

GLENCOE

*California
Edition*



SCIENCE VOYAGES
**PHYSICAL
SCIENCE**



 NATIONAL
GEOGRAPHIC
SOCIETY

GLENCOE

California
Edition



SCIENCE VOYAGES
**PHYSICAL
SCIENCE**



 NATIONAL
GEOGRAPHIC
SOCIETY



**Glencoe
McGraw-Hill**

New York, New York Columbus, Ohio Woodland Hills, California Peoria, Illinois

A Glencoe Program

California
Edition



Glencoe Science Voyages

California Student Edition
California Teacher Wraparound Edition
Assessment
Chapter Review
California Science Content Standards Practice Questions
Performance Assessment
Assessment—Chapter and Unit Tests
ExamView Test Bank Software
Performance Assessment in the Science Classroom
Alternate Assessment in the Science Classroom
Study Guide for Content Mastery, SE and TE
Chapter Overview Study Guide, SE and TE
Reinforcement
Enrichment
Critical Thinking/Problem Solving
Multicultural Connections

Activity Worksheets
Laboratory Manual, SE and TE
Science Inquiry Activities, SE and TE
California Home Involvement
Teaching Transparencies
Section Focus Transparencies
Science Integration Transparencies
Spanish Resources
California Lesson Plans
Lab and Safety Skills in the Science Classroom
Cooperative Learning in the Science Classroom
Exploring Environmental Issues
MindJogger Videoquizzes and Teacher Guide
English/Spanish Audiocassettes
Interactive Lesson Planner CD-ROM
Interactive CD-ROM
Internet Site
Using the Internet in the Science Classroom



The "Test-Taking Tip" and "Test Practice" features in this book were written by The Princeton Review, the nation's leader in test preparation. Through its association with McGraw-Hill, The Princeton Review offers the best way to help students excel on standardized assessments.

The Princeton Review is not affiliated with Princeton University or Educational Testing Service.

Glencoe/McGraw-Hill

A Division of The McGraw-Hill Companies



Copyright © 2001 by the McGraw-Hill Companies, Inc. All rights reserved. Except as permitted under the United States Copyright Act, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without prior written permission of the publisher.

The "Science Connection" features found in each chapter and the unit opening pages of this textbook were designed and developed by the National Geographic Society's Education Division, copyright © 2001 National Geographic Society. The name "National Geographic Society" and the yellow border rectangle are trademarks of the Society, and their use, without prior written permission, is strictly prohibited.

Send all inquiries to:
Glencoe/McGraw-Hill
8787 Orion Place
Columbus, OH 43240

ISBN 0-07-823991-5

Printed in the United States of America.

3 4 5 6 7 8 9 10 071/043 06 05 04 03 02 01

Series Authors

Alton Biggs

Biology Instructor
Allen High School
Allen, Texas

John Eric Burns

Science Teacher
Ramona Jr. High School
Chino, California

Lucy Daniel, Ph.D.

Teacher, Consultant
Rutherford County Schools
Rutherfordton, North Carolina

Cathy Ezrailson

Science Department Head
Oak Ridge High School
Conroe, Texas

Ralph Feather, Jr., Ph.D.

Science Department Chair
Derry Area School District
Derry, Pennsylvania

Patricia Horton

Math and Science Teacher
Summit Intermediate School
Etiwanda, California

Thomas McCarthy, Ph.D.

Science Department Chair
St. Edwards School
Vero Beach, Florida

Ed Ortleb

Science Consultant
St. Louis Public Schools
St. Louis, Missouri

Susan Leach Snyder

Science Department Chair
Jones Middle School
Upper Arlington, Ohio

Eric Werwa, Ph.D.

Department of Physics and Astronomy
Otterbein College
Westerville, Ohio

National Geographic Society

Educational Division
Washington D.C.

Contributing Authors

Al Janulaw

Science Teacher
Creekside Middle School
Rohnert Park, California

Penny Parsekian

Science Writer for
The National Geographic Society
New London, Connecticut

Gerry Madrazo, Ph.D.

