Cover Image: Climber rappelling from a winter camp below Basin Mountain, Eastern Sierra, California (Galen Rowell/Mountain Light)

Taken from:

*Earth Science*, Twelfth Edition
by Edward J. Tarbuck and Frederick K. Lutgens, illustrated by Dennis Tasa
Published by Pearson Prentice-Hall
Upper Saddle River, New Jersey 07458


Copyright © 2012 by Pearson Learning Solutions

All rights reserved. No part of this book may be reproduced, in any form or by any means, without permission in writing from the publisher.

This special edition published in cooperation with Pearson Learning Solutions.

The information, illustrations, and/or software contained in this book, and regarding the above-mentioned programs, are provided “As Is,” without warranty of any kind, express or implied, including without limitation any warranty concerning the accuracy, adequacy, or completeness of such information. Neither the publisher, the authors, nor the copyright holders shall be responsible for any claims attributable to errors, omissions, or other inaccuracies contained in this book. Nor shall they be liable for direct, indirect, special, incidental, or consequential damages arising out of the use of such information or material.

All trademarks, service marks, registered trademarks, and registered service marks are the property of their respective owners and are used herein for identification purposes only.

Pearson Learning Solutions, 501 Boylston Street, Suite 900, Boston, MA 02116
A Pearson Education Company
www.pearsoned.com

Printed in the United States of America

2 3 4 5 6 7 8 9 10 XXXX 16 15 14 13 12 11

000200010270575680

CF/CB

ISBN 10: 0-558-64927-0 (Florida Edition)
To our wives, Joanne and Nancy,
For their support and patience

Environmental Statement
This book is carefully crafted to minimize environmental impact. Pearson Prentice Hall is proud to report that the materials used to manufacture this book originated from sources committed to sustainable forestry practices, tree harvesting, and associated land management. The binding, cover, and paper come from facilities that minimize waste, energy usage, and the use of harmful chemicals.

Equally important, Pearson Prentice Hall closes the loop by recycling every out-of-date text returned to our warehouse. We pulp the books, and the pulp is used to produce other items such as paper coffee cups or shopping bags.

The future holds great promise for reducing our impact on Earth’s environment, and Pearson Prentice Hall is proud to be leading the way in this initiative. From production of the book to putting a copy in your hands, we strive to publish the best books with the most up-to-date and accurate content, and to do so in ways that minimize our impact on Earth.
# Brief Contents

<table>
<thead>
<tr>
<th>UNIT ONE</th>
<th>Earth Materials</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Introduction to Earth Science</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2 Minerals: Building Blocks of Rocks</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>3 Rocks: Materials of the Solid Earth</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT TWO</th>
<th>Sculpturing Earth's Surface</th>
<th>82</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Weathering, Soil, and Mass Wasting</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>5 Running Water and Groundwater</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>6 Glaciers, Deserts, and Wind</td>
<td>153</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT THREE</th>
<th>Forces Within</th>
<th>186</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 Plate Tectonics: A Scientific Theory Unfolds</td>
<td>187</td>
<td></td>
</tr>
<tr>
<td>8 Earthquakes and Earth's Interior</td>
<td>219</td>
<td></td>
</tr>
<tr>
<td>9 Volcanoes and other Igneous Activity</td>
<td>247</td>
<td></td>
</tr>
<tr>
<td>10 Mountain Building</td>
<td>283</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT FOUR</th>
<th>Deciphering Earth's History</th>
<th>308</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Geologic Time</td>
<td>309</td>
<td></td>
</tr>
<tr>
<td>12 Earth's Evolution through Geologic Time</td>
<td>335</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT FIVE</th>
<th>The Global Ocean</th>
<th>364</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 The Ocean Floor</td>
<td>367</td>
<td></td>
</tr>
<tr>
<td>14 Ocean Water and Ocean Life</td>
<td>391</td>
<td></td>
</tr>
<tr>
<td>15 The Dynamic Ocean</td>
<td>411</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT SIX</th>
<th>Earth's Dynamic Atmosphere</th>
<th>442</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 The Atmosphere: Composition, Structure, and Temperature</td>
<td>445</td>
<td></td>
</tr>
<tr>
<td>17 Moisture, Clouds, and Precipitation</td>
<td>477</td>
<td></td>
</tr>
<tr>
<td>18 Air Pressure and Wind</td>
<td>513</td>
<td></td>
</tr>
<tr>
<td>19 Weather Patterns and Severe Storms</td>
<td>539</td>
<td></td>
</tr>
<tr>
<td>20 World Climates and Global Climate Change</td>
<td>569</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT SEVEN</th>
<th>Earth's Place in the Universe</th>
<th>596</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 Origins of Modern Astronomy</td>
<td>599</td>
<td></td>
</tr>
<tr>
<td>22 Touring Our Solar System</td>
<td>625</td>
<td></td>
</tr>
<tr>
<td>23 Light, Astronomical Observations, And The Sun</td>
<td>653</td>
<td></td>
</tr>
<tr>
<td>24 Beyond Our Solar System</td>
<td>675</td>
<td></td>
</tr>
</tbody>
</table>
Unit 1: Earth Materials
A. Minerals
   1. Introduction to Minerals
   2. Mineral Groups
   3. Physical Properties of Minerals
   4. Quiz: Minerals
B. Rock Cycle
C. Igneous Rocks
   1. Introduction to Igneous rocks
   2. Igneous Textures
   3. Igneous Compositions
   4. Naming Igneous Rocks
   5. Quiz: Igneous Rocks
D. Sedimentary Rocks
   1. Introduction to Sedimentary Rocks
   2. Types of Sedimentary Rocks
   3. Sedimentary Environments
   4. Quiz: Sedimentary Rocks
E. Metamorphic Rocks
   1. Introduction to Metamorphic Rocks
   2. Agents of Metamorphism
   3. Textural and Mineralogical Changes
   4. Common Metamorphic Rocks
   5. Quiz: Metamorphic Rocks

Unit 2: Sculpturing Earth’s Surface
A. Weathering and Soil ALL NEW
   1. Earth’s External Processes
   2. Types of Weathering
   3. Mechanical Weathering
   4. Chemical Weathering
   5. Rates of Weathering
   6. Quiz: Weathering and Soil
B. Mass Wasting: The Work of Gravity ALL NEW
   1. Controls and Triggers of Mass Wasting
   2. Mass-Wasting Processes
   3. Quiz: Mass Wasting
C. Running Water
   1. Hydrologic Cycle
   2. Stream Characteristics
   3. Reviewing Valleys and Stream-Related Features
   4. Quiz: Running Water
D. Groundwater
   1. Importance and Distribution
   2. Springs and Wells
   3. Quiz: Groundwater
E. Glaciers and Glaciation
   1. Introduction
   2. Budget of a Glacier
   3. Reviewing Glacial Features NEW SECTION
   4. Quiz: Glaciers and Glaciation
F. Deserts and Winds
   1. Distribution and Causes of Dry Lands
   2. Common Misconceptions About Deserts
   3. Reviewing Landforms and landscapes NEW SECTION
   4. Quiz: Deserts and Winds

