

Chemistry

I. Course Description

This course is a first year high school course that gives the student a rigorous foundation in chemistry, preparing them for college-level work. Providing a broad overview of matter that makes up God's creation and how it changes, it is composed of both classroom instruction and laboratory investigations.

II. Goals and Objectives

1. To appreciate the sheer grandeur of God's mighty power demonstrated through His creation
2. Become equipped to meet college level entrance requirements for chemistry
3. Develop skills and understanding of proper experiment techniques and recording procedures
4. Provide unique opportunities for the development of discipline, diligence and accuracy
5. Recognize the role of chemistry in the debate of the origin of the universe
6. Better understand our role as stewards of God's creation

III. Instructional Materials

Exploring Creation with Chemistry, Apologia Educational Ministries, Inc., 2003

IV. Course Outline

- Module One: Measurements and Units
1. Experiment 1.1 air has mass
 2. Experiment 1.2 air takes up space
 3. Units of Measurement
 4. The Metric System
 5. Manipulating Units
 6. Converting Between Units
 7. Converting Between Unit Systems
 8. More Complex Unit Conversions
 9. Derived Units
 10. Making Measurements
 11. Accuracy, Precision, and Significant Figures
 12. Scientific Notation
 13. Using Significant Figures in Mathematical Problems
 14. Experiment 1.3 comparing conversions to measurements
 15. Density
 16. Experiment 1.4 the density of liquids
- Module Two: Energy, Heat and Temperature
1. Energy and Heat
 2. The Nature of a Scientific Law
 3. The First Law of Thermodynamics
 4. Units for Measuring Heat and Energy
 5. Experiment 2.1 calibrating your thermometer
 6. The Calorie Unit
 7. Measuring Heat
 8. Calorimetry
 9. Experiment 2.2 Measuring the specific heat of a metal
- Module Three: Atoms and Molecules
1. Early Attempts to Understand Matter
 2. The Law of Mass Conservation
 3. Experiment 3.1 the conservation of mass
 4. Elements: The Basic Building Blocks of Matter
 5. The Periodic Table of Elements

6. Compounds
7. The Law of Multiple Proportions
8. Dalton's Atomic Theory
9. Molecules: The Basic Building Blocks of Compounds
10. Abbreviating and Classifying Compounds
11. Classifying Matter as Ionic or Covalent
12. Experiment 3.2 electrical conductivity of compounds dissolved in water
13. Naming Compounds

Module Four: Classifying Matter and Its Changes

1. Classifying Matter
2. Experiment 4.1 separating a mixture of sand and salt
3. Classifying Changes That Occur in Matter
4. Experiment 4.2 distinguishing between chemical and physical change
5. Phase Changes
6. Experiment 4.3 condensing steam in an enclosed vessel
7. Phase Changes in Water Chemical Reactions and Chemical Equations
8. Determining Whether or Not a Chemical Equation is Balanced
9. Balancing Chemical Equations

Module Five: Counting Molecules and Atoms in Chemical Equations

1. Three Basic Types of Chemical Reactions
2. Decomposition Reactions
3. Formation Reactions
4. Complete Combustion Reactions
5. Incomplete Combustion Reactions
6. Molecular Mass
7. The Mole Concept
8. Experiment 5.1 measuring the width of a molecule
9. Using the Mole Concept in Chemical Equations

Module Six: Stoichiometry

1. Mole Relationships in Chemical Equations
2. Limiting Reactants and Excess Components
3. Experiment 6.1 limiting reactants
4. Fully Analyzing Chemical Equations
5. Relating Products to Reactants in Chemical Equations
6. Using Chemical Equations When the Limiting Reactant is Identified
7. Volume Relationships in Chemical Equations
8. Using Stoichiometry to Determine Chemical Formulas
9. Empirical and Molecular Formulas
10. More Complicated Experiments for Determining Chemical Formulas

Module Seven: Atomic Structure

1. Historical Overview
2. Electrical Charge
3. Experiment 7.1 electrical charge
4. Electrical Charge and Atomic Structure
5. Determining the Number of Protons and Electrons in an Atom
6. Determining the Number of Neutrons in an Atom
7. Isotopes and Nuclear Bombs
8. Atomic Structure in More Detail
9. The Nature of Light
10. The Electromagnetic Spectrum
11. The Relationship Between Frequency and Energy
12. How the Eye Detects Color

13. Experiment 7.2 how the eye detects color
14. The Bohr Model of the Atom
15. The Quantum Mechanical Model of the Atom
16. Building Atoms in the Quantum Mechanical Model (Electron Configurations)
17. Abbreviated Electron Configurations
18. The Amazing Design of Atoms