Mathematics and Science Education
Network
University of North Carolina, Chapel Hill
Chapel Hill, North Carolina

Series Consultants

Chemistry

Douglas Martin, Ph.D.
Chemistry Department
Sonoma State University
Rohnert Park, California

Cheryl Wistrom, Ph.D.
Associate Professor of Chemistry
Saint Joseph's College
Rensselaer, Indiana

Earth Science

Maureen Allen
Science Resource Specialist
Irvine Unified School District
Laguna Hills, California

Tomasz K. Baumiller, Ph.D.
Museum of Paleontology
University of Michigan
Ann Arbor, Michigan

Connie Sutton, Ph.D.
Department of Geoscience
Indiana University
Indiana, Pennsylvania

Physics

Thomas Barrett, Ph.D.
Department of Physics
The Ohio State University
Columbus, Ohio

David Haase, Ph.D.
Professor of Physics
North Carolina State University
Raleigh, North Carolina

Life Science

William Ausich, Ph.D.
Department of Geological Sciences
The Ohio State University
Columbus, Ohio

Dennis Stockdale
Asheville High School
Asheville, North Carolina

Daniel Zeigler, Ph.D.
Director
Bacillus Genetic Stock Center
The Ohio State University
Columbus, Ohio

Reading

Nancy Farnan, Ph.D.
School of Teacher Education
San Diego State University
San Diego, California

Gary Kroesch
Mount Carmel High School
San Diego, California

Safety

Mark Vinciguerra
Lab Safety Instructor
Department of Physics
The Ohio State University
Columbus, Ohio

Curriculum

Tom Custer, Ph.D.
Maryland State Department of
Education
Challenge/Reconstructed Schools
Baltimore, Maryland

Series Reviewers

Jhina Alvarado
Potrero Hill Middle School
for the Arts
San Francisco, California

Richard Cheeseman
Bert Lynn Middle School
Torrance, California

Linda Cook
Rider High School
Wichita Falls, Texas

John B. Davis
Niagara-Wheatfield
Central School
Sanborn, New York

Shirley Ann DeFilippo
Timothy Edwards
Middle School
South Windsor, Connecticut

Janet Doughty
H J McDonald Middle School
New Bern, North Carolina

Jason Druten
Jefferson Middle School
Torrance, California

Lin Harp
Magellan Middle School
Raleigh, North Carolina

Doris Holland
West Cary Middle School
Raleigh, North Carolina

Deborah Huffine
Noblesville Intermediate School
Noblesville, Indiana

Paul Osborne
DeValls Bluff High School
DeValls Bluff, Arkansas

Erik Resnick
Robert E. Peary Middle School
Gardena, California

Robert Sirbu
Lowell Junior High School
Oakland, California

Michael Tally
Wake County Public Schools
Raleigh, North Carolina

Cindy Williamson
Whiteville City Schools
Whiteville, North Carolina

Maurice Yaggi
Middlebrook School
Wilton, Connecticut

Donna York
Anchorage School District
Anchorage, Alaska

Activity Testers

Clayton Millage
Science Teacher
Lynden Middle School
Lynden, Washington

Science Kit and Boreal Laboratories
Tonawanda, New York



GRADE EIGHT: FOCUS ON PHYSICAL SCIENCE

What are science content standards and why does California have them? Standards are guidelines for schools, students, and parents that describe the essential science concepts and skills for understanding the world in which we live. In 1999, The California State Board of Education established science content standards, and these standards will be the basis for state assessments that measure student achievement in science.

ADDITIONAL CONTENT STANDARDS FOR GRADE 8

- California Science Standards and Case Studies, found at the back of the book
- California Science Content Standards Assessment Practice booklets
- Chapter Assessments at the end of each chapter
- Science Voyages Website at www.glencoe.com/sec/science/ca

Motion

1. The velocity of an object is the rate of change of its position. As a basis for understanding this concept, students know:
 - a. position is defined relative to some choice of standard reference point and a set of reference directions. Sections 11-1, 17-2, 20-4, page 478
 - b. average speed is the total distance traveled divided by the total time elapsed. The speed of an object along the path traveled can vary. Sections 11-1, 17-1, 19-1, 19-2, page 478
 - c. how to solve problems involving distance, time, and average speed. Sections 11-1, 19-1, 19-2, page 479
 - d. to describe the velocity of an object, one must specify both direction and speed. Section 11-1, page 479
 - e. changes in velocity can be changes in speed, direction, or both. Sections 11-1, 11-2, page 480
 - f. how to interpret graphs of position versus time and speed versus time for motion in a single direction. Section 11-1, page 480

Forces

2. Unbalanced forces cause changes in velocity. As a basis for understanding this concept, students know:
 - a. a force has both direction and magnitude. Sections 5-1, 12-1, 12-2, 12-3, 12-4, 17-2, page 482
 - b. when an object is subject to two or more forces at once, the effect is the cumulative effect of all the forces. Sections 5-2, 12-1, 12-2, 24-4, 25-3, page 482
 - c. when the forces on an object are

balanced, the motion of the object does not change.

