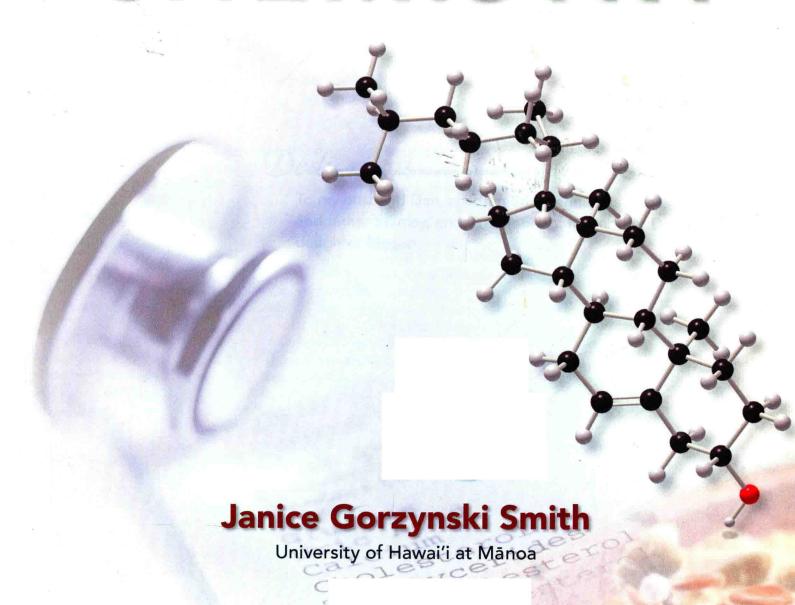
This INTERNATIONAL STUDENT EDITION is not to be sold or purchased in North America and contains content that is different from its North American version. General, Organic, and Biological Chemistry Janice Gorzynski Smith

McGRAW-HILL INTERNATIONAL EDITION



# CHEMISTRY



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### GENERAL, ORGANIC, AND BIOLOGICAL CHEMISTRY

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### **Preface**

y goal in writing this text was to relate the fundamental concepts of general, organic, and biological chemistry to the world around us, and in this way illustrate how chemistry explains many aspects of everyday life. I have followed two guiding principles: use relevant and interesting applications for all basic chemical concepts, and present the material in a student-friendly fashion using bulleted lists, extensive illustrations, and step-by-step problem solving.

This text is different—by design. Since today's students rely more heavily on visual imagery to learn than ever before, this text uses less prose and more diagrams and figures to reinforce the major themes of chemistry. A key feature is the use of molecular art to illustrate and explain common phenomena we encounter every day. Each topic is broken down into small chunks of information that are more manageable and easily learned. Students are given enough detail to understand basic concepts, such as how soap cleans away dirt and why trans fats are undesirable in the diet, without being overwhelmed.

This textbook is written for students who have an interest in nursing, nutrition, environmental science, food science, and a wide variety of other health-related professions. The content of this book is designed for an introductory chemistry course with no chemistry prerequisite, and is suitable for either a two-semester sequence or a one-semester course. I have found that by introducing one new concept at a time, keeping the basic themes in focus, and breaking down complex problems into small pieces, many students in these chemistry courses acquire a new appreciation of both the human body and the larger world around them.

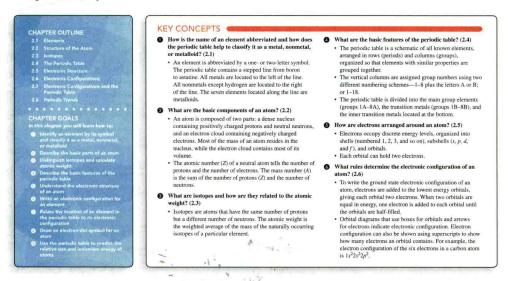
### **BUILDING THE TEXT**

Writing a textbook is a multifaceted process. McGraw-Hill's 360° Development Process is an ongoing, never ending market-oriented approach to building accurate and innovative print and digital products. It is dedicated to continual large scale and incremental improvement, driven by multiple customer feedback loops and checkpoints. This is initiated during the early planning stages of new products and intensifies during the development and production stages, and then begins again upon publication, in anticipation of the next edition. This process is designed to provide a broad, comprehensive spectrum of feedback for refinement and innovation of learning tools, for both student and instructor. The 360° Development Process includes market research, content reviews, faculty and student focus groups, course- and product-specific symposia, accuracy checks, and art reviews, all guided by a carefully selected Board of Advisors.

