

4200301716

MERRILL

Focus On— Earth Science

AUTHORS

Dale T. Hesser

North Syracuse Central Schools—North Syracuse, New York

Susan S. Leach

Upper Arlington Schools—Columbus, Ohio

CONSULTANT

Dr. Berry Sutherland

University of Texas at San Antonio—San Antonio, Texas

CONTENT CONSULTANTS

Dr. Allen A. Ekdale, Department of Geology University of Utah, Salt Lake City, Utah

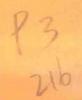
Dr. Robert Howe, Department of Geography and Geology Indiana State University, Terre Haute, Indiana

Dr. G.H. Newsom, Department of Astronomy The Ohio State University, Columbus, Ohio

Dr. James B. Phipps, Department of Marine Geology and Environmental Science Gray's Harbor College, Aberdeen, Washington

Dr. Jeffrey Rogers, Department of Geography The Ohio State University, Columbus, Ohio

Dr. Russell O. Utgard, Department of Geology and Mineralogy
The Ohio State University, Columbus, Ohio



MERRILL PUBLISHING COMPANY

Columbus, Ohio

A MERRILL SCIENCE PROGRAM

Focus on Earth Science: Student Edition Focus on Earth Science: Teacher Edition

Focus on Earth Science: Teacher Resource Package Focus on Earth Science: Review and Reinforcement Guide

Focus on Earth Science: Review and Reinforcement Guide, Teacher Annotated Edition

Focus on Earth Science: Laboratory Manual

Focus on Earth Science: Laboratory Manual, Teacher Annotated Edition

Focus on Earth Science: Overhead Transparency Package

Focus on Earth Science: Chapter Review Software Focus on Earth Science: Test Generator Software

Earth and Space Science Skillcards

Safety Card Package

Focus on Life Science Program
Focus on Physical Science Program

Dale T. Hesser currently serves as the Assistant Superintendent of Schools in North Syracuse, New York. A past recipient of the Outstanding Earth Science Teacher award from the National Association of Geology Teachers, Mr. Hesser received his B.S. in earth science from Buffalo State College, New York, and holds an M.S. and Certificate of Advanced Studies in Science Education from Syracuse University. He has over 20 years of classroom teaching experience in the earth sciences ranging from junior/senior high school through college astronomy, and numerous pre-service and in-service teacher training institutes. Mr. Hesser is co-author of a number of textbooks and publications related to the earth sciences.

Susan S. Leach is a teacher of earth science at Jones Middle School, Upper Arlington School District, Columbus, Ohio. She serves on the Board of Trustees of North American Astrophysical Observatory and has served on the Boards of Directors for state and national science organizations. Ms. Leach received a B.S. in Comprehensive Science from Miami University, Oxford, Ohio, and a M.S. in Entomology from the University of Hawaii. She has 15 years of teaching experience and is author of various educational materials. Ms. Leach, in addition to receiving Exemplary Earth Science and Career Awareness in Science Teaching Team awards from NSTA, was the 1987 Ohio Teacher of the Year, and one of four finalists for the 1987 National Teacher of the Year.

Reading Consultant

David R. Urbanski, Reference Librarian, Dublin Branch Library, Dublin, Ohio Special Features Consultants

Julie Herold, Science Teacher, Westerville North High School, Westerville, Ohio

Laurel Sherman, Affiliate Scholar, Oberlin College, Oberlin, Ohio

Nancy Von Vrankeken, Teacher's Clearinghouse for Science and Society Education, New York, New York

Reviewers

Sr. Johanna Danko, Science Teacher, Most Blessed Sacrament School, Franklin Lakes, New Jersey Linda E. Delano, Science Coordinator, Dodgen Middle School, Cobb County, Georgia Terry Dyroff, Science Teacher, St. Albans School, Wash-

ington, DC

Nancy E. Greenwood, Earth Science Teacher, Northwood Junior High, North Little Rock, Arkansas John F. Hartnett, Earth and Marine Science Teacher, Wilmington High School, Wilmington, Massachusetts Norman E. Holcomb, Science Teacher, Marion Elementary School, Maria Stein, Ohio

Mazie R. Lunn, Science Teacher/Coordinator, Busbee Middle School, Cayce, South Carolina

Susan T. Roberts, Science Teacher, Wirt County High School, Elizabeth, West Virginia

Lawana M. Scoville, Science Teacher, Laurel County Junior High, London, Kentucky

Dennis W. Sterner, Science Supervisor, Warwick School District, Lititz, Pennsylvania

Timothy W. White, Earth Science Teacher, Cimarron Middle School, Edmond, Oklahoma

