



# Chemistry Fundamentals

An Environmental Perspective

SECOND EDITION

Phyllis Buell  
James Girard  
American University



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### **Dedication**

*Dedicated to the Memory of  
William C. Buell IV and  
Mary Catherine Girard*

At present, there is worldwide concern that many human activities are endangering—perhaps permanently—the quality of the environment and that the time for action to address these problems is running out. The public is becoming increasingly aware of the environmental damage caused by pesticides, toxic wastes, chlorofluorocarbons, nuclear radiation, oil spills, the greenhouse effect, and other human inputs. Environmental organizations such as the Sierra Club, the National Wildlife Federation, and Friends of the Earth are gaining support—especially on college campuses—and are becoming a major influence in the political arena. Articles on environmental issues appear daily in the newspapers, and Congress is introducing legislation to combat threats to the environment.

Paralleling this widespread concern for the environment is the realization that the majority of U.S. citizens, including those with a college degree, are virtually science-illiterate and are not, therefore, well-equipped to make informed decisions on environmental issues. As a response to this crisis in science education, many universities and colleges, American University included, are altering their general curriculums to require science courses for all entering students—nonscience majors as well as science majors. To meet the new science requirements, more and more chemistry departments are offering courses with an environmental perspective, hoping to capture the interest of students who otherwise would not choose a chemistry course.

## Objectives

We designed *Chemistry Fundamentals: An Environmental Perspective* as a liberal arts chemistry text for nonscience majors who have little or no previous knowledge of chemistry. Our primary objective in this text is to enable students to make informed judgments on crucial issues that are of current concern worldwide while providing a basic understanding of chemical principles and practices. We aim to guide students to the knowledge that humans live in a chemical environment and that chemistry affects every aspect of life. The text emphasizes that all living and nonliving parts of our environment are made up of chemicals, and that all the natural processes occurring continuously in the environment involve chemical reactions. Once they have grasped this notion of interdependence, students begin to see that without some understanding of chemistry, it is impossible to fully understand environmental issues such as ozone depletion, global warming, air and water pollution, and the hazards of radioactivity.

## Organization

The organization and approach of this text differ in several ways from other chemistry books intended for nonscience majors. This book places an environmental perspective within the proven framework of basic chemistry, assuming little or no scientific background.

The opening chapter introduces basic chemical principles and familiarizes students with the language of chemistry. The next chapter provides an early orientation to the earth and its ecosystems. This early coverage of the dynamic nature of the earth and its natural cycles not only establishes the importance of maintaining a sustainable natural world but also gives students a firm foundation for the further study of chemical principles.

The middle portion of the text focuses primarily on chemical processes and principles, with applications to the environment and other areas interwoven throughout. Chapters 3–7 offer a solid introduction to the core chemical principles normally included in chemistry texts for nonscience majors. Topics include the atom, electron configuration, bonding, nuclear reactions, the mole, acids and bases, and oxidation-reduction reactions.

Chapter 8, which introduces students to organic chemistry, is followed by a chapter devoted to synthetic polymers. Wherever possible in these two chapters, the chemistry is discussed in the context of natural processes, building a bridge to understanding the chemistry-related environmental issues examined in the chapters that follow.

The next four chapters (Chapters 10–13) show students the relevance of the basic chemistry just covered by focusing on specific applications that pertain to the environment. Chapter 10 covers water—its properties, its importance to life on earth, and the dangers of polluting and misusing it. The focus in Chapter 11 turns to the earth's atmosphere, with discussions of pollution, ozone depletion, global warming, and the greenhouse effect. Chapters 12 and 13 are devoted to energy, addressing the chemistry of fossil fuels and their use as our major energy source. Emphasized are the dangers of depleting these nonrenewable resources and the need to explore other energy sources such as nuclear and wind power and geothermal and solar energy.

Chapter 14, which introduces students to the more advanced subject of biochemistry, is a useful introduction to the coverage of food and nutrition in Chapters 15 and 16. These two chapters include insightful discussions of the risks and benefits of food additives, synthetic fertilizers, and pesticides, with respect to both human health and environmental well-being.

Chemicals used in the home environment every day are discussed in Chapter 17. The last two chapters examine toxic and hazardous chemicals and their effects on human health, with the final chapter, Chapter 19, concentrating on the laws governing the proper disposal of hazardous and radioactive chemicals. For example, the Clean Air Act, the Clean Water Act, EPA regulations, and Superfund are all considered.

## Chapter Elements

**Chapter Objectives** Each chapter opener has a list of the concepts and subject matter students should understand after reading the chapter. This statement of learning objectives provides goals that students should strive for and serves as a useful guide for reviewing each chapter.

**Introduction** The chapter text begins with an introduction that explains the importance of the subject matter to our understanding of the environment and outlines the material that will be covered.

**Examples and Practice Exercises** Illustrative worked examples, each one accompanied by a challenging practice exercise, are included in most chapters, particularly those covering basic chemical principles.