### THE LEARNING SYSTEM USED IN GENERAL, ORGANIC, AND BIOLOGICAL CHEMISTRY

- Writing Style A concise writing style allows students to focus on learning major concepts
  and themes of general, organic, and biological chemistry. Relevant materials from everyday
  life are used to illustrate concepts, and topics are broken into small chunks of information
  that are more easily learned.
- Chapter Outline The chapter outline lists the main headings of the chapter, to help students map out the organization of each chapter's content.

• Chapter Goals, tied to end-of-chapter Key Concepts The Chapter Goals at the beginning of each chapter identify what students will learn, and are tied numerically to the end-of-chapter Key Concepts, which serve as bulleted summaries of the most important concepts for study.



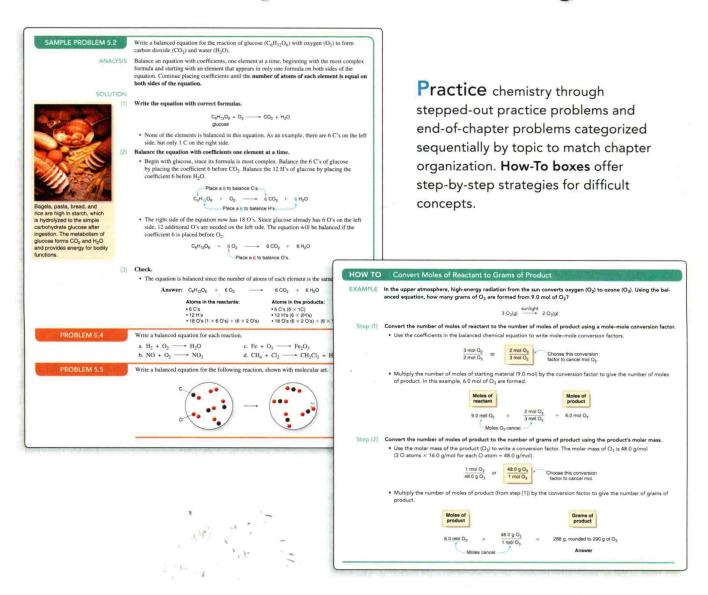
- Macro-to-Micro Illustrations Because today's students are visual learners, and because visualizing molecular-level representations of macroscopic phenomena is critical to the understanding of any chemistry course, many illustrations in this text include photos or drawings of everyday objects, paired with their molecular representation, to help students visualize and understand the chemistry behind ordinary occurrences.
- **Problem Solving** Sample Problems lead students through the thought process tied to successful problem solving by employing Analysis and Solution parts. Sample Problems are categorized sequentially by topic to match chapter organization, and are often paired with practice problems to allow students to apply what they have just learned. Students can immediately verify their answers to the follow-up problems in the appendix at the end of the book.
- **How To's** Key processes are taught to students in a straightforward and easy-to-understand manner by using examples and multiple, detailed steps to solving problems.
- Applications Common applications of chemistry to everyday life are found in margin-placed Health Notes, Consumer Notes, and Environmental Notes, as well as sections entitled "Focus on Health & Medicine," "Focus on the Environment," and "Focus on the Human Body."

### OUR COMMITMENT TO SERVING TEACHERS AND LEARNERS

**TO THE INSTRUCTOR** Writing a new chemistry textbook is a colossal task. Teaching chemistry for over 20 years at both a private, liberal arts college and a large state university has given me a unique perspective with which to write this text. I have found that students arrive with vastly different levels of preparation and widely different expectations for their college experience. As an instructor and now an author I have tried to channel my love and knowledge of chemistry into a form that allows this spectrum of students to understand chemical science more clearly, and then see everyday phenomena in a new light.