Luigina B. Yerino, Earth Science Teacher, Dayton High School, Dayton, Kentucky

Series Editor: Joyce T. Spangler; Project Editor: Mary Dylewski; Editors: Nancy F. Gore, Jane L. Parker, Greg A. Shannon; Book Designer: Kip M. Frankenberry; Project Artist: Catharine L. White; Illustrators: Bill Robison, Charles Passarelli, Dennis Tasa, David German; Photo Editor: Mark Burnett; Production Editor: Joy E. Dickerson

Cover Photograph: Waterfall, Arizona: Harold Sund/The Image Bank

ISBN 0-675-02671-7

Published by

MERRILL PUBLISHING COMPANY

Columbus, Ohio 43216

Copyright © 1989, 1987, 1984, 1981, 1976, 1972, 1969

All rights reserved. No part of this book may be reproduced in any form, electronic or mechanical, including photocopy, recording, or any information retrieval system without written permission from the publisher.

Printed in the United States of America.

To the Student

Most students enjoy their study of earth science because they are curious about the world around them and the planet on which they live. In using *Focus on Earth Science*, you will increase your knowledge of topics such as Earth history, the solar system, and the universe beyond. You will find out how natural resources are recovered and used and how we can conserve resources. You will learn how the movement of the continents has affected life on Earth. You will learn about earthquakes, volcanoes, and the weather. Thus, earth science is a study of the planet Earth and its place in space.

Many jobs and careers require a background in earth science. Careers in mining, teaching, ceramics, wastewater treatment, astronomy, and map making involve earth science fields. As you read *Focus on Earth Science*, *Career* features and *Biographies* will help you explore your interests in these fields and in many others.

Scientists use certain methods to solve problems and find answers. In this textbook, you will learn about scientific methods and how to use them to solve problems. Investigation, Skill, and Problem Solving activities will help you discover how you can use these same methods. Using scientific methods will increase your success in solving everyday problems and accomplishing tasks.

Focus on Earth Science contains many features that will help you learn. Each unit begins with a photograph and a brief introduction to the theme of the unit. A Time line points out important discoveries and historical events. The photograph and introductory paragraph at the beginning of each chapter describe the major theme of the chapter and relate it to your everyday life.

Each chapter has several major divisions. At the beginning of each major division, a list of *Goals* identifies what you will learn as you study the short, numbered

sections. *Margin questions* printed in blue emphasize the main ideas of each section. Use these questions as self-checks to evaluate your progress. Major terms are highlighted in boldface type. At the end of each major division, *Review* questions provide another means of self-evaluation.

At the end of each chapter are study and review materials. The Summary provides a list of the major points and ideas presented within the chapter. Vocabulary lists important new terms, and contains a ten question vocabulary review. Main Ideas contains questions that are useful as a review of the chapter's concepts and questions that require you to apply what you have learned. Skill Review includes questions about and applications of the skills learned in this chapter and previous chapters. Projects provides thought-provoking problems and ideas for projects. Sources of more information are listed under Readings.

Several special features have been included to make your study of earth science more interesting. *Technology* features provide exciting information on new technological developments in earth science. A *Science and Society* feature located at the end of each unit offers you the opportunity to explore the interactions and effects of earth science on society.

At the end of the textbook are the *Appendices*, *Glossary*, and *Index*. The Appendices contain tables, charts, and safety information. The Glossary contains definitions of the major terms presented in the textbook. The complete Index will help you quickly locate specific topics within the textbook.

This textbook has been written and organized to help you succeed in your earth science class. As you do your classwork and complete your assignments, you will gain the satisfaction of understanding earth science and its application to everyday life.

Table of Contents.

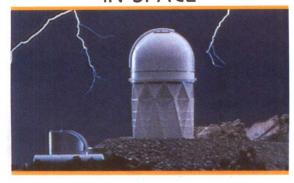
UNIT 1 EARTH SCIENCE FOUNDATIONS



Chapter 1 The Nature of Science	5
PROBLEM SOLVING AND SCIENCE	
1:1 Hot Tub Mystery	5
1:2 Problem Solving	
1:3 Problem Solving Strategies	
SCIENTIFIC PROCESSES	
1:4 Scientific Methods	9
SKILL 1–1	
SKILL 1–2	12
1:5 Theories and Laws	13
1:6 Models	14
SKILL 1–3	16
WHAT IS SCIENCE?	
1:7 Science and Technology	17
BIOGRAPHY: Katherine Johnson	18
TECHNOLOGY: APPLICATIONS	19
CAREER: Earth Science Teacher	20
1:8 Earth Science	20
PROBLEM SOLVING	22
Chapter 2 Earth Science Skills	27
MEASUREMENT	
2:1 Scientific Measurement	
CAREER: Precision-Instrument and Tool Maker	28
2:2 International System of Units	28
USING SI	
2:3 Length, Area, and Volume	30
SKILL 2-1	31
2:4 Mass, Weight, and Density	32
2:5 Time and Temperature	33
BIOGRAPHY: Garrett A. Morgan	33
PROBLEM SOLVING	34