**Explorations** The two-page Explorations essays near the ends of chapters explore ways in which chemistry affects our dynamic world. They profile people such as Marie Curie and Linus Pauling, advances such as the pace-maker and the hybrid car, and events such as the eruption of Krakatoa and environmental terrorism during the Persian Gulf War.

**Chapter Summary** Each chapter ends with a summary of the main topics covered in the chapter.

**Key Terms** Lists of key terms introduced in each chapter are included at chapter's end to help reinforce the most important information.

**Questions and Problems** Each chapter includes a large selection (40–50) of problems and questions, with answers to all even-numbered ones given in an appendix. Quantitative, review, and discussion-type questions are included.

## Course Use

*Chemistry Fundamentals: An Environmental Perspective* offers the flexibility to tailor a course to suit both instructors' preferences and the needs of particular audiences. The full text may be used for a comprehensive two-semester course, or the book may be broken down in several ways for a one-semester course. One option for a one-semester course is to use the first seven chapters followed by choices from the remaining chapters on more advanced chemistry and environmental applications according to the instructor's preferences. For a more traditional course, Chapter 2 may be omitted, and following Chapters 3–7, the course can be rounded out with organic chemistry (Chapter 8) and biochemistry (Chapter 15), and choices from the remaining chapters. If students already have a strong chemistry background, Chapters 3–7 may be omitted, and the course can be devoted to the environmental issues discussed in Chapter 2 and in later chapters.

## Ancillary Materials

Jones and Bartlett Publishers offers traditional print and interactive multimedia supplements to assist instructors and aid students in mastering chemistry. Additional information and review copies of any of the following items are available through your Jones and Bartlett Sales Representative.

### For the Instructor

**Instructor's Toolkit CD-ROM** This CD-ROM contains full-color illustrations from the text for computer projection, an electronic test bank, test-generating software, and

Microsoft PowerPoint™ Lecture Outline Slides that can be edited to suit your lectures. The image bank illustrations can be printed on acetates to create your own transparencies or used in the Lecture Outline Slides. Also included are the complete text files, written by James Girard, for the lecture outlines, sample syllabi, and answers to all of the end-of-chapter questions and problems. The test bank contains approximately 1500 questions in a variety of formats.

The CD-ROM also provides the complete Instructor's Manual for the Laboratory Manual. The Instructor's Manual contains directions for preparing the reagents and other materials used in each experiment. It also provides useful comments regarding the experiments, suggestions for proper disposal of used and hazardous materials, and additional sources for reagents and equipment. **Color Transparencies** One hundred full-color acetates provide clear and effective lecture illustrations of important diagrams from the text.

### For the Student

#### **Laboratory Manual to accompany Chemistry Fundamentals: An Environmental Perspective, Second Edition**

Written by Phyllis Buell and James Girard, the laboratory manual is a well-tested collection of twenty experiments that parallel the topics in Chemistry Fundamentals. The experiments focus on important chemical principles while assuming a minimum of laboratory skills.

#### **Study Guide to accompany Chemistry Fundamentals: An Environmental Perspective, Second Edition**

Designed to help the students prepare for the course, the study guide contains learning objectives, chapter overviews, study tips, an expanded glossary for each chapter's key terms, and practice tests.

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We would also like to thank the many people at Jones and Bartlett who worked with us to produce this book. Special thanks go to development editor, Dick Morel, who gave us many valuable ideas for improving our manuscript.

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We and our team at Jones and Bartlett have labored long and hard to make this book as error-free as possible. If, despite all our efforts, a reader discovers an error or has suggestions for ways to improve this book, we would be delighted to hear from her or him.