Unit 3: Forces Within
A. Plate Tectonics EXPANDED AND REVISED
   1. Introduction to Plate Tectonics
   2. Divergent Boundaries
   3. Convergent Boundaries
   4. Transform fault boundaries
   5. Formation and Breakup of Pangaea
   6. Plate Tectonics Quiz
B. Earthquakes
   1. What is an Earthquake?
   2. Seismology
   3. Locating the Source of an Earthquake
   4. Earthquakes at Plate Boundaries
   5. Earthquake Quiz
C. Earth’s Interior ALL NEW
   a. Earth’s Layered Structure
   b. Earth’s Interior Quiz
D. Volcanoes and Other Igneous Activity
   a. The Nature of Volcanic Eruptions
   b. Materials extruded During an Eruption
   c. Volcanic Structures and Eruptive Styles
   d. Volcanoes Quiz
E. Mountain Building ALL NEW
   a. Deformation
   b. Folds
c. Faults and Fractures
d. Continental Collisions
e. Crustal Fragments and Mountain Building
f. Mountain Building Quiz

Unit 4: Deciphering Earth’s History
A. Geologic Time Scale
B. Relative Dating—Key Principles
C. Dating With Radioactivity
D. Quiz: Geologic Time

Unit 5: The Global Ocean
A. Floor of the Ocean
   1. Mapping the ocean Floor
   2. Features of the Ocean Floor
   3. Quiz: Ocean Floor
B. Coastal Processes
   1. Waves and Beaches
   2. Wave Erosion
   3. Quiz: Coastal Processes

Unit 6: Earth’s Dynamic Atmosphere
A. Introduction to the Atmosphere
   1. The Importance of Weather
   2. Weather and Climate
   3. Composition of the Atmosphere
   4. Extent of the Atmosphere
   5. Temperature Structure of the Atmosphere
   6. Quiz: Introduction to the Atmosphere
   7. In The Lab: Reading Weather maps
B. Heating Earth’s Surface and Atmosphere
   1. Understanding Seasons, Part 1
   2. Understanding Seasons, Part 2
   3. Solar Radiation
   4. What happens to Incoming Solar Radiation
   5. The Greenhouse Effect
   6. Quiz: Heating Earth’s Surface and Atmosphere
   7. In The Lab: The Influence of Color on Albedo

C. Temperature Data and the Controls of Temperature
   1. Basic Temperature Data
   2. Controls of Temperature
   3. Quiz: Temperature Data and Controls

D. Moisture and Cloud Formation
   1. Water’s Changes of State
   2. Humidity: Water Vapor in the Air
   3. The Basics of Cloud Formation: Adiabatic Cooling
   4. Processes That Lift Air
   5. The Critical Weathermaker: Atmospheric Stability
   6. Quiz: Moisture and Cloud Formation
   7. In The Lab: Atmospheric Stability

E. Forms of Condensation and Precipitation
   1. Classifying Clouds
   2. Types of Fog
   3. How Precipitation Forms
   4. Forms of Precipitation
   5. Quiz: Forms of Condensation and Precipitation

F. Air Pressure and Wind
   1. Measuring Air Pressure
   2. Factors Affecting Wind
   3. Highs and Lows
   4. Quiz: Air Pressure and Wind

G. Basic Weather Patterns
   1. Air Masses
   2. Fronts
   3. Introducing Middle-Latitude Cyclones
   4. In The Lab: Examining a Middle-Latitude Cyclone
   5. Quiz: Basic Weather Patterns

Unit 7: Earth’s Place in the Universe
A. The Planets: An Overview
B. Calculating Your Age and Weight on Other Planets
C. Earth’s Moon
D. A Brief Tour of the Planets
E. Quiz: Solar System
## Contents

### 1 Introduction to Earth Science
- What Is Earth Science? 2
- Earth Science, People, and the Environment 3
- Resources 3
- Population Growth 5
- Environmental Problems 6
- The Nature of Scientific Inquiry 6
- Hypothesis 7
- Theory 7
- Scientific Methods 8
- Scales of Space and Time in Earth Science 9
- Early Evolution of Earth 11
- Earth’s Spheres 12
  - Hydrosphere 12
  - Atmosphere 13
  - Biosphere 14
  - Geosphere 15
- A Closer Look at the Geosphere 15
  - Earth’s Internal Structure 15
  - The Mobile Geosphere 17
- The Face of Earth 18
  - Major Features of the Continents 19
  - Major Features of the Ocean Basins 19
- Earth as a System 22
  - Earth System Science 22
  - The Earth System 23

**BOX 1.1 ➤ EARTH AS A SYSTEM** Earth’s Place in the Cosmos 4

**BOX 1.2 ➤ UNDERSTANDING EARTH** Studying Earth from Space 9

### UNIT ONE

#### Earth Materials

#### 2 Minerals: Building Blocks of Rocks
- Minerals: The Building Blocks of Rocks 30
- Elements: Building Blocks of Minerals 32
  - Atoms 32
- Why Atoms Bond 33
  - Ionic Bonds: Electrons Transferred 33
  - Covalent Bonds: Electrons Shared 34
- Isotopes and Radioactive Decay 34
- Properties of Minerals 35
  - Optical Properties 35
  - Crystal Shape or Habit 36
  - Mineral Strength 36
- Density and Specific Gravity 38
- Other Properties of Minerals 40
- Silicate Minerals 41
- Important Nonsilicate Minerals 43

**BOX 2.1 ➤ PEOPLE AND THE ENVIRONMENT** Making Glass from Minerals 39

**BOX 2.2 ➤ UNDERSTANDING EARTH** Gemstones 45

### 3 Rocks: Materials of the Solid Earth
- Earth as a System: The Rock Cycle 52
  - The Basic Cycle 54
  - Alternative Paths 54
- Igneous Rocks: “Formed by Fire” 54
  - Magma Crystallizes to Form Igneous Rocks 55
  - Igneous Textures 55
  - Igneous Compositions 57
  - Classifying Igneous Rocks 57
  - How Different Igneous Rocks Form 59
- Sedimentary Rocks: Compacted and Cemented Sediment 62
  - Classifying Sedimentary Rocks 63
  - Lithification of Sediment 67
  - Features of Sedimentary Rocks 69
- Metamorphic Rocks: New Rock from Old 70
  - What Drives Metamorphism? 72
  - Metamorphic Textures 73
  - Common Metamorphic Rocks 74