LABORATORY AND SCIENCE SKILLS	
2:6 Safety Precautions	35
2:7 First Aid	36
2:8 Performing Investigations and	
Skills	38
TECHNOLOGY: APPLICATIONS	38
SKILL 2–2	39
2:9 Graphing	
SKILL 2–3	42
(L 2 \lambda F 1	
Chapter 3 Views of Earth	47
VIEWPOINTS	
3:1 Latitude and Longitude	47
CAREER: Cartographer	49
3:2 Earth Time	
3:3 Map Projections	51
LANDSCAPES	
3:4 Plains and Plateaus	
3:5 Mountains	55
UNDERSTANDING MAPS	
3:6 Topographic Maps	58
TECHNOLOGY: APPLICATIONS	
3:7 Using Topographic Maps	
INVESTIGATION 3—1	
INVESTIGATION 3-2	
3:8 Interpreting Topographic Maps	
BIOGRAPHY: Gerhardus Mercator	
PROBLEM SOLVING	
SKILL	70
Chapter 4 Matter and Its	
Changes	75
ATOMS	
4:1 Building Blocks of Matter	
4:2 Structure of Atoms	
BIOGRAPHY: Maria Goeppert-Mayer	77
4:3 How Atoms Combine	
TECHNOLOGY: ADVANCES	79
PROBLEM SOLVING	
INVESTIGATION 4-1	82
MATTER	
4:4 Physical Properties of Matter	
SKILL	
INVESTIGATION 4-2	
4:5 Physical States of Matter	
CAREER: Chemist	88
CCIENICE AND COCIETY	OO

UNIT 2 EARTH IN SPACE



Chapter 5 Earth-Moon System	97
EARTH MOTIONS	
5:1 Our Place in Space	97
5:2 Measurements of Earth	
SKILL	101
TECHNOLOGY: APPLICATIONS	102
5:3 Earth Motions and the Seasons	102
PROBLEM SOLVING	104
CAREER: Astronaut	105
EARTH'S MOON	
5:4 Measurements of the Moon	
INVESTIGATION 5-1	107
5:5 Eclipses	
INVESTIGATION 5–2	
5:6 Moon History	
BIOGRAPHY: Johannes Kepler	110
Chapter 6 Exploring Space	
TOOLS OF ASTRONOMY	117
6:1 Telescopes	117
6:1 Telescopes	117 118
6:1 Telescopes CAREER: Rocket Repair Person INVESTIGATION 6—1	117 118 119
6:1 Telescopes CAREER: Rocket Repair Person INVESTIGATION 6—1 6:2 The Spectrograph	117 118 119 120
6:1 Telescopes CAREER: Rocket Repair Person INVESTIGATION 6–1 6:2 The Spectrograph INVESTIGATION 6–2	117 118 119
6:1 Telescopes CAREER: Rocket Repair Person INVESTIGATION 6–1 6:2 The Spectrograph INVESTIGATION 6–2. ROCKETS AND SATELLITES	117 118 119 120 123
6:1 Telescopes CAREER: Rocket Repair Person INVESTIGATION 6–1 6:2 The Spectrograph INVESTIGATION 6–2 ROCKETS AND SATELLITES 6:3 A First Step into Space	117 118 119 120 123
6:1 Telescopes CAREER: Rocket Repair Person INVESTIGATION 6–1 6:2 The Spectrograph INVESTIGATION 6–2. ROCKETS AND SATELLITES 6:3 A First Step into Space 6:4 Race to the Moon	117 118 119 120 123 124 126
6:1 Telescopes CAREER: Rocket Repair Person INVESTIGATION 6—1 6:2 The Spectrograph INVESTIGATION 6—2. ROCKETS AND SATELLITES 6:3 A First Step into Space 6:4 Race to the Moon 6:5 The Space Shuttle	117 118 119 120 123 124 126 128
6:1 Telescopes CAREER: Rocket Repair Person INVESTIGATION 6-1 6:2 The Spectrograph INVESTIGATION 6-2. ROCKETS AND SATELLITES 6:3 A First Step into Space 6:4 Race to the Moon 6:5 The Space Shuttle PROBLEM SOLVING	117 118 119 120 123 124 126 128 128
6:1 Telescopes CAREER: Rocket Repair Person INVESTIGATION 6—1 6:2 The Spectrograph INVESTIGATION 6—2. ROCKETS AND SATELLITES 6:3 A First Step into Space 6:4 Race to the Moon 6:5 The Space Shuttle PROBLEM SOLVING BIOGRAPHY: Franklin Chang	117 118 119 120 123 124 126 128 128
6:1 Telescopes CAREER: Rocket Repair Person INVESTIGATION 6-1 6:2 The Spectrograph INVESTIGATION 6-2. ROCKETS AND SATELLITES 6:3 A First Step into Space 6:4 Race to the Moon 6:5 The Space Shuttle PROBLEM SOLVING	117 118 119 120 123 124 126 128 128

