

The Spectrum, Chemistry

Scope and Sequence

This course is designed for home schoolers as a follow-on to *The Rainbow* by *Beginnings Publishing House*. Intended as a high school course, *The Spectrum, Chemistry* may be taken by anyone having a substantial background in physical science and a mastery of Algebra I. *Bridge Math*, also by *Beginnings Publishing House*, will be helpful to anyone taking this course other than the exceptional math student who has a working knowledge of scientific math techniques (i.e., scientific notation, significant figures and the “factor-label” or “unit-factor” system).

While this course is not designed as an AP course *per se*, the student who successfully completes it will have all of the high school and much of the introductory college chemistry requirements behind them. Because of the high placement and motivation of home school students, we find this level of material entirely appropriate for the great majority of those who meet the prerequisites.

The following is the complete scope and sequence of the text. Afterward, a scope and sequence of the laboratory activities is provided.

Getting Ready (*Introduction and Preparatory Information*)

- 1: “Can We Talk?” (*Introduction*)
- 2: The Language of Chemistry (*Element names and symbols, Law of Definite Composition, Law of Multiple proportions, molecular formulas*)
- 3: How Do You Measure “Up”? (*Measurement, precision, accuracy, calibration and standard units*)
- 4: Anything Times One Is (*The unit factor system for organizing and solving problems*)

Properties of Matter (*The Elements and Their Fundamental Properties as Pure Substances*)

- 5: Bony People Tend to be Dense (*Density*)
- 6: Quiz 1
- 7: What’s the Matter? (*States and distributions of matter*)
- 8: Separation of Mixtures (*The use of physical and chemical properties to effect separations*)
- 9: Specific Heat (*Specific heat and heat transfer, calorimetry*)
- 10: Who Thought Up “Atoms”? (*Dalton’s atomic theory, atomic structure and particles, atomic number*)
- 11: What’s New (*The Bohr atom, excitation and spectra, s orbitals, electron configurations*)
- 12: The Periodic Table--To Be This Ugly, You Need a Reason! (*p and d orbitals*)
- 13: With the Exception of Hydrogen (*Analysis of the periodic table: atomic size, ease of ionization*)
- 14: Quiz 2
- 15: Isotopes and Atomic Mass (*Isotope notation, atomic mass, average atomic mass of natural elements*)

Bonds and Molecules (*Combinations of Elements*)

- 16: Chemical Bonding and Electron Pork (*Covalent bonds and electronegativity*)
- 17: Unequal Sharing and Unequal Not Sharing (*Polar covalent and ionic bonds*)
- 18: Striving for Nobility (*The octet rule and noble gas configurations, Lewis structures*)
- 19: Molecules and Shape (*Three-dimensional geometries of molecules*)
- 20: Quiz 3
- 21: What Do You Call This Stuff? (*Nomenclature and Type I Binary Compounds*)
- 22: Naming Type II Binary Compounds (*Nomenclature continued*)
- 23: Polyatomic Ions (*Nomenclature continued*)
- 24: Naming Type III Binary Compounds (*Nomenclature continued*)
- 25: The Mole (*Molecular weight, molar mass, gram atomic weight, Avogadro’s number*)
- 26: Percent Composition (*Mass percent composition, percent water in a hydrate*)
- 27: Quiz 4
- 28: Empirical Formulas (*Calculating empirical formula from percent composition*)
- 29: How Many Empiricals in a Molecular (*Molecular formula from empirical formula and molar mass*)

Chemical Reactions (Reaction Chemistry)

- 30: Teetering on the Brink of Reaction Chemistry (*Mass balance and chemical reaction equations*)
- 31: Chemical Equations: The Dark Side (*Balancing tougher equations*)
- 32: Reaction Types (*Synthesis, decomposition and single displacement reaction, activity series*)
- 33: The Double Switch (*Double displacement reactions*)
- 34: Oxidation-Reduction Reactions (*Simple electron transfer and oxidation number*)
- 35: Whose Electron Is This? (*Determining oxidation state and changes in oxidation state*)
- 36: Quiz 5
- 37: Stoichiometry (*Calculating quantities of reactants and products from chemical equations*)
- 38: Son of Stoichiometry (*Extra practice in stoichiometric calculations*)
- 39: How Much Can You Really Get? (*Actual, theoretical and percent yield*)
- 40: Quiz 6

State (The States of Matter, Changes of State and Simple Solutions)