**TO THE STUDENT** I hope that this text and its ancillary program will help you to better understand and appreciate the world of chemistry. My interactions with thousands of students in my long teaching career have profoundly affected the way I teach and write about chemistry, so please feel free to email me with any comments or questions at jgsmith@hawaii.edu.

### P.A.V.E. the Way to Student Learning



Apply chemistry through "Focus on Health & Medicine," "Focus on the Human Body," and "Focus on the

Environment" sections woven throughout the text. Chemistry applications are also woven into margin notes that cover topics on consumer, health, and environmental issues.





While alcohol use is socially acceptable, alcohol-related traffic fatalities are common with irresponsible alcohol consumption. In 2004, almost 40% of all fatalities in car crashes in the United States were alcohol-related.

#### FOCUS ON HEALTH & MEDICINE

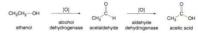
ETHANOL, THE MOST WIDELY ABUSED DRUG

Throughout history, humans have ingested alcoholic beverages for their pleasant taste and the feeling of euphoria they impart. Although we think of alcohol as a stimulant, largely because small amounts decrease social inhibitions, the ethanol (CH,CH,GH,DH) in an alcoholic beverage actually depresses the central nervous system. The chronic and excessive consumption of alcoholic beverages has become a major health and social crisis, making ethanol the most widely abused drug in the United States. One estimate suggests that there are 40 times more alcoholics than heroin addicts.

#### 14.6A THE METABOLISM OF ETHANOL

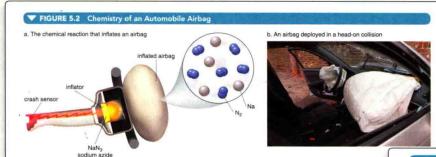
When ethanol is consumed, it is quickly absorbed in the stomach and small intestines and then rapidly transported in the bloodstream to other organs. Ethanol is metabolized in the liver, by a two-step oxidation sequence. The body does not use chromium reagents as oxidants. Instead, high molecular weight enzymes, alcohol dehydrogenase and aldehyde dehydrogenase, and a small molecule called a coenzyme carry out these oxidations.

The products of the biological oxidation of ethanol are the same as the products formed in the laboratory. When ethanol (CH $_{1}$ CH $_{2}$ OH, a 1° alcohol) is ingested, it is oxidized in the liver first to CH $_{3}$ CHO (acetaldehyde), and then to CH $_{3}$ COOH (acetic acid).



If more ethanol is ingested than can be metabolized in a given time period, the concentration of accetaldehyde accumulates. This toxic compound is responsible for the feelings associated with a hangover.

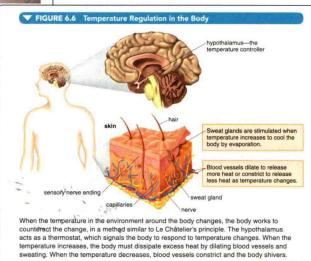
Antabuse, a drug given to alcoholics to prevent them from consuming alcoholic beverages, acts by interfering with the normal oxidation of ethanol. Antabuse inhibits the oxidation of acetaldehyde to acetic acid. Since the first step in ethanol metabolism occurs but the second does not, the concentration of acetaldehyde rises, causing an individual to become violently ill.

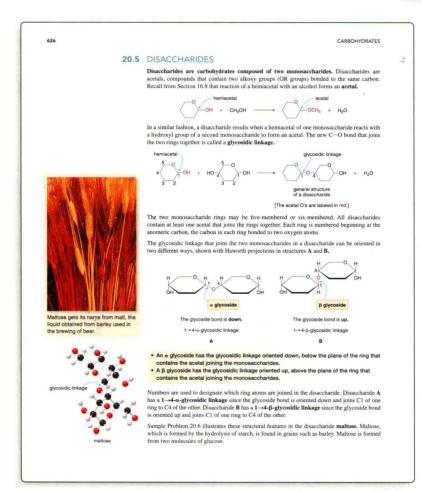


(Na) and nitrogen gas (N<sub>2</sub>). The nitrogen gas causes the bag to inflate fully in 40 milliseconds, helping to protect passenger injury. The sodium atoms formed in this first reaction are hazardous and subsequently converted to a safe sodium salt. It to develop a reliable airbag system for automobiles.