**BOX 3.1 ➤ EARTH AS A SYSTEM** The Carbon Cycle and Sedimentary Rocks 68

**BOX 3.2 ➤ PEOPLE AND THE ENVIRONMENT** United States Per Capita Use of Mineral and Energy Resources 76

**BOX 3.3 ➤ EARTH AS A SYSTEM** The Carbon Cycle and Sedimentary Rocks 68

**BOX 3.2 ➤ PEOPLE AND THE ENVIRONMENT** United States Per Capita Use of Mineral and Energy Resources 76
CONTENTS

UNIT TWO
Sculpturing Earth’s Surface 82

4 Weathering, Soil, and Mass Wasting 83

Earth’s External Processes 84
Weathering 85
Mechanical Weathering 85
Frost Wedging 86
Salt Crystal Growth 86
Unloading 86
Biological Activity 87
Chemical Weathering 88
Water and Carbonic Acid 88
How Granite Weathers 89
Weathering of Silicate Minerals 89
Spheroidal Weathering 90
Rates of Weathering 90
Rock Characteristics 90
Climate 91
Differential Weathering 91
Soil 92
An Interface in the Earth System 92
What Is Soil? 93
Soil Texture and Structure 93
Controls of Soil Formation 94
Parent Material 94
Time 94
Climate 94
Plants and Animals 95
Topography 96
The Soil Profile 96
Classifying Soils 97
Soil Erosion 98
How Soil Is Eroded 98
Rates of Erosion 100
Sedimentation and Chemical Pollution 101
Weathering Creates Ore Deposits 101
Bauxite 102
Other Deposits 102
Mass Wasting: The Work of Gravity 102
Mass Wasting and Landform Development 103
The Role of Mass Wasting 103

5 Running Water and Groundwater 115

Earth as a System: The Hydrologic Cycle 117
Running Water 118
Drainage Basins 118
River Systems 118
Streamflow 119
Gradient and Channel Characteristics 120
Discharge 120
Changes from Upstream to Downstream 121
The Work of Running Water 121
Erosion 122
Transportation 122
Deposition 124
Stream Channels 124
Bedrock Channels 124
Alluvial Channels 124
Base Level and Stream Erosion 126
Shaping Stream Valleys 127
Valley Deepening 127
Valley Widening 128
Changing Base Level and Incised Meanders 128
CONTENTS

Depositional Landforms 129
Deltas 129
Natural Levees 129
Alluvial Fans 132
Drainage Patterns 132
Floods and Flood Control 132
Causes of Floods 132
Flood Control 133
Groundwater: Water Beneath the Surface 134
The Importance of Groundwater 135
Groundwater’s Geological Roles 135
Distribution and Movement of Groundwater 136
Distribution 136
Factors Influencing the Storage and Movement of Groundwater 137
Groundwater Movement 137
Springs 138
Hot Springs 138
Geyser 138
Wells 139
Artesian Wells 141
Environmental Problems Associated with Groundwater 141
Treating Groundwater as a Nonrenewable Resource 142
Land Subsidence Caused by Groundwater Withdrawal 142
Groundwater Contamination 143
The Geologic Work of Groundwater 144
Caverns 144
Karst Topography 145

Glacial Erosion 159
How Glaciers Erode 159
Landforms Created by Glacial Erosion 160
Glacial Deposits 162
Types of Glacial Drift 163
Moraines, Outwash Plains, and Kettles 164
Drumlins, Eskers, and Kames 165
Other Effects of Ice Age Glaciers 166
Glaciers of the Ice Age 169
Causes of Glaciation 170
Plate Tectonics 170
Variations in Earth’s Orbit 170
Other Factors 171
Deserts 172
Geologic Processes in Arid Climates 173
Weathering 173
The Role of Water 174
Basin and Range: The Evolution of a Mountainous Desert Landscape 174
Wind Erosion 177
Deflation, Blowouts, and Desert Pavement 177
Wind Abrasion 178
Wind Deposits 179
Loess 179
Sand Dunes 180
Types of Sand Dunes 181

Box 6.1 Earth as a System Glacial Lake Missoula, MegaFloods, and the Channeled Scablands 168
Box 6.2 People and the Environment The Disappearing Aral Sea 175

UNIT THREE
Forces Within 186

7 Plate Tectonics: A Scientific Theory Unfolds 187
Continental Drift: An Idea Before Its Time 189
Evidence: The Continental Jigsaw Puzzle 189
Evidence: Fossils Match Across the Seas 191
Evidence: Rock Types and Structures Match 191
Evidence: Ancient Climates 192
The Great Debate 193
Plate Tectonics: The New Paradigm 194
Earth’s Major Plates 194
Plate Boundaries 195
Divergent Boundaries 195
Oceanic Ridges and Seafloor Spreading 195
Continental Rifting 199
Convergent Boundaries 199
Ocean–Continental Convergence 200
Ocean–Oceanic Convergence 201
Continental–Continental Convergence 202
Transform Fault Boundaries 202
Testing the Plate Tectonics Model 205
Evidence: Ocean Drilling 205
CONTENTS

Evidence: Hot Spots 206
Evidence: Paleomagnetism 208
Measuring Plate Motion 210
What Drives Plate Motion? 211
Forces That Drive Plate Motion 212
Models of Mantle–Plate Convection 212
Plate Tectonics into the Future 213

BOX 7.1 UNDERSTANDING EARTH The Breakup of Pangaea 190
BOX 7.2 UNDERSTANDING EARTH Susan DeBari—A Career in Geology 203

8 Earthquakes and Earth’s Interior 219

What Is an Earthquake? 220
Earthquakes and Faults 221
Discovering the Cause of Earthquakes 222
Foreshocks and Aftershocks 223
San Andreas Fault: An Active Earthquake Zone 224
Seismology: The Study of Earthquake Waves 225
Locating an Earthquake 226
Measuring the Size of Earthquakes 228
Intensity Scales 228
Magnitude Scales 229
Destruction from Earthquakes 231
Damage from Seismic Vibrations 231
What Is a Tsunami? 232
Landslides and Ground Subsidence 235
Fire 236
Can Earthquakes be Predicted? 236
Short-Range Predictions 236
Long-Range Forecasts 237
Earth’s Interior 238
Formation of Earth’s Layered Structure 238
Earth’s Internal Structure 238
Probing Earth’s Interior: “Seeing” Seismic Waves 240
Discovering Boundaries: The Moho 241
Discovering Boundaries: The Core–Mantle Boundary 242
Discovering Boundaries: The Inner Core–Outer Core Boundary 242

