

Discovering Design with Earth Science

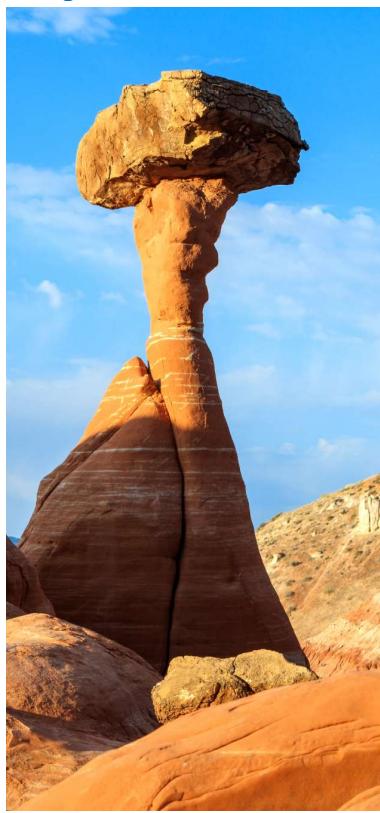
Table of Contents

Chapter 1: The Basics



Introduction.....	1
The Earth's Shape.....	1
Experiment 1.1: Hull Down.....	2
Chemicals	4
Experiment 1.2: Very Similar but Very Different!.....	4
It's Just a Phase	6
Units.....	7
The Metric System.....	8
Math With Units	10
Volume	12
Converting Between Metric Units	13
Converting Between Unit Systems	16
It's Not the Heat.....	21
Experiment 1.3: Movement You Do Not See.....	22
Measuring Temperature.....	24
Measuring Density.....	25
Measuring Concentration.....	27
Answers to the Comprehension Check Questions.....	29
Chapter Review	33

Chapter 2: It's a Little Crusty



Introduction.....	35
Spheres Within Spheres	36
The Geosphere	37
But Wait A Minute	38
Crusty and Dirty	40
Experiment 2.1: It's More Than Just Dirt.....	41
Components of Topsoil.....	42
Experiment 2.1 Continued	42
Experiment 2.2: Water Sorting	44
Particle Sizes in Soil	46
Experiment 2.3: Percolation	46
But Where Does Soil Come From?	49
Experiment 2.4: Breaking Down Rocks	49
Experiment 2.5: Physical Weathering	51
More About Physical Weathering	51
Other Kinds of Physical Weathering	53
Chemical Weathering	54
More About Chemical Weathering.....	56
Erosion.....	57
Uniformitarianism and Catastrophism.....	60
Answers to the Comprehension Check Questions.....	62
Chapter Review	64

Chapter 3: Minerals 65



Introduction.....	65
Minerals and Rocks	65
Experiment 3.1: Minerals and Rocks.....	65
Color: An Optical Property of Minerals	67
Other Optical Properties of Minerals.....	68
Experiment 3.2: Optical Properties of Minerals	68
Mechanical Properties of Minerals	70
Experiment 3.3: Mechanical Properties of Minerals	72
Other Properties of Minerals	74
Experiment 3.4: Effervescence and Magnetic Properties in Minerals ...	74
Chemical Properties of Minerals	77
How Do Minerals Form?	82
Polymorphism.....	84
How We Use Minerals.....	86
Precious and Semi-Precious Gems	89
Minerals in the Soil.....	91
Answers to the Comprehension Check Questions.....	92
Chapter Review	94

Chapter 4: Rocks 95



Introduction.....	95
Minerals in Rocks	95
Experiment 4.1: Minerals in Granite	96
Three Basic Types of Rock.....	97
Igneous Rock	99
Experiment 4.2: Igneous Rock	99
Sedimentary Rock.....	102
Experiment 4.3: Sedimentary Rock	102
Metamorphic Rock	105
Experiment 4.4: Metamorphic Rock.....	106
The Rock Cycle	110
Different Scientific Perspectives of The Rock Cycle	111
Sedimentary Rock Formations	115
Stranger Sedimentary Rock Formations	118
More on Sedimentary Rock	119
The Relative Age of Rocks	121
Really Useful Rocks	122
Answers to the Comprehension Check Questions.....	125
Chapter Review	129