A severe car crash triggers an airbag to deploy when an electric sensor causes sodium azide (NaN3) to ignite, converting it

Visualize chemistry through a dynamic art program that brings together macroscopic and microscopic representations of images to help students comprehend on a molecular level. Many illustrations include photos or drawings of everyday objects, paired with their molecular representation, to help students understand the chemistry behind ordinary occurrences. Many illustrations of the human body include magnifications for specific anatomic regions, as well as representations at the microscopic level, for today's visual learners.





Engage students with a unique writing style that matches the method in which students learn. Key points of general, organic, and biological chemistry, along with attention-grabbing applications to consumer, environmental, and health-related fields, are woven together in a succinct style for today's to-the-point readers.

### SUPPLEMENTS FOR THE INSTRUCTOR

### Online Homework and Resources

McGraw-Hill offers online electronic homework along with a myriad of resources for both instructors and students. Instructors can create homework with easy-to-assign algorithmically-generated problems from the text and the simplicity of automatic grading and reporting. *General, Organic, & Biological Chemistry*'s end-of-chapter problems appear in the online homework system in diverse formats and with various tools.

Instructors also have access to PowerPoint lecture outlines, created by Andrea Leonard of the University of Louisiana, Lafayette, which appear as ready-made presentations that combine art and lecture notes for each chapter of the text. For instructors who prefer to create their lectures from scratch, all illustrations, photos, and tables are pre-inserted by chapter into blank Power-Point slides.

An online digital library contains 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 Higher Education, but can be used by instructors for classroom purposes. The visual resources in this collection include:

- Art Full-color digital files of all illustrations in the book can be readily incorporated into
  lecture presentations, exams, or custom-made classroom materials. In addition, all files are
  pre-inserted into PowerPoint slides for ease of lecture preparation.
- Photos The photo collection contains digital files of photographs from the text, which can
  be reproduced for multiple classroom uses.
- Tables Every table that appears in the text has been saved in electronic form for use in classroom presentations and/or quizzes.
- Animations Numerous full-color animations illustrating important processes are also provided. Harness the visual impact of concepts in motion by importing these files into class-room presentations or online course materials.

### Instructor's Solutions Manual

This supplement, prepared by Lauren McMills of Ohio University, contains complete, worked out solutions for all problems in the text. It can be found within the Instructor's Resources for this text on the Connect website.

### Computerized Test Bank Online

A comprehensive bank of test questions prepared by Kathy Thrush-Shaginaw is provided within a computerized test bank, enabling you to create paper and online tests or quizzes in an easy-to-use program that allows you to prepare and access your test or quiz anywhere, at any time. Instructors can create or edit questions, or drag-and-drop questions, to prepare tests quickly and easily. Tests may be published to their online course, or printed for paper-based assignments.

### SUPPLEMENTS FOR THE STUDENT

### Student Study Guide/Solutions Manual

The Student Study Guide/Solutions Manual, prepared by Erin Smith and Janice Gorzynski Smith, begins each chapter with a detailed chapter review that is organized around the chapter goals and key concepts. The Problem Solving section provides a number of examples for solving each type of problem essential to that chapter. The Self-Test section of each chapter quizzes chapter highlights, with answers provided. Finally, each chapter ends with the solutions to all inchapter problems, as well as the solutions to all odd-numbered end-of-chapter problems.