BOX 8.1 PEOPLE AND THE ENVIRONMENT Damaging Earthquakes East of the Rockies 224
BOX 8.2 UNDERSTANDING EARTH Recreating the Deep Earth 241

9 Volcanoes and Other Igneous Activity 247

Mount St. Helens Versus Kilauea 248
The Nature of Volcanic Eruptions 250
Factors Affecting Viscosity 250
Why Do Volcanoes Erupt? 251
What is Extruded During Eruptions? 252
Lava Flows 252
Gases 253
Pyroclastic Materials 253
Volcanic Structures and Eruptive Styles 254
Anatomy of a Volcano 254
Shield Volcanoes 256
Cinder Cones 257
Composite Cones 258
Living in the Shadow of a Composite Cone 260
Nuée Ardente: A Deadly Pyroclastic Flow 260
Lahars: Mudflows on Active and Inactive Cones 262
Other Volcanic Landforms 262
Calderas 262
Fissure Eruptions and Lava Plateaus 264
Volcanic Pipes and Necks 265
Intrusive Igneous Activity 266
Dikes 266
Sills and Laccoliths 266
Batholiths 268
Origin of Magma 269
Generating Magma from Solid Rock 269
Partial Melting and Magma Compositions 271
Plate Tectonics and Igneous Activity 271
Igneous Activity at Convergent Plate Boundaries 272
Igneous Activity at Divergent Plate Boundaries 276
Intraplate Igneous Activity 276
Living with Volcanoes 277
Volcanic Hazards 277
Monitoring Volcanic Activity 277
BOX 9.1 PEOPLE AND THE ENVIRONMENT Eruption of Vesuvius A.D. 79 264
BOX 9.2 EARTH AS A SYSTEM Can Volcanoes Change Earth’s Climate? 272

10 Mountain Building 283

Rock Deformation 284
Temperature and Confining Pressure 285
Rock Type 285
Time 285
Folds 286
Types of Folds 286
Domes and Basins 287
Faults 288
Dip-Slip Faults 289
Strike-Slip Faults 291
12 Earth’s Evolution through Geologic Time 335

UNIT FOUR
Deciphering Earth’s History 308

11 Geologic Time 309

Geologic Time Needs a Time Scale 310
A Brief History of Geology 310
Geology Today 311

Relative Dating—Key Principles 312
Law of Superposition 313
Principle of Original Horizontality 313
Principle of Cross-Cutting Relationships 313
Inclusions 313
Unconformities 314
Using Relative Dating Principles 317

Correlation of Rock Layers 317
Fossils: Evidence of Past Life 318
Types of Fossils 318
Conditions Favoring Preservation 322
Fossils and Correlation 322

Dating with Radioactivity 323
Reviewing Basic Atomic Structure 323
Radioactivity 323
Half-Life 324
Radiometric Dating 324

Is Earth Unique? 336
The Right Planet 337
The Right Location 337
The Right Time 338

Birth of a Planet 339
From Planetesimals to Protoplanets 341
Earth’s Early Evolution 341

Origin of the Atmosphere and Oceans 341
Earth’s Primitive Atmosphere 342
Oxygen in the Atmosphere 342
Evolution of the Oceans 343

Precambrian History: The Formation of Earth’s Continents 344
Earth’s First Continents 344
The Making of North America 345
Supercontinents of the Precambrian 346

Phanerozoic History: The Formation of Earth’s Modern Continents 348
Paleozoic History 349
Mesozoic History 350
Cenozoic History 350

Earth’s First Life 352
Paleozoic Era: Life Explodes 354
Early Paleozoic Life-Forms 354
Vertebrates Move to Land 356

Mesozoic Era: Age of the Dinosaurs 356
Reptiles: The First True Terrestrial Vertebrates 357
CONTENTS

Cenozoic Era: Age of Mammals 359
  From Reptiles to Mammals 360
  Large Mammals and Extinction 362

BOX 12.1 EARTH AS A SYSTEM The Great Permian Extinction 358

BOX 12.2 UNDERSTANDING EARTH Demise of the Dinosaurs 360

UNIT FIVE

The Global Ocean 364

13 The Ocean Floor 367
  The Vast World Ocean 368
    Geography of the Oceans 368
    Comparing the Oceans to the Continents 369
  An Emerging Picture of the Ocean Floor 369
    Mapping the Seafloor 369
    Seismic Reflection Profiles 372
    Provinces of the Ocean Floor 372
  Continental Margins 372
    Passive Continental Margins 372
    Active Continental Margins 375
  The Deep-Ocean Basin 376
    Deep-Ocean Trenches 376
    Abyssal Plains 377
    Seamounts, Guyots, and Oceanic Plateaus 378
  The Oceanic Ridge 379
  Seafloor Sediments 381
    Types of Seafloor Sediments 381
    Distribution of Seafloor Sediments 383
    Seafloor Sediments and Climate Change 383
  Resources from the Seafloor 385
    Energy Resources 385
    Other Resources 386

BOX 13.1 UNDERSTANDING EARTH A Grand Break—Evidence for Turbidity Currents 376

BOX 13.2 UNDERSTANDING EARTH Explaining Coral Atolls—Darwin’s Hypothesis 378

BOX 13.3 UNDERSTANDING EARTH Collecting Geologic History from the Deep-Ocean Floor 384

14 Ocean Water and Ocean Life 391
  Composition of Seawater 392
    Salinity 392
    Sources of Sea Salts 392
    Processes Affecting Seawater Salinity 393
  Ocean Temperature Variation 394
    Temperature Variation with Depth 394
    Ocean Temperature Change over Time 394
  Ocean Density Variation 395
    Factors Affecting Seawater Density 395
    Density Variation with Depth 396
    Ocean Layering 397
  Recent Increase in Ocean Acidity 398
  The Diversity of Ocean Life 398
    Classification of Marine Organisms 398
    Marine Life Zones 401
  Oceanic Productivity 402
    Productivity in Polar Oceans 404
    Productivity in Tropical Oceans 404
    Productivity in Temperate Oceans 404
  Oceanic Feeding Relationships 406
    Trophic Levels 406
    Transfer Efficiency 406
    Food Chains and Food Webs 406

BOX 14.1 PEOPLE AND THE ENVIRONMENT Desalination of Seawater—Fresh Water from the Sea 396