Chapter 5: The Lithosphere 125



Introduction.....	125
One Big Difference Between Oceanic and Continental Crust.....	126
Experiment 5.1: Density of Rocks.....	126
A Surprising Thing About the Continents	128
Experiment 5.2: Magnetic Alignment	129
The Earth's Magnetic Field	131
What Causes the Earth's Magnetic Field?	132
Experiment 5.3: An Electromagnet	132
How Does This Relate to the Motion of the Continents?	134
It Is Not Constant.....	135
Learning From the Ocean	137
Why Does the Oceanic Crust Slip Under Continental Crust?	139
Experiment 5.4: When Crusts Collide	139
Plate Tectonics	140
Plate Movements	141
Hot Spots and Volcanic Islands.....	145
What's Actually Moving the Plates?	146
Experiment 5.5: Convection	146
Sample Data and Calculations for Experiment 5.1	149
Sample Data and Calculations for Experiment 5.4.....	149
Answers to the Comprehension Check Questions.....	140
Chapter Review	152

Chapter 6: More About Motion in the Lithosphere 153



Introduction.....	153
Different Types of Faults.....	153
Experiment 6.1: Friction in Faults	154
Earthquakes.....	156
Don't Lose Your Focus	160
Focusing in on Waves.....	161
Experiment 6.2: Waves.....	161
More About Seismic Waves	164
Reflection and Refraction	168
Experiment 6.3: Refraction of Light Waves	169
Tsunamis.....	171
Earth Has Its Ups and Downs	172
More About Volcanoes.....	175
Answers to the Comprehension Check Questions.....	180
Chapter Review	182

Chapter 7: Fossils in Rocks.....183



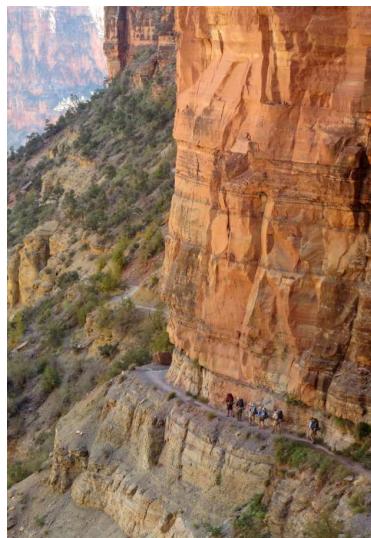
Introduction.....	183
Different Fossils.....	184
Experiment 7.1: Examining Fossils	184
The Key to Fossilization.....	185
Experiment 7.2: Partially Preventing a Reaction.....	186
Fossil Molds and Casts	189
It Looks Like a Mold, But.....	190
Fossil Footprints	192
Petrification.....	194
Experiment 7.3: A Quick Petrification	194
What Can We Learn from Petrified Fossils?	197
Experiment 7.4: Detailed Examination of Petrified Fossils	197
Surprising Fossils.....	200
Reading too Much into Fossils	202
Extinct or Not?.....	204
There Is a Pattern	206
Answers to the Comprehension Check Questions.....	210
Chapter Review	212

Chapter 8: Interpreting the Geological Record.....213



Introduction.....	213
Making Interpretations Based on Limited Data.....	213
Experiment 8.1: Did it Change?	213
Uniformitarianism's Approach to the Geological Record.....	216
Atoms and Radioactivity	216
The Speed at Which Radioactive Decay Occurs	221
Experiment 8.2: Half Life.....	221
Using Radioactive Decay to Determine the Age of Rocks.....	223
Experiment 8.3: Gases in Liquids.....	224
Radiometric Dating and the Geological Column.....	226
The Earth's History According to Uniformitarians	228
Catastrophism and the Worldwide Flood	231
The Catastrophist View of the Geological Column.....	233
The Earth's History According to Young-Earth Creationists.....	237
Answers to the Comprehension Check Questions.....	242
Chapter Review	244

Chapter 9: Uniformitarianism Versus Catastrophism 245



Introduction.....	245
Using Present-Day Observations to Interpret the Past	245
Experiment 9.1: How Long Has It Been Sitting There?.....	245
Potassium-Argon Dating	238
Carbon-14 Dating	250
Evidence for the Uniformitarian Interpretation	253
Evidence for the Catastrophist Interpretation.....	258
Evolution and the Geological Column	263
Do Similarities Imply Macroevolution?	266
Data That Are Hard Reconcile With Macroevolution	268
Data That Are Hard Reconcile With Young-Earth Creationism	270
It's Time to Talk About Time.....	273
Science Cannot Say Which Is Better	277
Answers to the Comprehension Check Questions.....	278
Chapter Review	280

Chapter 10: Water and the Hydrosphere..... 281



A Very Important Chemical	281
A Molecule with Charge.....	281
Experiment 10.1: Floating Paper Clips.....	282
An Exceptional Molecule	284
Experiment 10.2: Density Change	284
A High-Capacity Molecule.....	286
Experiment 10.3: Heating Things Up.....	286
The Opposite of Fresh is...Salt?.....	289
Experiment 10.4: Freshwater versus Saltwater	289
Evening Things Out.....	292
It's a Salty World After All.....	296
Why Do Both Exist on Earth?	297
Experiment 10.5: Purifying Water.....	297
The Hydrologic Cycle.....	300
How Long Have You Been a Resident?	303
Answers to the Comprehension Check Questions.....	305
Sample Calculations for Experiment 10.2	306
Sample Calculations for Experiment 10.4	306
Chapter Review	307