# Acknowledgments

Publishing the first edition of a modern chemistry textbook requires a team of knowledgeable and hard-working individuals who are able to translate an author's vision into a reality. I am thankful to work with such a group of dedicated publishing professionals at McGraw-Hill. Much thanks goes to Senior Sponsoring Editor Tami Hodge, whose enthusiasm, upbeat approach, and unflinching support led the conversion of a first draft manuscript to a completed text in record time. I was privileged to once again work with Senior Developmental Editor Donna Nemmers, who managed the day-to-day details of this project with a mix of humor and professionalism. Jayne Klein, Senior Project Manager, skillfully directed the production process, and Publisher Thomas Timp guided the project to assure that all the needed resources were available to see it to completion.

A special thanks goes to Michael Lange, Vice President, New Product Launches, whose experience and insights were critical in developing the early stages of this project. I am especially grateful to freelance Developmental Editor John Murdzek, whose unique blend of humor, chemical knowledge, and attention to detail were key ingredients at numerous stages in the creation of both the text and the student solutions manual. I have also greatly benefited from a team of advisors who have helped guide me through the preparation of my manuscript, as well as a panel of art reviewers who oversaw the conversion of my crude art manuscript into the beautiful figures present in the finished text.

Finally, I thank my family for their support and patience during the long process of publishing a textbook. My husband Dan, an emergency medicine physician, read the entire manuscript, took several photos that appear in the text, and served as a consultant for many medical applications. My daughter Erin co-authored the Student Study Guide/Solutions Manual with me, all of which was written while completing her residency in emergency medicine.

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## List of How To's

How to Convert a Standard Number to Scientific Notation 17 How to Solve a Problem Using Conversion Factors 20
How to Determine the Atomic Weight of an Element 42
How to Write a Formula for an Ionic Compound 77  How to Name an Ionic Compound That Contains a Metal with Variable Charge 81  How to Derive a Formula from the Name of an Ionic Compound 82
How to Draw a Lewis Structure 98 How to Name a Covalent Molecule 106
How to Balance a Chemical Equation 125  How to Calculate the Formula Weight of a Compound 132  How to Convert Moles of Reactant to Grams of Product 138  How to Convert Grams of Reactant to Grams of Product 141
How to Calculate the Equilibrium Constant for a Reaction 178
How to Use Boyle's Law to Calculate a New Gas Volume or Pressure 196 How to Convert Moles of Gas to Volume at STP 205 How to Carry Out Calculations with the Ideal Gas Law 206
How to Calculate Molarity from a Given Number of Grams of Solute 241
How to Predict the Direction of Equilibrium in an Acid-Base Reaction 271 How to Draw a Balanced Equation for a Neutralization Reaction Between HA and MOH 282 How to Determine the Molarity of an Acid Solution from a Titration 286
How to Balance an Equation for a Nuclear Reaction 303  How to Use a Half-Life to Determine the Amount of Radioisotope Present 308
How to Name an Alkane Using the IUPAC System 364 How to Name a Cycloalkane Using the IUPAC System 369
How to Name an Alkene or an Alkyne 382
How to Name an Alcohol Using the IUPAC System 422 How to Name an Alkyl Halide Using the IUPAC System 438
How to Draw Two Enantiomers of a Chiral Compound 456
How to Name an Ester ( $RCO_2R'$ ) Using the IUPAC System 507 How to Name a 2° or 3° Amide 509
How to Name 2° and 3° Amines with Different Alkyl Groups 544
How to Draw a Haworth Projection from an Acyclic Aldohexose 619
How to Draw a Dipeptide from Two Amino Acids 653
How to Use the Polymerase Chain Reaction to Amplify a Sample of DNA 708
How to Determine the Number of Molecules of ATP Formed from a Fatty Acid 76