SKILL	
6:7 Space Stations	13
TECHNOLOGY: APPLICATIONS	
Charles 7 The Color Custom	
Chapter 7 The Solar System	139
EXPLORING BEYOND EARTH	
7:1 Origin of the Solar System	139
7:2 Exploring Earth's Neighborhood	139
INVESTIGATION 7-1	
THE INNER PLANETS	
7:3 Mercury	142
7:4 Venus and Earth	
TECHNOLOGY: ADVANCES	
7:5 Mars	
THE OUTER PLANETS	
7:6 Jupiter	146
7:7 Saturn	
7:8 Uranus, Neptune, and Pluto	
BIOGRAPHY: Ursula Marvin	
INVESTIGATION 7–2	
OTHER OBJECTS OF THE SOLAR SYSTEM	170
7:9 Comets and Meteors	150
CAREER: Aeronautical Engineer	
7:10 Asteroids	
PROBLEM SOLVING	
SKILL	
	10
Chapter 8 Stars and Galaxies	159
STELLAR ASTRONOMY	
8:1 Early Astronomers	159
8:2 The Sun	159
8:3 Stars	
PROBLEM SOLVING	
INVESTIGATION 8-1	
STARS AS OTHER SUNS	100
	164
8:5 Classification of Stars	
	165
8:6 Variable Stars	
8:6 Variable Stars	166
INVESTIGATION 8-2	166 167
INVESTIGATION 8-2	166 167 168
INVESTIGATION 8—2. BIOGRAPHY: S. Jocelyn Bell Burnell. 8:7 Constellations	168 168 168
INVESTIGATION 8—2. BIOGRAPHY: S. Jocelyn Bell Burnell	168 168 168
INVESTIGATION 8–2. BIOGRAPHY: S. Jocelyn Bell Burnell	166 167 168 168
INVESTIGATION 8–2. BIOGRAPHY: S. Jocelyn Bell Burnell	166 168 168 171
INVESTIGATION 8-2. BIOGRAPHY: S. Jocelyn Bell Burnell. 8:7 Constellations SKILL DEEP SPACE ASTRONOMY 8:8 Galaxies TECHNOLOGY: ADVANCES.	166 168 168 171 172 174
INVESTIGATION 8–2. BIOGRAPHY: S. Jocelyn Bell Burnell. 8:7 Constellations SKILL DEEP SPACE ASTRONOMY 8:8 Galaxies TECHNOLOGY: ADVANCES 8:9 Relative Motion and the Universe	166 168 168 171 172 174 174
INVESTIGATION 8-2. BIOGRAPHY: S. Jocelyn Bell Burnell. 8:7 Constellations SKILL DEEP SPACE ASTRONOMY 8:8 Galaxies TECHNOLOGY: ADVANCES.	166 167 168 171 172 174 174

UNIT 3

EARTH'S AIR AND WATER



Chapter 9 Air 185
EARTH'S ATMOSPHERE
9:1 Composition of the Atmosphere 185
9:2 Structure of the Atmosphere 187
9:3 Atmospheric Pressure
BIOGRAPHY: Evangelista Torricelli
PROBLEM SOLVING
INVESTIGATION 9–1
HEAT
9:4 Energy from the Sun
CAREER: Professor of Atmospheric Science 192
9:5 Heat Transfer
SKILL
MOVEMENT OF AIR
9:6 Major Air Circulation
INVESTIGATION 9–2
9:7 Wind Systems 199 TECHNOLOGY: APPLICATIONS 202
TECHNOLOGY: APPLICATIONS
Chapter 10 Weather and Climate 207
WHAT IS WEATHER?
10:1 Factors of Weather 207
INVESTIGATION 10–1
10:2 The Water Cycle and Clouds 210
PROBLEM SOLVING
WEATHER PATTERNS
10:3 Changes in Weather 214
CAREER: Meteorological Technician
10:4 Severe Weather
TECHNOLOGY: ADVANCES
10:5 Forecasting 221