Phyllis Buell  
James Girard

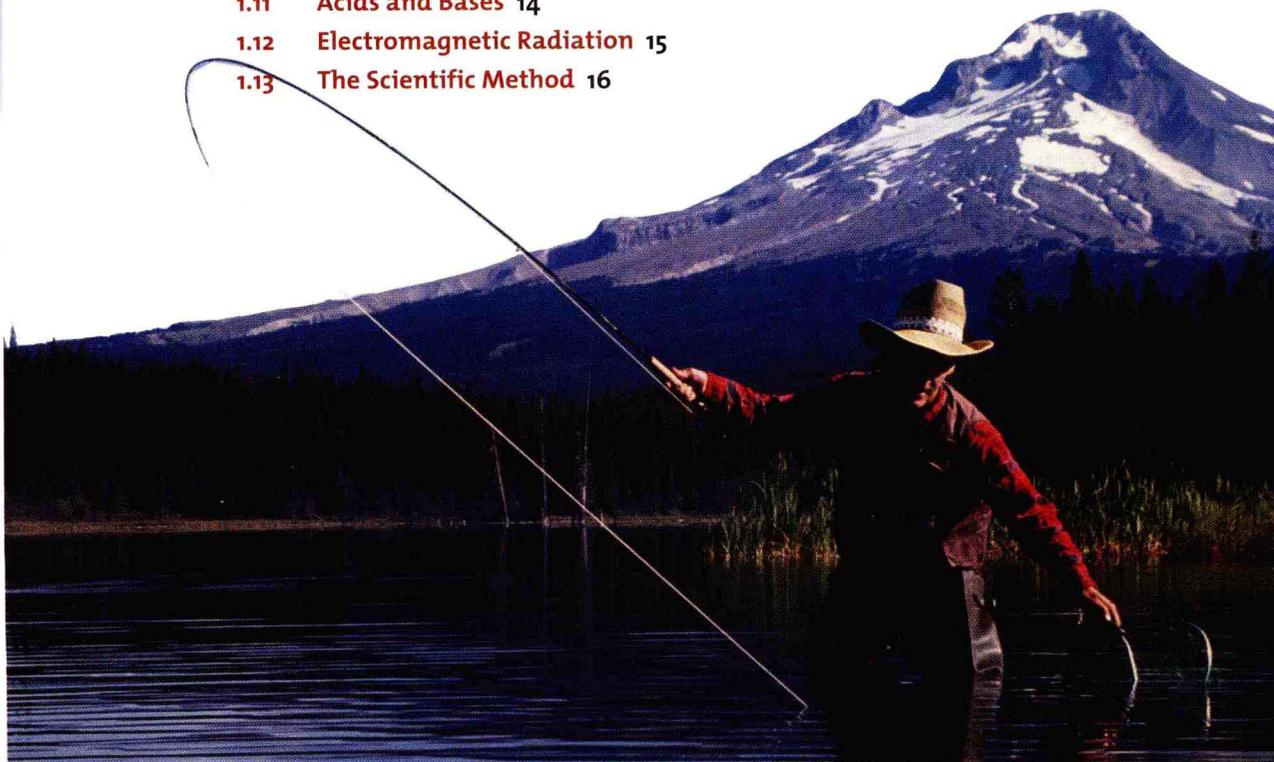
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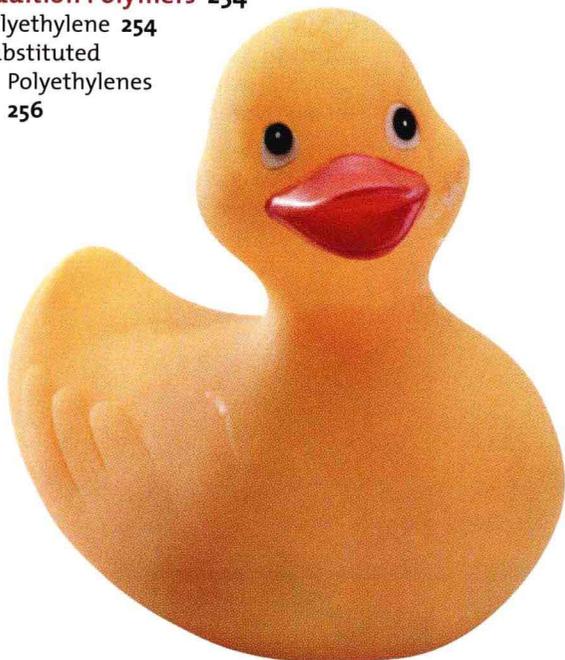
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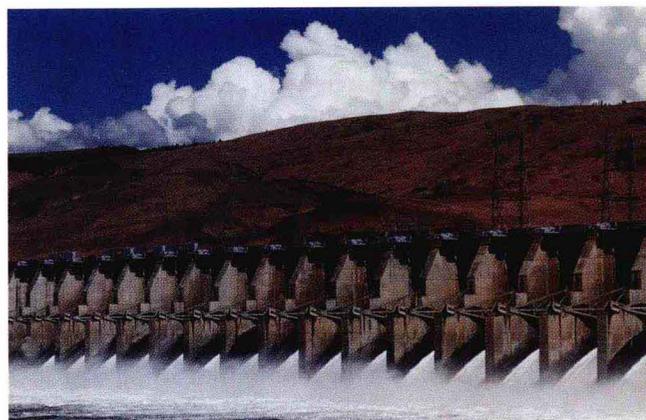
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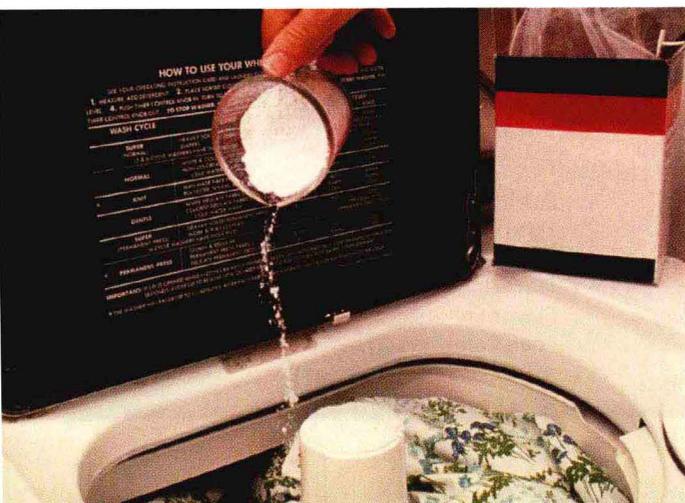
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