# List of Applications

Chapter 1	Focus on Health & Medicine: Problem Solving Using Clinical Conversion Factors 22
Chapter 2	Environmental Note: Carbon Monoxide 33 Focus on the Human Body: The Elements of Life 34 Focus on Health & Medicine: Isotopes in Medicine 43 Health Note: Radon Detectors 47 Environmental Note: Acid Rain 55 Health Note: Mercury 59
Chapter 3	Focus on the Human Body: Important Ions in the Body 74 Health Note: Foods High in Sodium 75 Focus on Health & Medicine: Ionic Compounds in Consumer Products 78 Health Note: Potassium 78 Health Note: Toothpaste 83 Health Note: Spam 85 Health Note: Barium Sulfate and X-Rays 85 Focus on Health & Medicine: Useful Ionic Compounds 87 Focus on Health & Medicine: Treating Osteoporosis 87 Health Note: Osteoporosis 87
Chapter 4	Focus on the Human Body: Covalent Molecules and the Cardiovascular System 96 Focus on the Environment: Ozone 104 Health Note: Cassava 107 Environmental Note: Spider Plants 108 Focus on Health & Medicine: Covalent Drugs and Medical Products 114
Chapter 5	Environmental Note: Cooking with Propane 125 Environmental Note: Car Exhaust 136 Health Note: Carbon Monoxide 137 Environmental Note: Ozone 138 Health Note: Ethanol in Wine 139 Environmental Note: Ethanol in Gasoline 143 Focus on Health & Medicine: The Importance of Percent Yield in the Pharmaceutical Industry 147 Focus on Health & Medicine: Pacemakers 152
Chapter 6	Focus on the Human Body: Energy and Nutrition 161 Environmental Note: Landfill Gas 165 Environmental Note: Gasoline 170 Focus on the Human Body: Lactase, a Biological Catalyst 171 Focus on the Environment: Catalytic Converters 172 Health Note: Smog 173 Focus on the Human Body: Body Temperature 182
Chapter 7	Focus on Health & Medicine: Blood Pressure 194 Focus on Health & Medicine: Boyle's Law and Breathing 197 Focus on the Environment: How Charles's Law Explains Wind Currents 198 Consumer Note: Pressure Cookers 201 Focus on the Human Body: The Lungs 207

LIST OF APPLICATIONS

Health Note: Hyperbaric Chambers 209 Consumer Note: Freeze Drying 222 Chapter 8 Health Note: Weight/Volume Concentration Measurement 237 Health Note: Alcohol Concentration in Everyday Products 238 Health Note: Ketamine 239 Environmental Note: DDT 240 Focus on the Human Body: Osmosis and Biological Membranes 250 Focus on Health & Medicine: Dialysis 251 Chapter 9 Focus on the Human Body: Hydrochloric Acid in the Stomach 267 Health Note: Lactic Acid 271 Health Note: Vitamin C 272 Focus on the Human Body: The pH of Body Fluids 280 Health Note: Antacids 282 Health Note: Kidney Stones 283 Environmental Note: Acid Rain 287 Focus on the Environment: Acid Rain and a Naturally Buffered Lake 291 Focus on the Human Body: Buffers in the Blood 292 Focus on Health & Medicine: The Effects of Radioactivity 301 Chapter 10 Consumer Note: Irradiated Fruit 302 Health Note: Smoke Detectors 302 Focus on Health & Medicine: External Radiation Treatment for Tumors 307 Focus on Health & Medicine: Medical Uses of Radioisotopes 311 Focus on Health & Medicine: Medical Imaging without Radioactivity 317 Chapter 11 Consumer Note: Polyethylene 336 Environmental Note: Asian Long-Horned Beetles 336 Health Note: Chloroethane 336 Focus on the Environment: Environmental Pollutants 344 Focus on Health & Medicine: Vitamins 345 Consumer Note: Anti-Aging Creams 345 Health Note: Vitamin C 346 Focus on Health & Medicine: Naming New Drugs 362 Chapter 12 Focus on the Environment: Fossil Fuels 370 Consumer Note: Natural Gas 370 Environmental Note: Methane 370 Environmental Note: Crude Oil 371 Focus on the Environment: Combustion 372 Environmental Note: Automobile Exhaust 372 Health Note: Carbon Monoxide Meters 373 Chapter 13 Environmental Note: Pheromones 387 Focus on Health & Medicine: Saturated and Unsaturated Fatty Acids 387 Health Note: Lycopene 390 Focus on Health & Medicine: Oral Contraceptives 390 Focus on Health & Medicine: Margarine or Butter? 396 Consumer Note: Margarine 397 Consumer Note: Peanut Butter 397 Focus on the Environment: Polymer Recycling 401 Focus on Health & Medicine: Aromatic Drugs, Sunscreens, and Carcinogens 405 Health Note: SPF 406 Focus on Health & Medicine: Phenols as Antioxidants 407 Health Note: Vitamin E 408