BIOGRAPHY: Leslie Roy Lemon SKILL INVESTIGATION 10—2 CLIMATE 10:6 Climatology. 10:7 Cultural Effects of Weather and Climate	224 225 226
Chapter 11 Earth's Ocean	233
	200
OCEAN WATER	
11:1 Origin of Oceans	
11:2 Composition of Ocean Water	
INVESTIGATION 11–1	
CAREER: Marine Maintainability Engineer	236
WATER IN MOTION	200
11:3 Surface Currents	
11:4 Density Currents	
BIOGRAPHY: Alexander Von Humboldt	
11:5 Waves PROBLEM SOLVING	
SKILL	
11:6 Tides.	
INVESTIGATION 11–2	
TECHNOLOGY: APPLICATIONS	
Chapter 12 Oceanography	251
SHORELINE DEVELOPMENT	
12:1 Shore Zones	251
12:2 Shore Deposits	
CAREER: Scuba Diver/Salvage Diver	
INVESTIGATION 12–1 THE BOTTOM OF THE SEA	256
12:3 Deep Sea Deposits	257
12:4 Topography of the Ocean Floor	
SKILL	
12:5 Mapping the Ocean Floor	
TECHNOLOGY: ADVANCES	
INVESTIGATION 12–2	
THE MARINE HABITAT	_00
12:6 Ocean Life	264
BIOGRAPHY: Eugenie Clark	
12:7 Life Processes in the Ocean	
12:8 Pollution and Its Effects	
PROBLEM SOLVING	
SCIENCE AND SOCIETY	

UNIT 4

SURFACE **PROCESSES**



Chapter 13 Weathering and	
Erosion	279
CHANGES AT EARTH'S SURFACE	
13:1 Weathering	279
13:2 Effects of Climate on Weathering	280
13:3 Products of Weathering	
13:4 Erosion	
13:5 Mass Movements	
BIOGRAPHY: Eve Balfour	284
SOILS	
13:6 Soil and Soil Profiles	
13:7 Classifying Soils	286
INVESTIGATION 13–1	287
WIND	
13:8 Wind Erosion	
INVESTIGATION 13–2	
CAREER: Civil Engineer	293
13:9 Wind Deposits	293
PROBLEM SOLVING	
SKILL	
TECHNOLOGY: APPLICATIONS	300
Chapter 14 Water Systems	305
MOVING WATER	
14:1 Runoff	305
14:2 Development of River Systems	306
14:3 Stream Patterns	307
PROBLEM SOLVING	308
SKILL	
14:4 Runoff in Arid Regions	310
RIVERS AT WORK	
14:5 Erosion by Rivers	311

MINERALS



Chapter 16 Minerals	349
MINERALS	
16:1 What Is a Mineral?	349
16:2 Internal Structure of Minerals	350
INVESTIGATION 16-1	353

MINERAL IDENTIFICATION	UNIT 6
16:3 Physical Properties of Minerals 354	OIVII O
CAREER: Goldsmith	INTERNAL
SKILL 359	
PROBLEM SOLVING	PROCESSES
16:4 Gems	
INVESTIGATION 16–2	The Marian State of the State o
16:5 Rock-forming Minerals	The Court of the C
BIOGRAPHY: Norman L. Bowen	
TECHNOLOGY: APPLICATIONS	Application of the state of the
Chapter 17 Igneous Rocks 369	S. William
IGNEOUS ROCKS	
17:1 Origin of Igneous Rocks 369	
17:2 Minerals in Igneous Rocks 371	2 2 2
17:3 Igneous Rock Classification 373	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
SKILL 374	
CAREER: Thin Section Technician	Chapter 19 Earthquakes 411
INVESTIGATION 17–1	MOVEMENTS WITHIN EARTH
IGNEOUS ACTIVITY	19:1 Earthquakes
17:4 Volcanic Mountains	19:2 Forces Within Earth
INVESTIGATION 17–2	INVESTIGATION 19–1
TECHNOLOGY: APPLICATIONS	DESTRUCTION BY EARTHQUAKES
17:5 Igneous Rock Structures	19:3 Earthquake Damage 416
PROBLEM SOLVING	19:4 Earthquake Safety 418
1 KODELIN 3014 ING	BIOGRAPHY: Waverly J. Person
	19:5 Measuring an Earthquake 419
Chapter 18 Metamorphic and	EARTHQUAKES AND EARTH'S INTERIOR
C'l'	19:6 Locating an Earthquake
9	SKILL
METAMORPHIC ROCKS	INVESTIGATION 19–2
18:1 Origin of Metamorphic Rocks 387	CAREER: Geophysicist 426 19:7 Earth's Interior 426
18:2 Metamorphic Rock Composition 388 18:3 Classification of Metamorphic	PROBLEM SOLVING. 427
Rocks	TECHNOLOGY: APPLICATIONS
SEDIMENTARY ROCKS	120111010011.7111201101101101101111111111
18:4 Formation of Sedimentary Rocks 392	d
TECHNOLOGY: APPLICATIONS	Chapter 20 Plate Tectonics 433
INVESTIGATION 18–1	CONTINENTAL DRIFT
18:5 Features of Sedimentary Rocks 395	20:1 Continents in Motion
BIOGRAPHY: Marjorie A. Chan	20:2 Fossil, Climate, and Rock Clues 434
18:6 Classification of Sedimentary	PROBLEM SOLVING
Rocks	20:3 Magnetic Clues 436
INVESTIGATION 18—2	PLATE TECTONICS
SKILL 400	20:4 Data from the Seafloor
CAREER: Pottery Maker	20:5 The Shifting Plates
18:7 The Rock Cycle	INVESTIGATION 20–1
PROBLEM SOLVING	20:6 Convergent Boundaries
SCIENCE AND SOCIETY	20:7 What Causes Plate Motion? 444

