feedback to enhance the knowledge base for the student.

Worked Examples along with the accompanying Practice Exercise are very important tools for learning and mastering chemistry. The problem-solving steps guide the student through the critical thinking necessary for succeeding in chemistry. Using sketches helps the student understand the inner workings of a problem. (See Example 6.1 on page 238.) A marginal note lists similar problems in the end-of-chapter problems section, enabling the student to apply new skill to other problems of the same type. Answers to the Practice Exercises are listed at the end of the chapter problems.

Review of Concepts enables students to evaluate whether they understand the concept presented in the section. Answers to the Review of Concepts can be found in the Student Solution Manual and online in the accompanying Connect Chemistry companion website.

Key Equations are highlighted within the chapter, drawing the student's eye to material that needs to be understood and retained. The key equations are also presented in the chapter summary materials for easy access in review and study.

Summary of Facts & Concepts provides a quick review of concepts presented and discussed in detail within the chapter.

Key Words lists of all important terms help the student understand the language of chemistry.

Testing Your Knowledge

Review of Concepts lets students pause and check their understanding of the concept presented and discussed in the section. Answers to the Review of Concepts can be found in the Student Solution Manual and online in the accompanying Connect Chemistry companion website.

End-of-Chapter Problems enable the student to practice critical thinking and problem-solving skills. The problems are broken into various types:

- By chapter section. Review questions test basic conceptual understanding, followed by Problems to test the student's skill in solving problems for that particular section of the chapter.
- Additional Problems uses knowledge gained from the various sections and/or previous chapters to solve the problem.

- Interpreting, Modeling & Estimating problems teach students the art of formulating models and estimating ballpark answers based on appropriate assumptions.

Real-Life Relevance

Interesting examples of how chemistry applies to life are used throughout the text. Analogies are used where appropriate to help foster understanding of abstract chemical concepts.

End-of-Chapter Problems pose many relevant questions for the student to solve. Examples include: Why do swimming coaches sometimes place a drop of alcohol in a swimmer's ear to draw out water? How does one estimate the pressure in a carbonated soft drink bottle before removing the cap?

Chemistry in Action boxes appear in every chapter on a variety of topics, each with its own story of how chemistry can affect a part of life. The student can learn about the science of scuba diving and nuclear medicine, among many other interesting cases.

Chemical Mystery poses a mystery case to the student. A series of chemical questions provide clues as to how the mystery could possibly be solved. Chemical Mystery will foster a high level of critical thinking using the basic problem-solving steps built up throughout the text.

Enhanced Support for Teachers and Students

McGraw-Hill offers tools and technology products to support *Chemistry* for teachers and students alike. Teachers can obtain support by calling McGraw-Hill Customer Service Department at 1-800-334-7344, visiting our online catalog at www.mhonline.com, or by contacting a McGraw-Hill sales representative.

Supplemental Resources



McGraw-Hill Connect[®]Plus Chemistry is a Web-based, interactive assignment and assessment platform that incorporates cognitive science principles to customize the learning process. It features AP chapter introductions, AP chapter questions, and a complete AP Practice Exam.

End-of-chapter problems from this textbook are available in Connect Chemistry for teachers to build assignments that are automatically graded and tracked through reports that export easily to Excel. Teachers can edit existing problems and write entirely new problems; track individual student performance—by problem, assignment, concepts, or in relation to the class overall—with automatic grading; provide instant feedback to students; and store detailed grade reports securely online. Grade reports can be easily integrated with learning management systems such as WebCT and Blackboard. Single sign-on integration is available with Blackboard course management systems. Within Connect, teachers can also create and share materials with colleagues. Ask your McGraw-Hill representative for more information, and then check it out at connect.mcgraw-hill.com/advplac

With ConnectPlus, if you or your students are ready for an alternative version of the traditional textbook, McGraw-Hill has your solution. EBooks from McGraw-Hill are smart, interactive, searchable, and portable. Included is a powerful suite of built-in tools that enable detailed searching, highlighting, note taking, or instructor-to-student note sharing. In addition, the media-rich eBook for *Chemistry* integrates relevant animations and videos into the content for a multimedia learning experience.