BOX 14.2 EARTH AS A SYSTEM Deep-Sea Hydrothermal Vent Biocommunities—Earth’s First Life? 403

15 The Dynamic Ocean 411
  Surface Circulation 412
    Ocean Circulation Patterns 413
    The Gulf Stream 414
    Ocean Currents and Climate 417
    Upwelling 417
  Deep-Ocean Circulation 418
  The Shoreline: A Dynamic Interface 418
    Coastal Zone Features and Terminology 419
    Beach Composition 421
  Waves 421
    Wave Characteristics 421
## CONTENTS

**Earth–Sun Relationships** 455  
  Earth’s Motions 455  
  Seasons 456  
  Earth’s Orientation 456  
  Solstices and Equinoxes 457  

**Energy, Heat, and Temperature** 460  
  Conduction 460  
  Convection 461  
  Radiation 461  

**The Fate of Incoming Solar Radiation** 462  
  Reflection and Scattering 463  
  Absorption 463  

**Heating the Atmosphere: The Greenhouse Effect** 464  
**For the Record: Air Temperature Data** 464  

**Why Temperatures Vary: The Controls of Temperature** 467  
  Land and Water 468  
  Altitude 469  
  Geographic Position 469  
  Cloud Cover and Albedo 470  

**World Distribution of Temperature** 471  

**Between the Pages**  
**Altering the Atmosphere’s Composition—Sources and Types of Air Pollution** 449  
**Ozone Depletion—A Global Issue** 452  
**Blue Skies and Red Sunsets** 465

---

**UNIT SIX**

**Earth’s Dynamic Atmosphere** 442

**16 The Atmosphere: Composition, Structure, and Temperature** 445  
  Weather and Climate 446  
  Composition of the Atmosphere 448  
    Major Components 448  
    Variable Components 450  
  Height and Structure of the Atmosphere 453  
    Pressure Changes 453  
    Temperature Changes 453  

---

**17 Moisture, Clouds, and Precipitation** 477  
  Water’s Changes of State 478  
    Ice, Liquid Water, and Water Vapor 478  
    Latent Heat 479  
  Humidity: Water Vapor in the Atmosphere 480  
    Saturation 480  
    Mixing Ratio 481  
    Relative Humidity 481  
    Dew-Point Temperature 483  
    Measuring Humidity 483  

---

**Box 15.1 UNDERSTANDING EARTH**  
**Running Shoes as Drift Meters—Just Do It** 415  

**Box 15.2 PEOPLE AND THE ENVIRONMENT**  
**Rogue Waves—Ships Beware!** 423  

CONTENTS

The Basis of Cloud Formation: Adiabatic Cooling 485
Fog and Dew versus Cloud Formation 485
Adiabatic Temperature Changes 485
Adiabatic Cooling and Condensation 486

Processes that Lift Air 486
Orographic Lifting 487
Frontal Wedging 487
Convergence 488
Localized Convective Lifting 488

The Weathermaker: Atmospheric Stability 489
Types of Stability 489
Stability and Daily Weather 492

Condensation and Cloud Formation 492
Types of Clouds 493

Fog 498
Fogs Caused by Cooling 499
Evaporation Fogs 500

How Precipitation Forms 501
Precipitation from Cold Clouds: The Bergeron Process 501
Precipitation from Warm Clouds: The Collision–Coalescence Process 503

Forms of Precipitation 504
Rain 505
Snow 505
Sleet and Glaze 505
Hail 506
Rime 506

Measuring Precipitation 506
Measurement Errors 507
Measuring Snowfall 507
Precipitation Measurement by Weather Radar 508

BOX 17.1 PEOPLE AND THE ENVIRONMENT Atmospheric Stability and Air Pollution 492

BOX 17.2 UNDERSTANDING EARTH Science and Serendipity 502

Air Pressure and Wind 513
Understanding Air Pressure 514
Measuring Air Pressure 515
Factors Affecting Wind 516

Weather Patterns and Severe Storms 539
Air Masses 540
What Is an Air Mass? 541
Source Regions 541
Weather Associated with Air Masses 541

Fronts 543
Warm Fronts 544
Cold Fronts 544
Stationary Fronts and Occluded Fronts 545

The Middle-Latitude Cyclone 546
Life Cycle 546
Idealized Weather 550
The Role of Airflow Aloft 550
What’s in a Name? 551

Thunderstorms 552
Thunderstorm Occurrence 552
Stages of Thunderstorm Development 552
CONTENTS

Tornadoes 554
  Tornado Occurrence and Development 554
  Tornado Destruction 557
  Tornado Forecasting 558

Hurricanes 560
  Profile of a Hurricane 561
  Hurricane Formation and Decay 562
  Hurricane Destruction 563

BOX 19.1 UNDERSTANDING EARTH A Brief Overview of the Weather Business 547
BOX 19.2 PEOPLE AND THE ENVIRONMENT Surviving a Violent Tornado 559

UNIT SEVEN
Earth’s Place in the Universe 596

21 Origins of Modern Astronomy 599

Ancient Astronomy 600
  The Golden Age of Astronomy 602
  Ptolemy’s Model 603

The Birth of Modern Astronomy 605
  Nicolaus Copernicus 605
  Tycho Brahe 606
  Johannes Kepler 607
  Galileo Galilei 608
  Sir Isaac Newton 610

Positions in the Sky 611
  Constellations 611
  The Equatorial System 614

The Motions of Earth 615
  Rotation 615
  Revolution 616
  Precession 616

Motions of the Earth–Moon System 617
  Lunar Motions 617
  Phases of the Moon 618
  Eclipses of the Sun and Moon 619

BOX 21.1 UNDERSTANDING EARTH Foucault’s Experiment 602
BOX 21.2 UNDERSTANDING EARTH Astrology—the Forerunner of Astronomy 612
22 Touring Our Solar System 625

The Planets: An Overview 626
How Did the Planets Form? 626
Terrestrial and Jovian Planets 627
The Compositions of the Planets 628
The Atmospheres of the Planets 628
Earth's Moon 629
The Lunar Surface 629
Lunar History 632
The Planets: A Brief Tour 632
Mercury: The Innermost Planet 632
Venus: The Veiled Planet 634
Mars: The Red Planet 635
Jupiter: Lord of the Heavens 638
Saturn: The Elegant Planet 640
Uranus and Neptune: The Twins 642
Minor Members of the Solar System: Asteroids, Comets, Meteoroids, and Dwarf Planets 643
Asteroids: Planetesimals 643
Comets: Dirty Snowballs 644
Meteoroids: Visitors to Earth 647
Dwarf Planets 649