CAREER: Geologist	INVESTIGATION 22-1
	UNIT 8 EARTH'S RESOURCES
Chapter 21 Clues to Earth's Past 459 CORRELATING ROCKS 21:1 Age Relationships Among Rocks 459 21:2 Relative Dating 461 21:3 Gaps in the Rock Record 462 SKILL 463 21:4 Fossil Clues 465 PROBLEM SOLVING 465 CAREER: Biostratigrapher 468 ABSOLUTE DATES 21:5 Absolute Dating 468 INVESTIGATION 21-1 470 21:6 Radiometric Dating 471 BIOGRAPHY: Marie Curie 471 INVESTIGATION 21-2 473 TECHNOLOGY: APPLICATIONS 474	Chapter 23 Renewable Resources 507 THE ENVIRONMENT 23:1 Humans and the Environment 507 23:2 Earth's Resources 508 RENEWABLE RESOURCES 23:3 Land Use 509 CAREER: Sanitary Landfill Operator 511 SKILL 512
Chapter 22 Geologic Time 479 EARTH'S PAST 22:1 The Geologic Time Scale	23:4 Air 513 PROBLEM SOLVING 516 INVESTIGATION 23–1 517 23:5 Water 518

BIOGRAPHY: Lorna J. Mike	GEOTHERMAL AND NUCLEAR ENERGY
TECHNOLOGY: APPLICATIONS	25:4 Geothermal Energy 558
INVESTIGATION 23–2	25:5 Nuclear Energy 559
PROTECTING OUR RESOURCES	CAREER: Powerhouse Supervisor
23:6 Conservation of Earth's	FOSSIL FUELS
Resources	25:6 Coal 562
23:7 Pollution Control 524	25:7 Petroleum and Natural Gas 564
Chapter 24 Mineral Resources 529	SKILL
ORES	25:8 Synfuels
- 1.1	25:9 Biomass Fuels
24:1 Nonrenewable Resoures	INVESTIGATION 25–2
24:2 Types of Ore Deposits 530 24:3 Metallic Ores 532	SCIENCE AND SOCIETY
BIOGRAPHY: Jo Dovison	
24:4 Nonmetallic Deposits	
PROBLEM SOLVING	ADDEAIDICEC
SKILL 536	APPENDICES
INVESTIGATION 24–1 538	Appendix A: International System of
CAREER: Miner	Units 578
MINING EARTH'S RESOURCES	Appendix B: Safety in the Science
24:5 Mines	Classroom 579
24:6 Effects of Mining	Appendix C: Safety Symbols 580
24:7 Land Reclamation	Appendix D: Earth Data 581
INVESTIGATION 24–2	Appendix E: Topographic Map Symbols 582
TECHNOLOGY: APPLICATIONS	Appendix F: Solar System Information 583
24:8 Recycling Earth's Natural	Appendix G: Periodic Table 584
Resources	Appendix H: Spring Star Chart 586
	Appendix I: Summer Star Chart 587
Chapter 25 Energy Resources 551	Appendix J: Fall Star Chart
	Appendix K: Winter Star Chart 589
ENERGY FROM WATER, SUN, AND WIND	Appendix L: Weather Map Symbols 590
25:1 Water Energy	Appendix M: Minerals with Metallic
25:2 Solar Energy 553 BIOGRAPHY: Rene Dubos 553	Luster 591
TECHNOLOGY, ADVANCES FEB	Appendix N: Minerals with Nonmetallic
TECHNOLOGY: ADVANCES553INVESTIGATION 25-1555	Luster 592
25:3 Wind Power	GLOSSARY
PROBLEM SOLVING	INDEX 607
TROUCHI JOLAING	PHOTO CKEDIIS 619