Sections 12-1, 12-4, 24-4, pages 482–483

- d. how to identify separately two or more forces acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction. Sections 12-1, 25-3, page 483
- e. when the forces on an object are unbalanced, the object will change its motion (that is, it will speed up, slow down, or change direction). Sections 7-1, 12-1, 12-2, 12-3, 12-4, 17-2, 24-3, 25-3, page 483
- f. the greater the mass of an object, the more force is needed to achieve the same change in motion. Sections 11-2, 12-2, 12-3, 19-2, page 484
- g. the role of gravity in forming and maintaining planets, stars, and the solar system. Sections 17-2, 17-3, 18-2, 19-1, 19-2, 19-3, 19-4, 20-3, 20-4, page 484

Structure of Matter

3. Elements have distinct properties and atomic structure. All matter is comprised of one or more of over 100 elements. As a basis for understanding this concept, students know:
 - a. the structure of the atom and how it is composed of protons, neutrons, and electrons. Sections 5-1, 5-2, 7-1, 7-2, 9-2, 10-1, page 487
 - b. compounds are formed by combining two or more different elements. Compounds have properties that are different from the constituent elements. Sections 4-1, 4-2, 5-1, 7-2, 8-1, 9-

1, 9-2, 10-1, 10-2, 10-3, page 487

- c. atoms and molecules form solids by building up repeating patterns such as the crystal structure of NaCl or long chain polymers. Sections 4-1, 7-2, 10-3, pages 487–488
- d. the states (solid, liquid, gas) of matter depend on molecular motion. Sections 4-1, 4-2, 4-3, pages 262–263
- e. in solids the atoms are closely locked in position and can only vibrate, in liquids the atoms and molecules are more loosely connected and can collide with and move past one another, while in gases the atoms or molecules are free to move independently, colliding frequently. Sections 4-1, 4-2, 4-3, 9-1, pages 262–263
- f. how to use the Periodic Table to identify elements in simple compounds. Sections 6-1, 6-2, 6-3, 7-1, 7-1, pages 488–489

Earth in the Solar System (Earth Science)

4. The structure and composition of the universe can be learned from the study of stars and galaxies, and their evolution. As a basis for understanding this concept, students know:
 - a. galaxies are clusters of billions of stars, and may have different shapes. Section 20-4, page 490
 - b. the sun is one of many stars in our own Milky Way galaxy. Stars may differ in size, temperature, and color. Sections 19-1, 19-3, 20-1, 20-2, 20-3, 20-4, page 490

- c. how to use astronomical units and light years as measures of distance between the sun, stars, and Earth. Sections 19-2, 19-3, 20-1, 20-4, page 490
- d. stars are the source of light for all bright objects in outer space. The moon and planets shine by reflected sunlight, not by their own light. Sections 17-1, 18-2, 18-3, 19-1, 19-2, 20-3, pages 490–491
- e. the appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids. Sections 17-2, 17-3, 18-1, 18-2, 18-3, 19-1, 19-2, 19-3, 19-4, page 491

Reactions

- 5. Chemical reactions are processes in which atoms are rearranged into different combinations of molecules. As a basis for understanding this concept, students know:
 - a. reactant atoms and molecules interact to form products with different chemical properties. Sections 8-1, 8-2, 9-3, 10-1, 10-2, 10-3, 22-2, 23-1, page 494
 - b. the idea of atoms explains the conservation of matter: in chemical reactions the number of atoms stays the same no matter how they are arranged, so their total mass stays the same. Section 8-1, page 494
 - c. chemical reactions usually liberate heat or absorb heat. Sections 8-1, 9-2, 26-2, page 494
 - d. physical processes include freezing and boiling, in which a material changes form with no chemical reaction. Sections 4-1, 4-2, 8-1, 9-1, 9-2, page 495
 - e. how to determine whether a solution is acidic, basic or neutral. Sections 9-3, 22-2, 27-1, page 496

Chemistry of Living Systems (Life Science)

- 6. Principles of chemistry underlie the functioning of biological systems. As a basis for understanding this concept, students know:
 - a. carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organisms.