BOX 22.1 UNDERSTANDING EARTH Pathfinder—The First Geologist on Mars 635

BOX 22.2 EARTH AS A SYSTEM Is Earth on a Collision Course? 645

23 Light, Astronomical Observations, And The Sun 653

Signals From Space 654
Nature of Light 654
The Doppler Effect 656
Light and Processes 658
Light Collection and Detection 658
Historical Development 658
Optical Telescopes 658
Light Detection 662
Radio Telescopes 663
Orbiting Observatories 663
The Sun 665
Structure of the Sun 665
The Active Sun 669
The Solar Interior 671

BOX 23.1 UNDERSTANDING EARTH The Largest Optical Telescopes 661

BOX 23.2 EARTH AS A SYSTEM Variable Sun and Climate Change 666

24 Beyond Our Solar System 675

Stars Like The Sun 676
Measuring Distances to the Closest Stars 676
Stellar Brightness 678
Stellar Color and Temperature 678
Binary Stars and Stellar Mass 679
Variable Stars 680

Hertzsprung-Russell Diagram 681
Interstellar Matter 683
Stellar Evolution 684
Stellar Birth 685
Protostar Stage 685
Main-Sequence Stage 686
Red Giant Stage 686
Burnout and Death 686
H-R Diagrams and Stellar Evolution 687
Stellar Remnants 688
White Dwarfs 689
Neutron Stars 689
Black Holes 692
The Milky Way Galaxy 692
Normal Galaxies 693
Types of Galaxies 694
Galactic Clusters 695
The Big Bang and the Fate Of The Universe 695
The Expanding Universe 696
The Origin of the Universe 697
The End of the Universe 697

BOX 24.1 UNDERSTANDING EARTH Determining Distance from Magnitude 680

BOX 24.2 UNDERSTANDING EARTH Supernova 1987A 689

BOX 24.3 EARTH AS A SYSTEM From Stardust to You 690

Appendix A: Metric and English Units Compared 703
Appendix B: Earth’s Grid System 704
Appendix C: Relative Humidity and Dew Point Tables 706
Appendix D: Landforms of the Conterminous United States 708

Glossary 711
Index 729
Earth Science, Twelfth Edition, Florida Edition, consists of seven units that emphasize broad and up-to-date coverage of basic topics and principles in geology, oceanography, meteorology, and astronomy. The book is intended to be a meaningful, nontechnical survey for students with little background in science. In addition to being informative and up-to-date, a major goal of Earth Science is to meet the need of beginning students for a readable and user-friendly text, a book that is a highly usable “tool” for learning basic Earth science principles and concepts.

Distinguishing Features

Readability
The language of this book is straightforward and written to be understood. Clear, readable discussions with a minimum of technical language are the rule. Frequent headings and subheadings help students follow discussions and identify the important ideas presented in each chapter. In the twelfth edition, improved readability was achieved by examining chapter organization and flow, and writing in a more personal style. Large portions of the text were substantially rewritten in an effort to make the material more understandable.

Focus on Learning
When a chapter has been completed, several useful devices help students review. First, the Chapter Summary recaps all of the major points. Next is a checklist of Key Terms with page references. Learning the language of Earth science helps students learn the material. This is followed by Review Questions that help students examine their knowledge of significant facts and ideas. Next is a reminder to visit the Website for Earth Science, Twelfth Edition, Florida Edition. It contains many excellent opportunities for review and exploration. See page xxiii for more details. Finally, each chapter closes with two frames from the GEODe: Earth Science DVD to remind students about this unique and effective learning aid.

New GEODe: Earth Science, Version 3
The new version of the text’s student-friendly GEODe: Earth Science included with each book is an even better and more complete learning tool than before. It reinforces key concepts using interactive exercises, animations, and practice quizzes. This dynamic, easy-to-use aid is now a DVD that has significantly broader coverage than previous versions. The GEODe: Earth Science table of contents (see pp. vii–viii) highlights these additions and changes. We continue to use a special icon that appears throughout the book whenever a text discussion has a corresponding GEODe: Earth Science activity.

Illustrations and Photographs
The Earth sciences are highly visual. Therefore, photographs and artwork are a very important part of an introductory book. Earth Science, Twelfth Edition, Florida Edition, contains dozens of new high-quality photographs that were carefully selected to aid understanding, add realism, and heighten the interest of the reader.

There has been substantial revision and improvement of the art program. Clearer, easier-to-understand line drawings show greater color and shading contrasts. We also added more figures that combine the use of diagrams and photos. Moreover, many new art pieces have additional labels that “narrate” the process being illustrated and/or “guide” readers as they examine the image. The result is an art program that illustrates ideas and concepts more clearly than ever before. As in previous editions, we are grateful to Dennis Tasa, a gifted artist and respected Earth science illustrator, for his outstanding work.

Focus on Basic Principles and Instructor Flexibility
Although many topical issues are treated in Earth Science, Twelfth Edition, Florida Edition, it should be emphasized that the main focus of this new edition remains the same as its predecessors—to foster student understanding of basic Earth science principles. Whereas student use of the text is a primary concern, the book’s adaptability to the needs and desires of the teacher is equally important. Realizing the broad diversity of Earth science courses in both content and approach, we have continued to use a relatively nonintegrated format to allow maximum flexibility for the teacher. Each of the major units stands alone; hence, they can be taught in any order. A unit can be omitted entirely without appreciable loss of continuity, and portions of some chapters may be interchanged or excluded at the teacher’s discretion.

Three Important Themes
Chapter 1, “Introduction to Earth Science,” presents students with three important themes that recur throughout the book: Earth as a System, People and the Environment, and Understanding Earth.
Earth as a System

An important occurrence in modern science has been the realization that Earth is a giant multidimensional system. Our planet consists of many separate but interacting parts. A change in any one part can produce changes in any or all of the other parts—often in ways that are neither obvious nor immediately apparent. Although it is not possible to study the entire system at once, it is possible to develop an awareness and appreciation for the concept and for many of the system’s important interrelationships. Therefore, starting with the revised discussion of “Earth System Science” in Chapter 1, the theme of “Earth as a System” keeps recurring through all major units of the book. It is a thread that “weaves” through the chapters and helps tie them together. Several new and revised special interest boxes relate to Earth as a system. In addition, each chapter concludes with a section on Examining the Earth System. The questions and problems found here are intended to develop an awareness and appreciation for some of the Earth system’s many interrelationships.

