

Exploring Creation With Physical Science

Table of Contents

MODULE #1: The Basics.....	1
Introduction	1
Atoms and Molecules	1
Experiment 1.1: Atoms and Molecules	1
Measurement and Units.....	7
The Metric System	8
Manipulating Units.....	10
Converting Between Units	11
Converting Between Systems.....	14
Experiment 1.2: Cubits and Fingers	15
Concentration	17
Experiment 1.3: Concentration	17
 MODULE #2: Air	 25
Introduction	25
The Air and Humidity	25
Experiment 2.1: Evaporation and Temperature	25
The Composition of Air	28
Experiment 2.2: Oxygen and Fire	30
Carbon Dioxide in the Air	32
Experiment 2.3: Carbon Dioxide and the Greenhouse Effect.....	33
Global Warming.....	36
Parts Per Million.....	41
Ozone.....	42
Air Pollution.....	44
 MODULE #3: The Atmosphere	 55
Introduction	55
Atmospheric Pressure.....	55
Experiment 3.1: Atmospheric Pressure	56
The Layers of Earth’s Atmosphere	60
The Homosphere	62
What Is Temperature?	66
Experiment 3.2: Seeing the Effect of Changing Temperature	66
The Temperature Gradient in the Homosphere.....	69
The “Hole” in the Ozone Layer	69
The Heterosphere	73

MODULE #4: The Wonder of Water	81
Introduction	81
The Composition of Water	81
Experiment 4.1: The Chemical Composition of Water	81
Chemical Formulas	85
Water's Polarity	86
Experiment 4.2: Water's Polarity	86
Water as a Solvent	90
Experiment 4.3: Solvents and Solutes	90
Hydrogen Bonding in Water	93
Experiment 4.4: Comparing Solid Water to Solid Butter	95
Water's Cohesion	97
Experiment 4.5: Water's Cohesion	97
Experiment 4.6: The Forces Between Molecules	99
Hard Water and Soft Water	100
 MODULE #5: The Hydrosphere	 105
Introduction	105
The Parts of the Hydrosphere and the Hydrologic Cycle	107
Experiment 5.1:Evaporation, Condensation, and Precipitation	109
The Ocean	113
Glaciers and Icebergs	116
Experiment 5.2: Ice and Salt	116
Groundwater and Soil Moisture	120
Surface Water	122
Atmospheric Moisture	122
Experiment 5.3: Cloud Formation	122
Water Pollution	126
 MODULE #6: Earth and the Lithosphere	 131
Introduction	131
The Crust	132
The Mantle	133
Experiment 6.1: How Sound Travels Through Different Substances	133
Experiment 6.2: A Simulation of Plastic Rock	136
The Earth's Core	138
Experiment 6.3: Making an Electromagnet	140
Plate Tectonics	144
Experiment 6.4: A Model of Plate Tectonics	145
Earthquakes	148
Mountains and Volcanoes	151

MODULE #7: Factors That Affect Earth's Weather.....	157
Introduction	157
Factors That Influence Weather	157
Clouds.....	157
Experiment 7.1: A Long-Term Weather Experiment.....	160
Earth's Thermal Energy	161
Latitude and Longitude	165
Uneven Thermal Energy Distribution	166
Air Masses.....	172
 MODULE #8: Weather and Its Prediction	 181
Introduction	181
Precipitation	181
Thunderstorms.....	183
Experiment 8.1: Making Your Own Lightning.....	186
Tornadoes and Hurricanes.....	190
Weather Maps and Weather Prediction.....	194
Interpreting the Results of Experiment 7.1 and Making Your Own Weather Predictions.....	198
Experiment 8.2: Turning Experiment 7.1 into a Weather Prediction Tool	199
 MODULE #9: An Introduction to the Physics of Motion.....	 203
Introduction	203
Mechanics – The Study of Motion, Forces, and Energy	203
Speed: How Quickly Motion Occurs	206
Velocity: Speed and Direction	208
Experiment 9.1: The Importance of Direction	209
Acceleration: The Rate of Change in Velocity	212
The Acceleration Due to Gravity	218
Experiment 9.2: The Acceleration Due to Gravity is Independent of the Object Falling.....	219
Experiment 9.3: Measuring Height With a Stopwatch	221
 MODULE #10: Newton's Laws.....	 229
Introduction	229
Sir Isaac Newton	229
Newton's First Law of Motion.....	230
Experiment 10.1: Two Experiments Demonstrating Newton's First Law	231
Experiment 10.2: An Experiment to See How Well You Understand Newton's First Law	235
Friction	237
Experiment 10.3: Friction	237
Newton's Second Law of Motion	240
Static and Kinetic Friction.....	244
Newton's Third Law of Motion	246
Experiment 10.4: Newton's Third Law	247