Sections 6-2, 10-1, 10-2, 10-3, 21-1, 21-2, 22-2, 23-1, 26-2, page 498

- b. living organisms are made of molecules largely consisting of carbon, hydrogen, nitrogen, oxygen, phosphorus and sulfur. Sections 10-1, 10-2, 10-3, 21-2, 23-1, pages 498–499
- c. living organisms have many different kinds of molecules including small ones such as water and salt, and very large ones such as carbohydrates, fats, proteins and DNA. Sections 9-3, 10-1, 10-3, 23-1, 23-3, 24-4, pages 498–499

Periodic Table

- 7. The organization of the Periodic Table is based on the properties of the elements and reflects the structure of atoms. As a basis for understanding this concept, students know:
 - a. how to identify regions corresponding to metals, nonmetals and inert gases. Sections 6-1, 6-2, 6-3, 7-2, page 501
 - b. elements are defined by the number of protons in the nucleus, which is called the atomic number. Different isotopes of an element have a different number of neutrons in the nucleus. Sections 5-2, 6-1, page 501
 - c. substances can be classified by their properties, including melting temperature, density, hardness, heat, and electrical conductivity. Sections 6-1, 6-2, 6-3, 7-1, page 502

Density and Buoyancy

- 8. All objects experience a buoyant force when immersed in a fluid. As a basis for understanding this concept, students know:
 - a. density is mass per unit volume. Sections 1-2, 4-3, 18-1, pages 504–505
 - b. how to calculate the density of substances (regular and irregular solids, and liquids) from measurements of mass and volume. Sections 1-2, 4-3, pages 504–506
 - c. the buoyant force on an object in a fluid is an upward force equal to the weight of the fluid it has displaced. Sections 4-3, 25-1, pages 504–505
 - d. how to predict whether an object will float or sink. Sections 1-2, 4-3, pages 504–505

Investigation and Experimentation

- 9. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content of the other three strands, students should develop their own questions and perform investigations. Students will:
 - a. plan and conduct a scientific investigation to test a hypothesis. Sections 1-1, 1-2, 4-2, 4-3, 5-1, 5-2, 6-2, 6-3, 7-1, 7-2, 8-1, 8-2, 9-2, 10-3, 11-1, 20-4, 21-1, 24-3, 25-4, 27-1, pages 127, 482, 483, 484, 486, 487, 489, 494, 495, 496, 507
 - b. evaluate the accuracy and reproducibility of data. Sections 1-1, 5-1, 5-2, 6-3, 7-1, 8-1, 17-2, 21-1, 24-3, 25-4, pages 481, 483, 493, 495, 503
 - c. distinguish between variable and controlled parameters in a test. Sections 1-1, 1-2, 6-3, 8-1, 8-2, 9-2, 11-2, 12-2, 18-1, 21-1, 21-2, 24-3, 25-4, 27-1, pages 481, 482, 483, 488, 494, 495, 497, 500, 503, 555
 - d. recognize the slope of the linear graph as the constant in the relationship $y=kx$ and apply this to interpret graphs constructed from data. Sections 11-1, 26-1, pages 479, 480, 498, 953–954, 978
 - e. construct appropriate graphs from data and develop quantitative statements about the relationships between variables. Sections 1-1, 1-2, 4-1, 4-2, 5-2, 6-1, 9-2, 10-1, 25-1, 25-4, 26-1, pages 121, 149, 233, 479, 480, 498, 502, 978
 - f. apply simple mathematical relationships to determine one quantity given the other two (including speed = distance/time, density = mass/volume, force = pressure x area, volume = area x height). Sections 1-1, 1-2, 4-1, 4-2, 4-3, 5-2, 7-1, 8-2, 9-2, 10-1, 10-3, 11-1, 11-2, 11-3, 12-4, 17-1, 17-2, 19-2, 21-2, 23-3, 26-1, 27-1, pages 324, 357, 479, 499, 505
 - g. distinguish between linear and non-linear relationships on a graph of data. Sections 1-1, 4-1, 4-2, 5-2, 10-1, 11-1, pages 325, 480, 491, 502, 953–954, 978