-Skills and Investigations ----

SKILL 1–1	Observations and Inferences11	INVESTIGATION 13-2 SKILL	Wind Erosion
SKILL 1–2	Determining Variables and Controls		Variables
SKILL 1-3 SKILL 2-1	Constructing Models16 Determining Length, Area,	SKILL INVESTIGATION 14-1 INVESTIGATION 14-2	Forming Hypotheses308 Stream Velocity313 Artesian Wells318
SKILL 2–2	and Volume $\dots 31$	SKILL	Interpreting a Glacial Map
SKILL 2-3	Investigations 39 Constructing Graphs 42	INVESTIGATION 15_1	Glacial Erosion and Meltwater334
INVESTIGATION 3-1 INVESTIGATION 3-2	Determining Elevation64 Reading Topographic	INVESTIGATION 15-2 INVESTIGATION 16-1	Rebounding339 Crystal Formation353
SKILL	Maps	SKILL INVESTIGATION 16-2	Classification
INVESTIGATION 4-1 SKILL	Forms of Matter82 Using Laboratory	SKILL INVESTIGATION 17-1	Classifying Rocks374 Classifying Igneous
INVESTIGATION 4-2	Equipment	INVESTIGATION 17-2	Rocks
SKILL INVESTIGATION 5-1 INVESTIGATION 5-2	Using a Globe	INVESTIGATION 18—1 INVESTIGATION 18—2 SKILL	Rock Identification
INVESTIGATION 6-1 INVESTIGATION 6-2 SKILL	Telescopes	INVESTIGATION 19-1 SKILL INVESTIGATION 19-2	Internal Forces
INVESTIGATION 7-1 INVESTIGATION 7-2	Planetary Orbits	INVESTIGATION 20-1 SKILL INVESTIGATION 20-2	Sea-floor Spreading440 Interpreting Data446 Tracking Plates448
SKILL INVESTIGATION 8-1 INVESTIGATION 8-2 SKILL	Making Scale Drawings154 Sunspots163 Stars167 Using Star Charts	SKILL INVESTIGATION 21—1	Sequencing Events463 Constructing an Absolute Time Scale470
INVESTIGATION 9-1 SKILL INVESTIGATION 9-2	Air Pressure	INVESTIGATION 21-2 INVESTIGATION 22-1 SKILL	Radioactive Decay473 Geologic Time Line481 Interpreting a Cross
INVESTIGATION 10—1 SKILL	Relative Humidity209 Reading a Weather	INVESTIGATION 22-2 SKILL	Section
INVESTIGATION 10—2 INVESTIGATION 13—1	Map	INVESTIGATION 23-1 INVESTIGATION 23-2	Experiment
SKILL INVESTIGATION 11—2 INVESTIGATION 12—1	Cause and Effect242 Tidal Range245	SKILL INVESTIGATION 24-1	Interpreting Tables
SKILL INVESTIGATION 12-2	Beach Sand	INVESTIGATION 24–2 INVESTIGATION 25–1	Pollution from Mining543 Solar Energy
INVESTIGATION 13-1	Soil Characteristics287	SKILL INVESTIGATION 25-2	Predicting Outcomes567 Insulation571

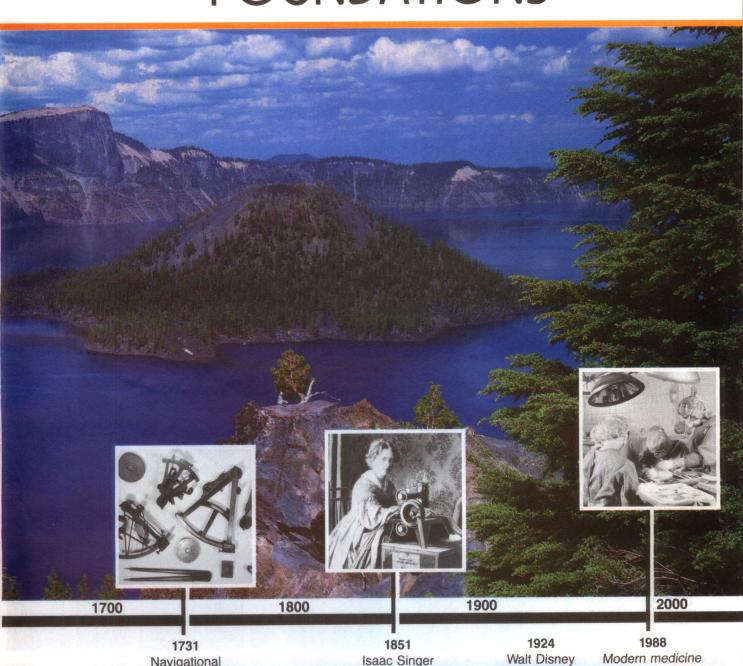
UNIT 1

Earth is a dynamic planet. Some changes occur within minutes or hours. Other changes span millions of years. Streams change Earth every day by eroding and depositing sand, gravel, and pebbles. Mountains form over millions of years as the result of forces within Earth. What kinds of processes and forces produce these changes?



~3490 B.C. Petroglyphs are carved into cave walls. ~3000 B.C. Hieroglyphics are a form of writing. 1617
Triangulation
method of land
measurement used.