LearnSmart™

McGraw-Hill LearnSmart™, an adaptive diagnostic learning system, powered by Connect Chemistry and based on artificial intelligence, constantly assesses your knowledge of the course material. As you work within the system, LearnSmart develops a personal learning path adapted to what you have actively learned and retained. This innovative study tool also has features to enable your teacher to see exactly what you have accomplished, with a built-in assessment tool for graded assignments. You can access LearnSmart for general chemistry by going to connect.mcgraw-hill.com/advplac

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AP Online Learning Center

- **AP Teacher's Manual** outlines major principles in the updated AP Chemistry Curriculum, specifies important vocabulary and math skills, identifies common student mistakes, and provides a useful pacing guide. Revised by Michael Schaab, Associate Professor of Physics at the Maine Maritime Academy and updated by Duane Swank, Professor Emeritus of Chemistry at Pacific Lutheran University and AP Institute Instructor, the AP Teacher's Manual focuses on the AP Exam by providing sample multiple choice and free-response questions for every chapter. The Teacher's Manual provides guidance for the new curriculum including a brief summary of the contents of each chapter, along with learning goals, references to background concepts, and teaching tips.
- **AP Practice Questions** allow students to perfect their skills and properly prepare for the AP Exam.
- **Complete AP Practice Exam** is included with scoring rubrics and topic correlations.
- **AP Chapter Introductions** highlight critical AP chapter content for students, as well as breaking down the key concepts and seeing how topics relate to the Big Ideas in Chemistry.
- NEW! *ExamView™ for AP* Chemistry*

For the first time, we are offering ExamView™ to accompany Chemistry. This DVD provides a test bank for each chapter of the textbook and contains thousands of questions correlated to the new AP Chemistry Curriculum Framework. With this software, teachers will be able to create their own tests to assess student understanding of content and prepare students for the AP Exam in May.

Presentation Center

The **Presentation Center** is a complete set of electronic book images and assets for teachers. You can build instructional materials wherever, whenever, and however you want! Accessed from your textbook's Connect website, the Presentation Center is an online digital library containing photos, artwork, animations, and other media types that can be used to create customized lectures, visually enhanced tests and quizzes, compelling course websites, or attractive printed support materials. All assets are

copyrighted by McGraw-Hill Education, but can be used by teachers for classroom purposes. The visual resources in this collection include:

- **Art** Full-color digital files of all illustrations in the book.
- **Photos** The photos collection contains digital files of photographs from the text.
- **Tables** Every table that appears in the text is available electronically.
- **Animations** Numerous full-color animations illustrating important processes are also provided.
- **PowerPoint Lecture Outlines** Ready-made presentations for each chapter of the text.
- **PowerPoint Slides** All illustrations, photos, and tables are pre-inserted by chapter into blank PowerPoint slides.

Access to all books from the Library tab in the Teacher version of your textbook's Connect website, Presentation Center's dynamic search engine enables you to explore by discipline, course, textbook chapter, asset type, or keyword.

Test Bank and Solutions Manual

A comprehensive bank of test questions is provided within the Online Learning Center, enabling teachers to prepare and access tests or quizzes anywhere, and at any time. Featuring both multiple-choice and free-response question types, these question banks allow teachers to assign chapter tests and prepare students for the AP Chemistry exam. Tests can be published to their online course, or printed for paper-based assignments.

The **Instructor's Solution Manual** is written by Brandon J. Cruickshank (*Northern Arizona University*), Raymond Chang, and Ken Goldsby. The solutions to all of the end-of-chapter problems are given in the manual. The manual also provides the difficulty level and category type for each problem. This manual is online in the text's Connect Library tab.

The **Student Solutions Manual** contains detailed solutions and explanations for even-numbered problems in the main text. The manual also includes a detailed discussion of different types of problems and approaches to solving chemical problems and tutorial solutions for many of the end-of-chapter problems in the text, along with strategies for solving them. Note that solutions to the problems listed under Interpreting, Modeling & Estimating are not provided in the manual.