Module Eight: Molecular Structure

1. Electron Configurations and the Periodic Chart
2. Lewis Structures
3. Lewis Structures for Ionic Compounds
4. Handling the Exceptions in Ionic Compounds
5. Ionization Potential and Periodic Properties
6. Electro negativity: Another Periodic Property
7. Atomic Radius: Another Periodic Property
8. Lewis Structures of Covalent Compounds
9. More Complicated Lewis Structures

Module Nine: Polyatomic Ions and Molecular Geometry

1. Polyatomic Ions
2. Molecular Geometry: The VSEPR Theory
3. Purely Covalent and Polar Covalent Bonds
4. Experiment 9.1 polar covalent versus purely covalent compounds
5. Purely Covalent and Polar Covalent Molecules
6. The Practical Consequence of Whether or Not a Molecule is Polar Covalent
7. Experiment 9.2 Solubility of Ionic Compounds

Module Ten: Acid/Base Chemistry

1. Acids and Bases
2. Experiment 10.1 common household examples of acids and bases
3. The Chemical Definitions of Acids and Bases
4. The Behavior of Ionic Compounds in Aqueous Solutions
5. Identifying Acids and Bases in Chemical Reactions
6. Recognizing Acids and Bases From Their Chemical Formulas
7. Prediction the Reactions That Occur Between Acids and Bases
8. The Reactions Between Acids and Covalent Bases
9. Molarity
10. The Dilution Equation
11. The Importance of Concentration in Chemistry
12. Using Concentration in Stoichiometry
13. Acid/Base Titrations
14. Experiment 10.2 acid/base titration

Module Eleven: The Chemistry of Solutions

1. How Solutes Dissolve in Solvents
2. Solubility
3. Experiment 11.1 the effect of temperature on the solubility of solid solutes
4. Experiment 11.2 the effect of temperature on the solubility of a gas
5. Energy Changes That Occur When Making a Solution
6. Experiment 11.3 investigation of a solute that releases heat when dissolved
7. Applying Stoichiometry to Solutions
8. Molality
9. Experiment 11.4 Freezing-Point Depression
10. Boiling-Point Elevation

Module Twelve: The Gas Phase

1. The Definition of Pressure
2. Boyle's Law
3. Charles's Law
4. The Combined Gas Law Ideal Gases
5. Dalton's Law of Partial Pressures
6. An Alternative Statement of Dalton's Law
7. The Ideal Gas Law
8. Using the Ideal Gas Law in Stoichiometry
9. Experiment 12.1 using the ideal gas equation

Module Thirteen: Thermodynamics

1. Enthalpy
2. Determining ΔH for a Chemical Reaction By Experiment
3. Experiment 13.1 determining the ΔH of a chemical reaction
4. Determining the ΔH of a chemical Reaction Using Bond Energies
5. Hess's Law
6. Applying Enthalpy to Stoichiometry
7. Energy Diagrams
8. The Second Law of Thermodynamics
9. The Proper Application of the second Law of Thermodynamics
10. Gibbs Free Energy

Module Fourteen: Kinetics

1. Reaction Kinetics
2. Factors That Affect the Kinetics of a Chemical Reaction
3. Experiment 14.1 factors that affect chemical reaction rates
4. The Rate Equation
5. Using Experiments to Determine the Details of the Rate Equation
6. Rate Orders
7. Using Rate Equations
8. Temperature Dependence in the Rate Equation
9. Catalysts and Reaction Rate
10. Experiment 14.2 the effect of a catalyst on the decomposition of hydrogen peroxide

Module Fifteen: Chemical Equilibrium

1. The Definition of Chemical Equilibrium
2. Experiment 15.1 a demonstration of equilibrium
3. The Equilibrium Constant
4. A few More Details Concerning the Equilibrium Constant
5. Using the Equilibrium Constant to Predict the Progress of a Reaction
6. Le Chatelier's Principle
7. Pressure and Le Chatelier's Principle
8. Temperature and Le Chatelier's Principle
9. Experiment 15.2 temperature and Le Chatelier's Principle
10. Acid/Base Equilibria
11. The pH Scale
12. Acid Rain

Module Sixteen: Reduction/Oxidation Reactions

1. Oxidation Numbers
2. Determining Oxidation Numbers
3. Oxidation and Reduction
4. Recognizing Reduction/Oxidation Reactions
5. An Important Characteristic of Reduction/Oxidation Reactions
6. Experiment 16.1 Invisible Writing

7. How Batteries Work
8. Real Batteries
9. Corrosion

V. Teaching Methods

1. Reading assignments
2. Discussion
3. Laboratory experiments
4. Written assignments

VI. Evaluation

A. Components

1. Tests

B. Grading Scale

100-90%	=	A
89-80%	=	B
79-70%	=	C
69-60%	=	D
59-below	=	F