Contents in Brief

UNIT 1 The Nature of Matter **2**

Chapter 1	The Nature of Science	4
Chapter 2	Matter	34
Chapter 3	Energy	62
Chapter 4	States of Matter	94
Chapter 5	Inside the Atom	122
Chapter 6	The Periodic Table	150

UNIT 2 Chemical Interactions **184**

Chapter 7	Chemical Bonds	186
Chapter 8	Chemical Reactions	210
Chapter 9	Solutions	234
Chapter 10	Carbon Chemistry	268

UNIT 3 Forces and Motion **296**

Chapter 11	Motion	298
Chapter 12	Force and Newton's Laws	326
Chapter 13	Work and Simple Machines	358

UNIT 4 Interactions in the Physical World **386**

Chapter 14	Waves	388
Chapter 15	Light, Mirrors, and Lenses	414
Chapter 16	Electricity	446



Contents

UNIT

1


The Nature of Matter

2

Chapter 1

The Nature of Science

4

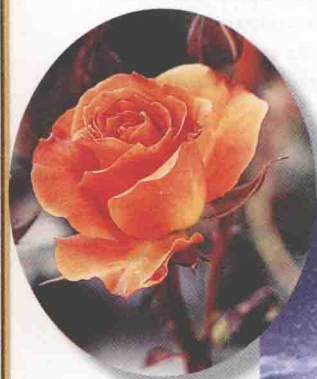
- 1-1 Scientific Problem Solving 6
Activity 1-1 Design Your Own Experiment:
Follow the Bouncing Ball 20
- 1-2 Using Science to Explore 22
Activity 1-2 Comparing Densities 28
- Reading & Writing in Science  NATIONAL GEOGRAPHIC .. 29

Chapter 2

Matter


34

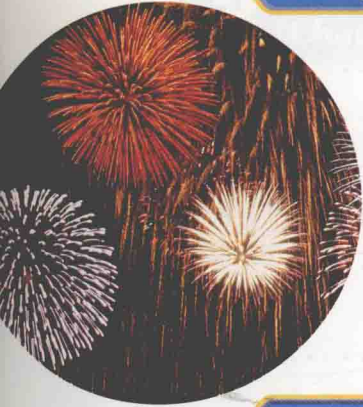
- 2-1 Structure of Matter 36
- 2-2 Elements 44
Activity 2-1 Elements and the
Periodic Table 49
- Science & Society**  NATIONAL GEOGRAPHIC 50
- 2-3 Compounds and Mixtures 51
Activity 2-2 Mystery Mixture 56



Chapter 3


Energy 62

- 3-1 Energy Changes 64
Activity 3-1 Where's the energy? 72
- 3-2 Temperature and Thermal Energy 73
Activity 3-2 Can you observe a temperature change? 82
- 3-3 Chemical Energy 84
- Science & Society**  89




Chapter 4

States of Matter 94

- 4-1 Solids 96
Science & Math  102
- 4-2 Liquids and Gases 103
Activity 4-1 Visit Three States in Science Class 108
- 4-3 Behavior of Liquids and Gases 109
Activity 4-2 Design Your Own Experiment: Design Your Own Boat 116

Chapter 5


Inside the Atom 122

- 5-1 The Story of the Atom 124
Activity 5-1 Making a Model of the Invisible 134
- 5-2 The Nucleus 135
Science & Society  143
Activity 5-2 Design Your Own Experiment: Half-Life 144



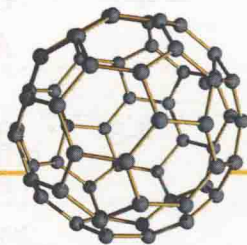
Contents

Chapter 6 The Periodic Table 150

- 6-1 Introduction to the Periodic Table 152
- 6-2 Representative Elements 160
- Activity 6-1** Preparing an Alloy 171
- 6-3 Transition Elements 172
- Science & Society**  177
- Activity 6-2** On the Internet:
Health Risks from Heavy Metals 178




UNIT 2 Chemical Interactions 184



Chapter 7 Chemical Bonds 186

- 7-1 Why do atoms combine? 188
- Activity 7-1** Design Your Own Experiment:
Atomic Structure 194
- 7-2 Ionic and Covalent Bonds 196
- Activity 7-2** Ionic Compounds 204
- How it Works**  205