People and the Environment

Because knowledge about our planet and how it works is necessary to our survival and well-being, the treatment of environmental issues has always been an important part of Earth Science. Such discussions serve to illustrate the relevance and application of Earth science knowledge. With each new edition this focus has been given greater emphasis. This is certainly the case with the twelfth edition. The text integrates a great deal of information about the relationship between people and the natural environment and explores the application of the Earth sciences to understanding and solving problems that arise from these interactions. In addition to many basic text discussions, many of the text’s special interest boxes involve the “People and the Environment” theme.

Understanding Earth

As members of a modern society, we are constantly reminded of the benefits derived from science. But what exactly is the nature of scientific inquiry? Developing an understanding of how science is done and how scientists work is a third important theme that appears throughout this book, beginning with the section on “The Nature of Scientific Inquiry” in Chapter 1. Students will examine some of the difficulties encountered by scientists as they attempt to acquire reliable data about our planet and some of the ingenious methods that have been developed to overcome these difficulties. Students will also explore many examples of how hypotheses are formulated and tested as well as learn about the evolution and development of some major scientific theories. Many basic text discussions as well as a number of the special interest boxes on “Understanding Earth” provide the reader with a sense of the observational techniques and reasoning processes involved in developing scientific knowledge. The emphasis is not just on what scientists know, but how they figured it out.

Highlights of the Twelfth Edition

The twelfth edition of Earth Science represents a thorough revision. Every part of the book was examined carefully with the dual goals of keeping topics current and improving the clarity of text discussions. People familiar with preceding editions will see much that is new in the twelfth edition. The list of specifics is long. Examples include the following:

- Chapters open with a correlation of the content to the Next Generation Sunshine State Standards.
- Much of Chapter 2, “Minerals: Building Blocks of Rocks,” is new, including a revamped introductory overview and a revised and expanded discussion of mineral properties.
- There is much that is new in the chapters that focus on external processes. Chapter 4 has a new case study (Box 4.2) on the landslide hazards at La Conchita, California. Chapter 5 includes new material on infiltration capacity and sediment transport as well as a new case study (Box 5.1), “Costal Wetlands are Vanishing on the Mississippi Delta.” Chapter 6 contains new material on proglacial lakes and a new case study (Box 6.1) that focuses on glacial Lake Missoula and Washington’s Channeled Scablands.
- Chapter 8, “Earthquakes and Earth’s Interior,” includes an all-new examination of tsunami. There is also a revised discussion of Earth’s interior that more clearly explains how geologists probe the crust, mantle, and core.
- The section on the nature of volcanic eruptions in Chapter 10 more clearly explains why volcanoes erupt and behave the way they do. The chapter also includes revised discussions of cinder cones and calderas.
- Chapter 12, “Earth’s Evolution through Geologic Time” (formerly “Earth History: A Brief Summary”), is completely revised and rewritten. The chapter presents a clear, concise summary of Earth history that begins with an engaging introduction titled, “Is Earth Unique?” The chapter includes easy-to-follow discussions on the birth and early evolution of the planet and on the origin of continents, the atmosphere, and oceans. To allow maximum teacher flexibility, there are separate discussions of Earth’s physical history and the evolution of life through geologic time.
- Unit 5, “The Global Ocean,” has been thoroughly updated with the assistance of Professor Al Trujillo of Palomar College. Changes include revised discussions and line art dealing with ocean circulation, the behavior of waves, and rip currents. There is also a new special interest box on rogue waves.
- Chapter 19, “Weather Patterns and Severe Storms,” has a revised discussion of tornadoes that includes updated statistics, the newly revised intensity scale, and a new box that focuses on “Surviving a Violent Tornado.” The chapter also has expanded treatment of hurricanes that includes examples and images from the devastating and record-breaking 2004 and 2005 hurricane seasons.
• Chapter 20 (formerly “Climate”) has a new title, “World Climates and Global Climate Change.” The chapter begins with a new introduction that is followed by a strengthened presentation on climate classification and the distribution and characteristics of Earth’s major climate groups. The second half of the chapter examines one of the most serious environmental issues facing humankind—global climate change. This discussion provides an excellent opportunity to explore human impact on the climate system and many interrelationships in the Earth system. It includes up-to-date information and analysis from the 2007 reports by the Intergovernmental Panel on Climate Change.

• All four chapters comprising Unit 7, Earth’s Place in the Universe, have been revised, updated, and substantially rewritten with the assistance of Mark Watry and Teresa Tarbuck of Spring Hill College. This is the most complete revision of this unit ever. The subject matter is better organized and more up-to-date. Discussions progress in a manner that is easier to follow for the beginning student. Readers get an engaging perspective on the historical development of astronomy (Chapter 21) and a factual, up-to-date tour of the solar system (Chapter 22). They also learn about telescopes and are introduced to modern methods of observing the universe such as orbiting observatories (Chapter 23). The unit concludes with a clear presentation on stellar evolution and the origin of the universe (Chapter 24).

Additional Highlights

• “Students Sometimes Ask . . .” This popular feature has been retained and improved in the twelfth edition. Teachers and students continue to react favorably and indicated that the questions and answers that are sprinkled throughout each chapter add interest and relevance to discussions.

• Although there is not a significant change in the number of special interest boxes, several are totally new or substantially revised. As in the previous edition, most are intended to illustrate and reinforce the three themes of “Earth as a System,” “People and the Environment,” and “Understanding Earth.”

The Teaching and Learning Package

The challenge is fundamental and too often overlooked in what seems to have become a weapons race of resources supplemental to the text: instructors need more time, students need more preparation. With this as a credo, Pearson/Prentice Hall has produced for this edition perhaps the best set of teacher and student resources ever assembled to support an introductory Earth science textbook. Not only are they of the highest quality, they are the most useful. Please see pages xxii-xxiii of this Preface for detailed descriptions.

Acknowledgments

Writing a textbook requires the talents and cooperation of many individuals. We value the excellent work of Mark Watry and Teresa Tarbuck of Spring Hill College. They helped to make Unit 7, “Earth’s Place in the Universe,” a more readable, engaging, and up-to-date introduction to astronomy. We also appreciate the aid of Alan Trujillo of Palomar College. His contributions to the oceanography unit and to the “Students Sometimes Ask . . .” feature remain an important part of Earth Science.

Working with Dennis Tasa, who is responsible for all of the outstanding illustrations and much of the developmental work on GEODe: Earth Science, is always special for us. We not only value his outstanding artistic talents and imagination but his friendship. We are also grateful to Ken Pinzke at Southwestern Illinois College for his important work on the text’s laboratory manual, Applications and Investigations in Earth Science. Ken is an important part of our team and a valued friend as well.