> Health Note: Antioxidants 408 Environmental Note: DDT 409

Focus on Health & Medicine: Nitration and Sulfa Drugs 409

Chapter 14 Consumer Note: Gasohol 425 Focus on the Human Body: Oxidation and Blood Alcohol Screening 430 Focus on Health & Medicine: Ethanol, the Most Widely Abused Drug 431 Health Note: Red Tides 433 Focus on Health & Medicine: Ethers as Anesthetics 436 Focus on the Environment: Alkyl Halides and the Ozone Layer 439 Environmental Note: Aerosol Propellants 439 Environmental Note: Antarctic Ozone Hole 440 Focus on the Human Body: Making Straight Hair Curly 442 Chapter 15 Focus on Health & Medicine: The Unforgettable Legacy of Thalidomide 458 Health Note: Hansen's Disease 458 Focus on Health & Medicine: Chiral Drugs 459 Focus on the Human Body: The Sense of Smell 465 Chapter 16 Focus on Health & Medicine: Interesting Aldehydes and Ketones 480 Focus on the Human Body: Biological Reductions 486 Focus on the Human Body: The Chemistry of Vision 487 Consumer Note: Niacin 487 Health Note: Digoxin 493 Chapter 17 Focus on Health & Medicine: Skin Care Products 512 Health Note: Ginkgo Trees 512 Consumer Note: Skin Care Products 512 Focus on Health & Medicine: Aspirin and Anti-Inflammatory Agents 513 Consumer Note: Soap 518 Focus on Health & Medicine: Aspirin 519 Consumer Note: Nail Polish Remover 521 Environmental Note: Cockroach Population Control 523 Health Note: DEET 523 Focus on Health & Medicine: Olestra, a Synthetic Fat 527 Consumer Note: Olestra 527 Consumer Note: Nylon History 528 Consumer Note: Nylon 528 Consumer Note: Armadillo Bike Tires 529 Focus on Health & Medicine: Dissolving Sutures 530 Focus on the Environment: Polymer Recycling 531 Consumer Note: Recycling Codes 531 Focus on Health & Medicine: Penicillin 532 Focus on Health & Medicine: Caffeine and Nicotine 547 Chapter 18 Consumer Note: Caffeine in Chocolate 547 Health Note: Nicotine Patches and Gum 549 Consumer Note: Poppy Seed Tea 550 Focus on Health & Medicine: Ammonium Salts as Useful Drugs 555 Consumer Note: Antihistamines and Decongestants 555 Focus on the Human Body: Epinephrine and Related Compounds 560 Focus on Health & Medicine: Histamine and Antihistamines 562 Health Note: Scombroid Fish Poisoning 563 Chapter 19 Consumer Note: Spermaceti Wax 575 Health Note: Saturated Fats 578 Health Note: Fish Oils 579

Focus on Health & Medicine: Fats and Oils in the Diet 579
Focus on the Human Body: Metabolism of Triacylglycerols 582
Environmental Note: Biofuels 583
Focus on Health & Medicine: Nerve Cells and Multiple Sclerosis 588
Focus on Health & Medicine: Cholesterol, the Most Prominent Steroid 591