Chapter 8 Chemical Reactions 210


- 8-1 Describing a Chemical Reaction 212
- Activity 8-1** Design Your Own Experiment:
Exothermic or Endothermic? 220
- 8-2 Rates of Chemical Reactions 222
- Activity 8-2** Speeding Up a Reaction 228
- Science & Math**  229



Chapter 9

Solutions

234

- 9-1 What is a solution? 236
- 9-2 Aqueous Solutions 243
- Activity 9-1** Growing Crystals 249
- 9-3 Acids and Bases 250
- History of Science**  257
- Activity 9-2** Testing pH Using Natural Indicators 258
- FIELD GUIDE** to Kitchen Chemistry 260

Chapter 10

Carbon Chemistry

268

- 10-1 Simple Organic Compounds 270
- 10-2 Other Organic Compounds 276
- Activity 10-1** Conversion of Alcohols 280
- Science & Society**  281
- 10-3 Biological Compounds 282
- Activity 10-2** Design Your Own Experiment: Detecting Fats and Starches 290


UNIT 3 Forces and Motion

296

Chapter 11

Motion

298


- 11-1 What is motion? 300
- Activity 11-1** Design Your Own Experiment: The Tortoise and the Hare 308
- 11-2 What is momentum? 310
- Activity 11-2** Comparing Collisions 316
- 11-3 What is energy? 317
- Science & Society**  321

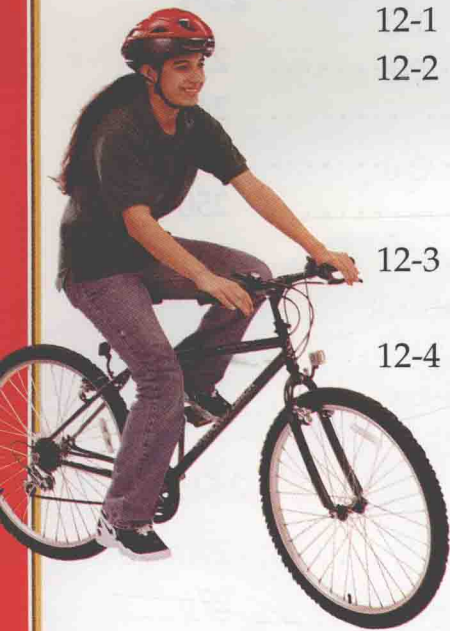


Contents

Chapter 12


Force and Newton's Laws 326

12-1	Newton's First Law	328
12-2	Newton's Second Law	335
	Science & Math 	341
	Activity 12-1 Design Your Own Experiment: Modeling Motion in Two Directions	342
12-3	Newton's Third Law	344
	Activity 12-2 Balloon Races	348
12-4	Describing Motion	349



Chapter 13


Work and Simple Machines 358

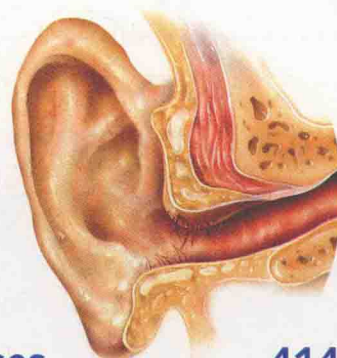
13-1	What is work?	360
	Activity 13-1 Building the Pyramids	365
13-2	Simple Machines	366
	How it Works 	375
	Activity 13-2 Design Your Own Experiment: Pulley Power	376
	FIELD GUIDE to Machines	378




UNIT 4 Interactions in the Physical World 386

Chapter 14 Waves 388


14-1	What are waves?	390
14-2	Wave Properties	395
	Activity 14-1 Waves on a Spring	399
14-3	Wave Behavior	400
	Science & Math 	407
	Activity 14-2 On the Internet: Doing the Wave	408



Chapter 15 Light, Mirrors, and Lenses 414

15-1	Properties of Light	416
15-2	Reflection and Mirrors	423
	Activity 15-1 Reflection from a Plane Mirror	429
15-3	Refraction and Lenses	430
	Activity 15-2 Image Formation by a Convex Lens	434
15-4	Microscopes, Telescopes, and Cameras	436
	Science & Math 	441