Special thanks goes to those colleagues who prepared in-depth reviews. Their critical comments and thoughtful input helped guide our work and clearly strengthened the text. We wish to thank:

Erin Argyilan, Indiana University Northwest
Jake Armour, University of North Carolina- Charlotte
Michael Bradley, Eastern Michigan University
Natalie Bursztyn, Bakersfield College
Marianne Caldwell, Hillsborough Community College
Dan Deocampo, California State University- Sacramento
Holly Dodson, Sierra College
Chris Hooker, Waubonsee Community College
Zoran Kilibarda, Indiana University Northwest
Michael Lewis, University of North Carolina- Greensboro
Tina Gayle Osborne, Palm Beach Community College
James Sacchinelli, Atlantic Cape Community College
Tom Sills, Wright State University
David Vorhees, Waubonsee Community College
Jim Wysong, Hillsborough Community College

We also acknowledge the outstanding professionals at Pearson. We sincerely appreciate the company’s continuing strong support for excellence and innovation. Special thanks to the hard-working geosciences team—Dav Kaveney, Dru Peters, Crissy Dudonis, John DeSantis, Sean Hale, and Amy Porubsky. In addition to being great people to work with, all are committed to producing the best textbooks possible. The production team, led by Patty Donovan at Pine Tree Composition, Inc., has once again done an outstanding job. All are true professionals with whom we are very fortunate to be associated.

Edward J. Tarbuck
Frederick K. Lutgens
The Teaching and Learning Package

Pearson continues to improve the teacher resources in this edition with the goal of saving you time in preparing for your classes.

The following supplements are available to qualified adopters.

Instructor's Resource Center (IRC) on DVD

The IRC puts all your class resources in one easy-to-reach place:
Three PowerPoint® presentations for each chapter
101 animations of Earth processes
All of the line art, tables, and photos from the text in .jpg files (Are illustrations central to your lecture? Check out the Student Lecture Notebook.)
Images of Earth photo gallery
Instructor’s Manual in Microsoft Word
Test Item File in Microsoft Word
TestGen test generation and management software

Most of the teacher supplements and resources for this book are also available electronically for adoption preview and download online. Please go to www.pearsonschool.com/access_request and select “access to online instructor resources”. You will be required to complete a one time registration subject to verification before being emailed access information for download materials.

PowerPoints®

Found on the IRC are two PowerPoint files for each chapter. Cut down on your preparation time, no matter what your lecture needs.

1. Art and Animations—All of the line art, tables, and photos from the text, along with the animation library, pre-loaded into PowerPoint slides for easy integration into your presentation.
2. Lecture Outline—Authored by Stanley Hatfield of Southwestern Illinois College, this set averages 35 slides per chapter and includes customizable class outlines with supporting art.

Animations

The Prentice Hall Geoscience Animations Library includes over 100 animations illustrating the most difficult-to-visualize topics of Earth science. Created through a unique collaboration among five of the Pearson leading geoscience authors, these animations represent a significant leap forward in class presentation aids. They are provided both as Flash files and, for your convenience, pre-loaded into PowerPoint slides.

“Images of Earth” Photo Gallery

Supplement your personal and text-specific slides with this amazing collection of over 300 geologic photos contributed by Marli Miller (University of Oregon) and other professionals in the field. The photos are available on the IRC on DVD.

Transparencies

Simply put: Every Dennis Tasa illustration in Earth Science, Twelfth Edition is available as a full-color, projection enhanced transparency—175 in all. (Are illustrations central to your class? Check out the Student Lecture Notebook.)


(0-55-866727-9)

Authored by Stanley Hatfield (Southwestern Illinois College), the Instructor's Manual contains: learning objectives, chapter outlines, answers to end-of-chapter questions and suggested, short demonstrations to spice up your class. The Test Item File incorporates art and averages 75 multiple-choice, true/false, short answer and critical thinking questions per chapter.

TestGen

Use this electronic version of the Test Item File to customize and manage your tests. Create multiple versions, add or edit questions, add illustrations—your customization needs are easily addressed by this powerful software.

For the Laboratory

Applications and Investigations in Earth Science, Sixth Edition. Written by Ed Tarbuck, Fred Lutgens, and Ken Pinzke, this full-color laboratory manual contains 23 exercises that provide students with hands-on experience in geology, oceanography, meteorology, astronomy, and Earth science skills. Available for purchase.
Student Resources

The student resources to accompany Earth Science, Twelfth Edition, Florida Edition have been further refined with the goal of focusing the students’ efforts and improving their understanding of Earth science concepts.

GEODe: Earth Science

Somewhere between a text and a tutor GEODe: Earth Science version 3 DVD, included with your book, employs the unique capabilities of the computer to illuminate key concepts in Earth science. Animations, videos, photographs, text, narration, and interactive exercises are presented in a tutorial format. Do you learn better by doing? Exercises throughout the DVD get you interacting instead of just memorizing. Does your lab not always parallel your class? A quick review of the relevant module will help you prepare for the lab, whether or not you have covered the topic in class. Look for the GEODe: Earth Science icon throughout the text. The DVD is plug-and-play—no special software or installation is necessary—so it’s perfect for use in your school’s computer lab (though you should probably use headphones).

Study Guide

Written by experienced educators Stanley Hatfield and Ken Pinzke (Southwestern Illinois College), the Study Guide helps students identify the important points from the text, and then provides them with review exercises, study questions, self-check exercises, and vocabulary review. Available for purchase.

Companion Website

Authored by Molly Bell, the Companion Website contains numerous chapter review exercises (from which students get immediate feedback). Links to other resources are also included for further study. Teachers can utilize the Grade-Tracker to assess student progress.

High school teachers can obtain teacher and student preview or adoption access in one of two ways:

- By registering online at www.pearsonschool.com/access_request.
- Through the use of a physical pincode card. High school adopters will receive an adopter access pincode card (ISBN 0130343919) with their textbook order. Preview access pincode cards may be requested using ISBN 0131115989. Both adopter and preview pincode cards include follow-on directions and provide teacher and student access.

For questions concerning access, please contact your local Pearson sales representative or email PHwebaccess@pearsoned.com.

Student Lecture Notebook

Illustrations are tools—use them
Illustrations are critical to understanding Earth science. They are a centerpiece of your textbook and, most likely, your teacher’s class. In the Student Lecture Notebook you will find all the art from the text, reproduced with space for you to take notes. In fact, you may find that these illustrations are exactly the ones you will see in class. Using the Student Lecture Notebook means: more focused and more rapid note-taking, less writing in your textbook, and less to carry to class. Available for purchase.

Next Generation Sunshine State Standards for Earth/Space Science

The Next Generation Sunshine State Standards describe the knowledge and process skills that you are expected to learn before graduating from high school.