LIST OF APPLICATIONS

Health Note: Plant Products and Cholesterol 591 Health Note: Anabolic Steroids 595 Focus on Health & Medicine: Fat-Soluble Vitamins 597 Focus on Health & Medicine: Prostaglandins and Leukotrienes 599 Chapter 20 Consumer Note: Sunless Tanning Agents 611 Health Note: Dextrose 615 Health Note: Insulin 615 Health Note: Galactosemia 616 Consumer Note: "Lite" Foods 617 Consumer Note: Sorbitol 622 Focus on Health & Medicine: Monitoring Glucose Levels 625 Health Note: Glucose Test Strips 625 Focus on Health & Medicine: Lactose Intolerance 628 Focus on Health & Medicine: Sucrose and Artificial Sweeteners 629 Focus on the Human Body: Useful Carbohydrate Derivatives 634 Health Note: Heparin 634 Health Note: Arthritis Treatment 635 Focus on the Human Body: Blood Type 636 Health Note: Blood Type 636 Chapter 21 Health Note: Essential Amino Acids 647 Focus on the Human Body: Biologically Active Peptides 654 Focus on the Human Body: Common Proteins 664 Health Note: Sickle Cell Anemia 666 Health Note: Cleaning a Wound with Hydrogen Peroxide 669 Focus on Health & Medicine: Using Enzymes to Diagnose and Treat Diseases 674 Health Note: ACE Inhibitors 675 Chapter 22 Focus on the Human Body: DNA Fingerprinting 708 Focus on Health & Medicine: Viruses 710 Health Note: Childhood Vaccinations 710 Chapter 23 Focus on the Human Body: Creatine and Athletic Performance 727 Health Note: Riboflavin 731 Focus on Health & Medicine: Hydrogen Cyanide 739 Environmental Note: Golden Bamboo Lemur 739 Chapter 24 Focus on Health & Medicine: Glycolysis and Cancer Cells 754 Focus on Health & Medicine: Conversion to Lactate 755

Health Note: Lactate Buildup 755

Health Note: Atkins Diet 766

Health Note: Detecting Ketone Bodies 766

Focus on Health & Medicine: Conversion to Ethanol 756

# **Brief Contents**

1	Matter and Measurement 1
2	Atoms and the Periodic Table 32
3	Ionic Compounds 66
4	Covalent Compounds 93
5	Chemical Reactions 121
6	Energy Changes, Reaction Rates, and Equilibrium 159
7	Gases, Liquids, and Solids 190
8	Solutions 228
9	Acids and Bases 258
0	Nuclear Chemistry 298
1	Introduction to Organic Molecules and Functional Groups 322
2	Alkanes 355
3	Unsaturated Hydrocarbons 379
4	Organic Compounds That Contain Oxygen, Halogen, or Sulfur 418
5	The Three-Dimensional Shape of Molecules 449
6	Aldehydes and Ketones 473
17	Carboxylic Acids, Esters, and Amides 503
8	Amines and Neurotransmitters 540
9	Lipids 569
20	Carbohydrates 608
21	Amino Acids, Proteins, and Enzymes 644
22	Nucleic Acids and Protein Synthesis 682
23	Digestion and the Conversion of Food into Energy 718

Carbohydrate, Lipid, and Protein Metabolism 744

### Contents

Preface xxii
P.A.V.E. the Way to Student Learning xxiv
Acknowledgments xxvii
List of How To's xxix
List of Applications xxx



### Matter and Measurement

- 1.1 Chemistry—The Science of Everyday Experience 2
- 1.2 States of Matter 3
- 1.3 Classification of Matter 5
- 1.4 Measurement 8
  - 1.4A The Metric System 8
  - 1.4B Measuring Length 10
  - 1.4C Measuring Mass 10
  - 1.4D Measuring Volume 10
- 1.5 Significant Figures 11
  - 1.5A Determining the Number of Significant Figures 12
  - 1.5B Using Significant Figures in Multiplication and Division 13
  - 1.5C Using Significant Figures in Addition and Subtraction 15
- 1.6 Scientific Notation 16
- 1.7 Problem Solving Using the Factor-Label Method 18
  - 1.7A Conversion Factors 18
  - 1.7B Solving a Problem Using One Conversion Factor 19
  - 1.7C Solving a Problem Using Two or More Conversion Factors 21
- Focus on Health & Medicine: Problem Solving Using Clinical Conversion Factors 22
- 1.9 Temperature 24
- 1.10 Density and Specific Gravity 25
  - 1.10A Density 25
  - 1.10B Specific Gravity 27
  - Chapter Highlights 27