Student Study Guide

This valuable ancillary contains material to help the student practice problem-solving skills. For each section of a chapter, the author provides study objectives and a summary of the corresponding text. Following the summary are sample problems with detailed solutions. Each chapter has true–false questions and a self-test, with all answers provided at the end of the chapter.

Animations for MP3/iPod

A number of animations are available for download to your MP3/iPod through the textbook's Connect website.

Acknowledgments

We would like to thank the following reviewers and symposium participants, whose comments were of great help to us in preparing this revision:

William K. Adeniyi *North Carolina Agricultural and Technical State University*

Rachel J. Allenbaugh *Murray State University*

Yiyang Bai *Houston Community College*

Mufeed M. Basti *North Carolina Agricultural and Technical State University*

Shuhsien Batamo *Houston Community College*

Ilan Benjamin *University of California–Santa Cruz*

John Blaha *Columbus State Community College*

Stuart Burris *Western Kentucky University*

Tabitha Ruvarashe Chigwada *West Virginia University*

Guy Dadson *Fullerton College*

Jay Deiner *New York City College of Technology*

Jerome Delhommelle *University of North Dakota*

Fredesvinda Dura *New York City College of Technology*

Jahangir Emrani *North Carolina Agricultural and Technical State University*

Theodore Fickel *Los Angeles Valley College*

Sheree J. Finley *Alabama State University*

Jason F. Fuller *Eastern Kentucky University*

Eric Goll *Brookdale Community College*

Byron Howell *Tyler Junior College*

Mark D. Keränen *University of Tennessee–Martin*

Edith Kippenhan *University of Toledo*

James F. Kirby *Quinnipiac University*

Evguenii Kozliak *University of North Dakota*

Michael Langoh, *Tarrant County College*

Estelle Lebea, *Central Michigan University*

Joan Lebsack *Fullerton College*
Douglas P. Linder *Southwestern Oklahoma
State University*
Karen Lou *Union College*
Mary K. Lovato *J. Sargeant Reynolds
Community College*
Yin Mao *Camden County College*
Angela McGuirk *Central Michigan University*
Dennis McMinn *Gonzaga University*
Jeremy T. Mitchell-Koch *Emporia State University*
Svetlana Mitrovski *Eastern Illinois University*
David Nachman *Mesa Community College*
Elijah Nyairo *Alabama State University*
Manoj Patil *Western Iowa Tech Community College*
Les L. Pesterfield *Western Kentucky University*
Karla Radke *North Dakota State University*
Michael E. Rennekamp *Columbus State
Community College*
Arun Royappa *University of West Florida*
Diana Samaroo *New York City College of Technology*
Mark Schraf *West Virginia University*
Rhodora Snow *J. Sargeant Reynolds
Community College*
David Son *Southern Methodist University*
Lothar Stahl *University of North Dakota*
Jeffrey Temple *Southeastern Louisiana University*
Kristofoland Varazo *Francis Marion University*
Cheryl B. Vaughn *Columbus State Community College*
Anthony Wren *Butte College*
Wei Zhou *Southern Polytechnic State University*
William B. Bond *College Board Consultant, AP
Chemistry*
David L. Crow *AP Chemistry Consultant*
Duane Swank *Pacific Lutheran University and AP
Institute Instructor*

Connect: Chemistry has been greatly enhanced by the efforts of Yasmin Patell, *Kansas State University*; MaryKay Orgill, *University of Nevada—Las Vegas*; Mirela Krichten, *The College of New Jersey*; who did a masterful job of authoring hints and feedback to augment all of the system's homework problems.