- 41: The Big Squeeze (*Properties of gases, gas pressure, Boyle's Law*)
- 42: Turn Up the Heat, Turn Up the Volume (*Charles' Law, Gay-Lussac's Law, Combined Gas Law*)
- 43: Pulling It All Together (*Kinetic-Molecular Theory, Dalton's Law, Avogadro's Law*)
- 44: An Ideal Gas Obeys the Law (*Ideal Gas Law*)
- 45: Grandson of Stoichiometry (*Stoichiometric calculations based on the gas laws*)
- 46: Quiz 7
- 47: Liquids, and Changes from Liquids to Gases (*Properties of liquids: surface tension, capillary action, vaporization, heat of vaporization, hydrophobicity*)
- 48: Liquid-Vapor Equilibrium (*Dynamic equilibrium, volatility, boiling point, vapor pressure curves*)
- 49: Liquid-Solid Equilibrium, Etc. (*Freezing point, melting point, heat of fusion, sublimation, phase equilibrium diagrams, triple point, critical temperature and pressure*)
- 50: Solutions (*Diffusion, solubility, polarity, water as a solvent, saturation, rate of solution, solubility curves*)
- 51: Concentrations I--Express Yourself (*Mass fractions, mass percents, mass per unit volume*)
- 52: Quiz 8
- 53: Concentrations II--Our Furry Friend Gone Fractional (*Mole fraction, molarity, molality*)
- 54: Changing the Concentration of a Solution (*Dilution and concentration*)
- 55: Colligative Properties-roperties (*Freezing point lowering, boiling point elevation, vapor pressure lowering, osmotic pressure elevation, what all these have in common*)
- 56: Quiz 9

Applied Chemistry (Special Topics in Chemistry)

- 57: Water (*Water chemistry*)
- 58: Acids/Bases (*Acid/base theory*)
- 59: pH (*Logarithms and calculation of pH*)
- 60: Acids and Bases in Chemical Reactions
- 61: Chemical Equilibrium (*Reversible reactions, equilibrium constants*)
- 62: Quiz 10
- 63: Environmental Chemistry (*Complex systems, colloids, toxins, purification processes*)
- 64: Organic Chemistry and Biochemistry (*Introduction to carbon chemistry, structural tour of organic chemistry, the discontinuity between simple chemistry and biochemistry, introduction to the chemistry of living things*)
- 65: Chemistry and Evolution: An Essay (*Commentary on the absence of chemical support for abiogenesis and on the low probability of biogenesis against the current of entropy*)

Appendix (Laboratory Methods in Chemistry for Use with Home Laboratory)

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Home Laboratory
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- 1: What's Eating You? (*Lab safety*)
- 2: How Much Is a Little? (*Concentration and serial dilutions*)
- 3: Density: It's a Particle Thing (*Densities of liquids*)
- 4: Chemical Properties (*Separations*)
- 5: Pushy Substances (*A demonstration of molecular affinities among substances*)
- 6: Understanding the Dimensions of Atoms
- 7: Warning--People Might Think You're Intelligent (*Electron configurations of the elements*)
- 8: Chemical Changes I: Heat (*An exothermic, single displacement reaction*)
- 9: Chemical Changes II: Light Production (*A demonstration of chemiluminescence*)
- 10: Chemical Changes III: Gas Production (*A controlled "explosion" using hydrogen gas displaced from an acid*)
- 11: Chemical Changes IV: Changes in Reflected Light (*Color change reactions using acid/base indicators*)
- 12: Chemical Changes V: Precipitation (*A double displacement reaction that yields an insoluble solid*)
- 13: Moles (*An open-book, family crossword to reinforce the concept of molar quantity*)
- 14: Water of Waternation (*Visible dehydration and rehydration of copper sulfate*)
- 15: Electron Pressure (*Color demonstration of oxidizing and reducing environments*)
- 16: Electrochemistry (*Make, use and understand your own battery made from "wet chemicals"*)
- 17: Chemical King of the Hill (*Single displacement redox reactions that demonstrate the activity series of metals*)
- 18: Salivalysis (*Use of a color reaction to detect the presence of enzyme activity in human saliva*)
- 19: Thermal Gel (*Synthesis of a gel heat source*)
- 20: Chemical Clocks (*Effect of temperature and concentration on the rate of a visible chemical reaction*)
- 21: Surface Chemistry (*Removal of a colored solute from solution by adsorption on the surface of activated carbon*)
- 22: Bubbleometry (*Application of the ideal gas law using a self-made bubble meter*)
- 23: Vapor Pressure (*Effect of heat on the concentration of purple iodine gas in a sealed container*)
- 24: Heat of Unstickization (*Charting the difference in intermolecular forces among three liquids*)
- 25: Extraction Without Pulling Teeth (*Colorful extraction of iodine from water into mineral oil*)
- 26: Saturation and Supersaturation (*Dissolution and recrystallization of potassium sulfate*)
- 27: Heats of Solution (*Four salts differ in their heat requirements to enter solution*)
- 28: Birds of a Feather Colligate (*Demonstration of boiling point elevation and freezing point depression*)
- 29: Flowing Electrons and Still Waters (*Electrical conductivity of ionic solutions*)
- 30: Review (*Quiz on lab equipment and techniques*)
- 31: Reverse Chemistry (*Driving the separation of hydrogen and oxygen from water molecules*)