MODULE #11: The Forces in Creation - Part 1..... 255

Introduction	255
The Four Fundamental Forces of Creation	255
The Gravitational Force	255
Force and Circular Motion	260
Experiment 11.1: Force and Circular Motion	260
A Fictional Force.....	263
The Gravitational Force at Work in Our Solar System.....	265
Comets.....	269
Hey, What About Pluto?	272
What Causes the Gravitational Force?	274
Experiment 11.2: The "Bent Space and Time" Theory of Gravity	274
Experiment 11.3: The Graviton Theory of Gravity.....	276
A Brief History of Our View of the Solar System	278

MODULE #12: The Forces in Creation - Part 2..... 285

Introduction	285
James Clerk Maxwell	285
The Electromagnetic Force	286
Experiment 12.1: Electrical Attraction and Repulsion.....	286
Photons and the Electromagnetic Force	290
How Objects Become Electrically Charged.....	291
Experiment 12.2: Making and Using an Electroscope.....	291
Electrical Circuits.....	295
Resistance.....	299
Experiment 12.3: Current and Resistance	299
Switches and Circuits	302
Series and Parallel Circuits	303
Magnetism.....	305
Permanent Magnets	306

MODULE #13: The Forces in Creation - Part 3..... 313

Introduction	313
The Structure of the Atom.....	313
The Periodic Table of the Elements	320
The Strong Force.....	325
Radioactivity	327
The Dangers of Radioactivity	330
The Rate of Radioactive Decay	332
Radioactive Dating.....	334

MODULE #14: Waves and Sound 341

Introduction	341
Waves	341
Sound Waves	344
Experiment 14.1: The Medium Through Which Sound Waves Travel	344
The Speed of Sound	347
Experiment 14.2: The Speed of Sound	347
The Speed of Sound in Other Substances	351
Sound Wavelength and Frequency	353
Experiment 14.3: Wavelength and Sound	353
The Doppler Effect	355
Experiment 14.4: The Doppler Effect	356
The Volume of Sound	357
Experiment 14.5: The Amplitude of a Sound Wave	358
Uses of Sound Waves	361

MODULE #15: Light..... 367

Introduction	367
The Dual Nature of Light	367
Wavelength and Frequency of Light	370
Experiment 15.1: Seeing Different Wavelengths of Light	370
Reflection	374
Experiment 15.2: The Law of Reflection	374
Refraction	377
Experiment 15.3: Refraction of Light	378
Experiment 15.4: The "Magical" Quarter	380
Lenses	383
The Human Eye	385
How We Perceive Color	388
Experiment 15.5: How the Eye Detects Color	388
Adding and Subtracting Colors	389

MODULE #16: An Introduction to Astrophysics..... 397

Introduction	397
The Sun	397
Nuclear Energy	401
Classifying the Stars in the Universe	404
Variable Stars	409
Measuring the Distance to Stars	411
Galaxies	413
An Expanding Universe	414
Experiment 16.1: An Expanding Universe	416
Summing It All Up	418

Glossary 423

Appendix A..... 433

Appendix B..... 449

Appendix C..... 481

Index..... 489