Chapter 16 Electricity 446

16-1	Static Electricity	448
16-2	Electric Current	455
	Activity 16-1 A Model for Voltage and Current	460
16-3	Electric Currents	462
	Activity 16-2 Current in a Parallel Circuit ...	470
	Science & Society 	471

Contents

Content Standards & Case Studies **476**

Appendices **508**

Appendix A	Safety in the Science Classroom	509
Appendix B	SI/Metric-to-English Conversions	510
Appendix C	International System of Units	511
Appendix D	Care and Use of a Microscope	512
Appendix E	Classification	513
Appendix F	Minerals	517
Appendix G	Rocks	519
Appendix H	Topographic Map Symbols	520
Appendix I	Weather Map Symbols	521
Appendix J	Star Charts	522

Science Skill Handbook **524**

Technology Skill Handbook **544**

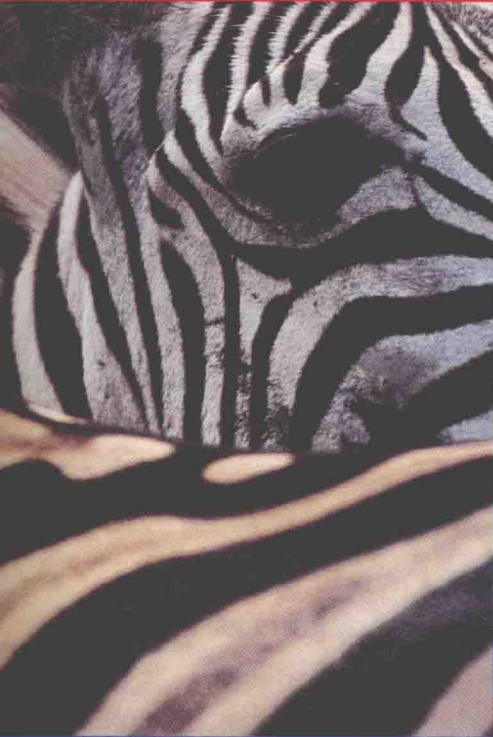
Skill Activities **553**

Glossary **570**

Spanish Glossary **579**

Index **590**





Reading & Writing in Science

The Circle of Life From: *Nature's Numbers* 29

Science & Society

Development of the Periodic Table 50

Hot-Vent Inhabitants 89

Preserving Food by Irradiation 143

Dentistry and the Elements 177

Nature's Medicines and the Organic Chemist 281

Discovery of the Neutrino 321

Energy Sources 471



History of Science

Making Paper 257

Science & Math

Exploring Symmetry 102

Using Proportions 229

Applying the Pythagorean Theorem 341

Graphing Waves 407

Scientific Notation 441

How it Works

Metallic Bonding 205

Using Electronic Calculators 375

Activities

1-1 Design Your Own Experiment: Follow the Bouncing Ball ...	20	7-1 Design Your Own Experiment: Atomic Structure	194
1-2 Comparing Densities	28	7-2 Ionic Compounds	204
2-1 Elements and the Periodic Table	49	8-1 Design Your Own Experiment: Exothermic or Endothermic	220
2-2 Mystery Mixture	56	8-2 Speeding Up a Reaction	228
3-1 Where's the energy?	72	9-1 Growing Crystals	249
3-2 Can you observe a temperature change?	82	9-2 Testing pH Using Natural Indicators	258
4-1 Visit Three States in Science Class	108	10-1 Conversion of Alcohols	280
4-2 Design Your Own Experiment: Design Your Own Boat	116	10-2 Design Your Own Experiment: Detecting Fats and Starches ..	290
5-1 Making a Model of the Invisible	134	11-1 Design Your Own Experiment: The Tortoise and the Hare ..	308
5-2 Design Your Own Experiment: Half-Life	144	11-2 Comparing Collisions	316
6-1 Preparing an Alloy	171	12-1 Design Your Own Experiment: Modeling Motion in Two Directions	342
6-2 On the Internet: Health Risks from Heavy Metals	178	12-2 Balloon Races	348
		13-1 Building the Pyramids	365
		13-2 Design Your Own Experiment: Pulley Power	376
		14-1 Waves on a Spring	399
		14-2 On the Internet: Doing the Wave	408
		15-1 Reflection from a Plane Mirror	429
		15-2 Image Formation by a Convex Lens	434
		16-1 A Model for Voltage and Current	460
		16-2 Current in a Parallel Circuit	470