Chapter 11: More on the Hydrosphere 309

Introduction.....	309
Motion in the Ocean, Part 1: Surface Waves.....	309
Experiment 11.1: Making Waves	309
Motion in the Ocean, Part 2: Tides	312
Motion in the Ocean, Part 3: Surface Currents.....	317
Experiment 11.2: Bending the Path	318
More on Surface Currents.....	320
Surface Currents Causing Vertical Currents.....	323
Thermohaline Currents	324
Experiment 11.3: Temperature and Density	325
Freshwater in the Hydrosphere, Part 1: Glaciers	327
Freshwater in the Hydrosphere, Part 2: Groundwater and Soil Moist..	330
Freshwater in the Hydrosphere, Part 3: Water in the Atmosphere	332
Experiment 11.4: Making a Cloud.....	332
Answers to the Comprehension Check Questions.....	335
Chapter Review	337

Chapter 12: The Atmosphere 339

Introduction.....	339
Air Has Weight and Takes Up Space	339
Experiment 12.1: Air Has Weight and Takes Up Space	339
Air Pressure	341
Experiment 12.2: Air Pressure.....	342
The Composition of Air.....	344
Divisions of the Atmosphere	346
Why Does the Temperature Vary Like That?.....	349
Experiment 12.3: Blowing Away the Temperature.....	349
What About the 1%?.....	352
More About Carbon Dioxide	355
Carbon Dioxide, Acids, and Bases	356
Experiment 12.4: Carbon Dioxide and pH	357
The Effect of Increasing Carbon Dioxide on Global Temperature	359
The Effect of Increasing Carbon Dioxide on Ocean pH.....	362
Answers to the Comprehension Check Questions.....	365
Chapter Review	367

Chapter 13: Weather, Part 1	369
Introduction.....	369
You Are My Sunshine	369
It's Like Night and Day.....	372
It's Not Even.....	373
Experiment 13.1: It's Not Really a Circle	375
We Take This Trip Every Year	376
Wind and Temperature	382
Experiment 13.2: Making Wind	382
Global Wind Patterns.....	384
Air Masses	388
Why Is the Sky Blue?	389
Experiment 13.2: Orange and Blue	389
Clouds.....	392
Answers to the Comprehension Check Questions.....	397
Chapter Review	399

Chapter 14: Weather, Part 2	401
Introduction.....	401
Weather Fronts.....	401
Weather Maps.....	403
Precipitation.....	406
Experiment 14.1: Skating Drops.....	406
More on Humidity	408
Experiment 14.2: Cool and Warm Fingers	409
More on Precipitation	411
Thunderstorms	416
Experiment 14.3: Knuckle Sparks	417
Hail in Thunderstorms	419
Tornadoes	420
Hurricanes.....	424
Is Severe Weather Getting Worse?	427
Answers to the Comprehension Check Questions.....	429
Chapter Review	431

Chapter 15: Earth's Solar System.....	433
Introduction.....	433
Experiment 15.1: Twirling around	434
Our Solar System.....	436
But It Doesn't Look Like That to Us!	440
“Sampling” the Sun	445
Experiment 15.2: A CD Spectrometer.....	446
Focusing on the Sun.....	448
More Details About the Sun	453
Experiment 15.3: Hydrostatic Equilibrium.....	453
The Moon.....	456
Answers to the Comprehension Check Questions.....	461
Chapter Review	463
Chapter 16: Earth's Solar System and the Universe.....	465
Introduction.....	465
Measuring Distance with Parallax	465
Experiment 16.1: Parallax and Distance.....	465
Let's Get Some Perspective.....	468
Outside Our Solar System	470
Star Light, Star Bright.....	473
Experiment 16.2: Distance and Brightness.....	473
Distance Isn't the Only Factor.....	476
What Happens When Parallax Doesn't Work?	478
Classifying Stars	479
Differences Among the Stars.....	481
Stars Group Together.....	482
Our Sun Is a Special Star	483
It's a Dusty Universe	485
It's Getting Bigger	487
A Word About Distance and Time	488
Summing it All Up.....	490
Answers to the Comprehension Check Questions.....	491
Chapter Review	493
Glossary	495
Photo and Illustration Credits	509
Index.....	511