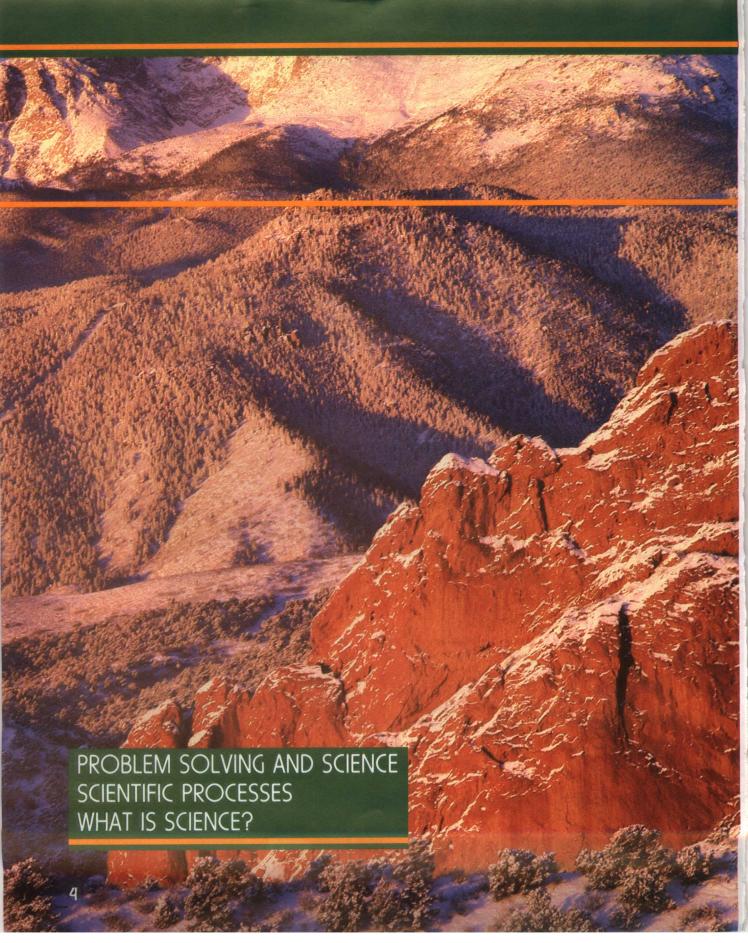
EARTH SCIENCE **FOUNDATIONS**



Navigational sextant is invented.

Isaac Singer manufactures first sewing machine.

makes Alice in Wonderland. increases average life expectancy.



The Nature of Science

t has been predicted that by the time you are 50 years old, 95% of all human knowledge will have been developed during your lifetime. Throughout the years, people have taken what is known and tried to expand their knowledge. Science is learning and doing. Science means "having knowledge." Much of our scientific knowledge has come from a process of observing and studying problems occurring in the world.

PROBLEM SOLVING AND SCIENCE

In order to solve a problem, it is important to approach it in an organized manner. In solving problems, the same path may not be used each time. However, there are methods that are common to most problem solving. Scientists work on problems in a logical way. This is called the scientific method.

1:1 Hot Tub Mystery

After a long jog around the neighborhood, John and Mary Doe decided to relax in their hot tub. While in the water, their eyes began to water and become irritated. After 15 to 20 minutes in the swirling water, they got out to dry off. They noticed that their skin was dry and irritated. They were puzzled about why this occurred. The previous night, they had cleaned the tub and had put in fresh water and new chemicals. John and Mary suspected that the chemicals were irritating their eyes and skin. They had always used the same brand of chemicals and were reasonably sure the amount was correct. However, they took a sample to a laboratory to be tested to see if the chemical composition had changed. When the report

GOALS

- 1. You will learn that solving a problem involves an organized process.
- 2. You will learn how to solve problems by applying some problem solving strategies.

What was the first suspected cause of John and Mary's irritation?

came back, they knew the irritation was not due to a change in composition.

The next time the hot tub was used, eye irritation and skin burning occurred again. Now, John and Mary suspected the water, the amount of the added chemicals, or possibly an allergic reaction. But, Mary doubted she and John would both develop an allergy to the chemicals at the same time. They called the water company to report the incident and asked to have the water analyzed.

Upon contacting the water company, they discovered that there had been other complaints about eye and skin irritation when other people in their area had bathed and showered. Thus, John and Mary were able to rule out an allergic reaction. They then asked the water company to test the water to determine the percent of chemicals in the water from the hot tub, wondering if perhaps they had added too much. They took the chemicals they had used along with a sample of water from the hot tub to the water company. The tests showed that the correct amounts had been used, but 50 parts per billion of benzene were found in the sample. Benzene is a cancer-causing chemical found in gasoline. Dilute concentrations of some chemicals enter the skin far more easily than the pure chemical. Thus, this amount of benzene presented a health problem.

The source of the benzene had to be determined. They thought about possible sources and realized that there was a gasoline station on the corner near their housing development. Mary had recently read an article in the newspaper about leakage from underground storage tanks and wondered if this could be the source of the problem. They called authorities to check the underground storage

FIGURE 1-1. Warm, swirling water in a hot tub is relaxing to tired muscles.