The following individuals helped write and review learning goal-oriented content for **LearnSmart for General Chemistry**: Margaret Ruth Leslie, *Kent State University*; David G. Jones, *North Carolina Central University*; Erin Witteck; Margaret Asirvatham, *University of Colorado—Boulder*; Alexander J. Seed, *Kent State University*; Benjamin Martin, *Texas State University—San Marcos*; Claire Cohen, *University of Toledo*; Manoj Patil, *Western Iowa Tech Community College*; Adam I. Keller, *Columbus State Community College*; Peter de Lijser, *California State University—Fullerton*; Lisa Smith, *North Hennepin Community College*.

We have benefited much from discussions with our colleagues at Williams College and Florida State, and from correspondence with many instructors here and abroad.

It is a pleasure to acknowledge the support given to us by the following members of McGraw-Hill's College Division: Tammy Ben, Annette Doerr, Kara Kudronowicz, Marty Lange, Thomas Timp, Scott Stewart, and Kurt Strand. In particular, we would like to mention Sandy Wille for supervising the production, David Hash for the book design, John Leland for photo research, Judi David for the media, and Tami Hodge, the marketing manager, for her suggestions and encouragement. We also thank our sponsoring editor, Jeff Huettman, and publisher, Ryan Blankenship, for their advice and assistance. Finally, our special thanks go to Shirley Oberbroeckling, the developmental editor, for her care and enthusiasm for the project and supervision at every stage of the writing of this edition.

—Raymond Chang and Ken Goldsby

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To the AP Chemistry Student

Successful completion of this course can satisfy a science requirement, allow you to be exempt from an introductory chemistry course, or help satisfy requirements for your major course of study. AP Chemistry may also reveal a career choice to you. Regardless of your future plans, enjoy your AP Chemistry course where you will observe changes in our visible world that will be explained by examination of particles and the forces that hold them together.

Your journey will follow a new curriculum focused on 6 Big Ideas that encompass concepts essential for understanding chemical events. The course will train you in 7 scientific practices needed to understand chemistry, including the use of models to explain observed phenomena, designing a lab to answer a question, or *justifying* the use of a math expression to solve a problem. The course will blend essential knowledge with scientific practices tied to specific learning objectives so you will be fully prepared for your AP exam in May.

Your experiences in the lab will teach you to pose questions, observe phenomena, collect data, seek patterns, discover principles and perhaps test what you discover. This inquiry process will not only sharpen your scientific practices but also allow you to be creative in your lab work and in your own learning process.

David L. Crow, AP Chemistry Consultant

To the AP Chemistry Teacher

The AP Chemistry curriculum redesign—scheduled to take effect during the 2013–2014 school year—is a response by the College Board to recommendations from the National Research Council and National Science Foundation that AP science classes should focus on *depth of understanding* rather than breadth of content, and should emphasize scientific inquiry and reasoning. In short, the new curriculum is asking students to think more like scientists.

Science can be thought of as being composed of 2 parts: the *process* of science and the *product* of science. In the past, courses have emphasized product over process. In such courses, AP chemistry students might be considered accomplished if they internalize a vast sum of knowledge and are able to apply that knowledge to solve problems. But if these students have little experience in designing an experiment to investigate a problem, their knowledge will be incomplete and will not represent how chemistry is practiced outside the classroom. This deficiency is addressed in the redesign through required Inquiry and Guided Inquiry based labs. To allow time for this new approach, specific content has been reduced from the old curriculum.

To help teachers make this transition, the College Board is providing many useful resources, including a Curriculum Framework which breaks material into Big Ideas, Enduring Understandings, and Essential Knowledge—with each of the topics cross-referenced within this text. The new curriculum provides 7 major Science Practices which together with the Essential Knowledge topics make up 117 Learning Objectives. Early in 2013, the College Board also plans to publish a lab manual containing specific Inquiry and Guided Inquiry based labs.

This latest edition of *Chemistry* references the changes in the AP Chemistry redesign in order to give students both a strong foundation in chemical knowledge and the skills necessary to think the way science is practiced outside the classroom. Creative thinking is what is required for us to advance to the next level in our scientific world.

**William B. Bond, AP Chemistry Teacher (Retired), Snohomish High School, WA
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