Curriculum at a Glance

Chemistry Honors
Level: 400
Grades 10 - 12

The curriculum for the Chemistry Honors 400 course is designed to provide higher performing students a strong, fundamental understanding of Chemistry. The course gives students the opportunity to learn core chemistry concepts and to enhance their abstract reasoning skills and strengthen problem-solving skills. Chemistry Honors introduces students to a variety of laboratory techniques and the analysis and reporting of results. The curriculum also prepares students for further study of Chemistry. This course is similar to Chemistry 300, but differs in several significant ways. The course is faster paced, covers topics to a greater depth and includes additional units. Students are expected to do nightly homework assignments and weekly lab reports. Students will frequently use their knowledge of mathematics in solving problems. Application of concepts is required throughout the course.

Unit Name / Description	Essential Content / Skills
Unit 1: Chemical Foundations: Lab Skills, Properties of Matter, Scientific Measurement, and Dimensional Analysis	1. What is chemistry? Why study chemistry? 2. Observations and inferences: use of a lab activity to illustrate the law of conservation of mass; safety & lab skills. 3. The scientific method. 4. Matter/classification of matter: properties and changes as physical or chemical; separation techniques. 5. Scientific measurement: scientific & standard notation; SI base units; metric system prefixes; significant figures; accuracy and precision. 6. Dimensional analysis: unit conversions and problems solving.
Unit 2: Atomic Structure and Atomic Theory	1. Early developments in atomic theory and development of modern atomic theory: Thomson, Rutherford, and Bohr models. 2. Atomic number (Z) and mass number (A): element symbols, isotopes, average atomic mass. 3. Atomic emission spectra: energy of an electron, excited and ground states. 4. Electromagnetic radiation: wavelength, frequency, and energy. 5. The quantum mechanical model: quantum numbers and atomic orbitals. 6. Electron configuration and orbital diagram.

	7. Electron dot diagrams for elements (Lewis symbols).
Unit 3: Chemical Formulas and Equations, Types of Reactions, and the Mole	1. Chemical formulas for ionic and molecular compounds. 2. Rules for naming compounds: oxidation number (charges) and state charges; monatomic and polyatomic ions. 3. Writing and naming chemical formulas. 4. Writing and balancing chemical reaction equations. 5. Types of chemical reactions. 6. The mole and molar mass. 7. Percent composition.
Unit 4: Stoichiometry and Empirical Formulas	1. Empirical and molecular formulas. 2. Molar relationships for chemical reaction calculations. 3. Mass-mass, mass-molecule, and mass-volume calculations. 4. Limiting and excess reactants. 5. Actual yield, theoretical yield, and percent yield.
Unit 5: Energy and Phase Changes	1. Heat transfers: systems vs. surroundings. 2. Endothermic and exothermic processes. 3. Energy unit conversions. 4. Heating and cooling curves. 5. Phase change diagrams. 6. Calorimetry. 7. Properties of solids. 8. Properties of liquids and changes of state (kinetic molecular theory). 9. Reversible changes of state in a closed system (equilibrium).
Unit 6: Behavior of Gases and Gas Laws	1. Kinetic molecular theory and the 3 states of matter. 2. Ideal behavior of gas particles. 3. Temperature (average kinetic energy) and energy transfers. 4. Conditions of STP. 5. Gas laws: Boyle's, Amonton's (Gay-Lussac), Charles', and Avogadro's (molar volume of a gas). 6. The combined gas law. 7. The ideal gas law. 8. Calculation of the molar mass of a gas from its mass, temperature, pressure, and volume. 9. Calculation of the density of a gas using the ideal gas law. 10. Dalton's Law of Partial Pressures 11. Gas stoichiometry including limiting reactant.

	12. Real vs. ideal gases.
Unit 7 Periodic Table Trends and Bonding	1. Development of the Periodic Table and periodic law 2. Nature of elements by period and group of elements and trends in properties. 3. List and explain the major periodic trends (activity, atomic radii, ionization energy, electronegativity) and underlying factors (shells, shield and nuclear charge) 4. Predict properties of an element given its position on the table. 5. What is a bond and how do they form compounds? 6. Differentiate the three types of bonds (ionic, covalent and metallic) and which elements are involved 7. Metallic bonding (sea of electron model) and properties. Formation of alloys. 8. Ionic bonding (transfer of electrons, Lewis structures, bonding orbital diagrams) and ionic properties 9. Covalent bonding (sharing electrons, polar vs. nonpolar covalent bonds, bonding orbital diagrams, Lewis structures for compounds) 10. Determining VSEPR geometries of molecules and their polarity 11. Hybridization and sigma and pi bonds. 12. Intermolecular forces and their effect on covalent compound properties.
Unit 8: Solutions	1. Solution concentration calculations 2. Molarity and dilution problems 3. Solving colligative properties problems (freezing point, boiling point, molecular formula) 4. Solubility rules and net ionic equations 5. Concentration of ions in solution 6. Solution stoichiometry problems
Unit 9: Thermochemistry	1. Overview of thermochemistry and energy flows. 2. Coffee-cup and bomb calorimetry 3. Enthalpy 4. Hess's Law 5. Finding heats of combustion/reaction from heats of formation 6. Determine heat of reaction for a chemical reaction 7. Finding heats of formation from heats of combustion

Unit 10: Kinetics	1. Rates of chemical reactions 2. Collision Theory 3. Four factors that influence reaction rates 4. Rate laws 5. Determining specific rate laws for a reaction experimentally 6. Calculating rate constant values 7. Calculating instantaneous rates of reactions 8. Rate mechanisms
Unit 11: Equilibrium	1. Equilibrium concepts including dynamic vs. static 2. Law of Mass Action 3. Equilibrium expressions and equilibrium constants 4. Solving for equilibrium constants 5. Solving for concentrations 6. Using ICE boxes to solve more complex equilibrium problems 7. Reaction quotient & predicting the direction of a reaction 8. Solubility equilibrium basics 9. Solving for Ksp and solubilities 10. Solving precipitation problems 11. Le Chatelier's principle
Unit 12: Acids and Bases	1. Naming acids and bases and identifying by operational properties 2. Arrhenius and Bronsted-Lowry definitions of acids and bases 3. Identifying acids, bases, conjugate acids, conjugate bases, and conjugate acid-base pairs in a reaction 4. Strong vs. weak acids 5. pH of strong and weak acids and bases 6. Calculating H+ and OH- concentrations and related pH and pOH 7. Weak acid equilibrium 8. pH of weak acids and bases 9. Mixtures of acids 10. Percent dissociation 11. Neutralization and Hydrolysis 12. pH of salts 13. Titration
Unit 13: Redox / Electrochemistry	1. Redox reactions: LEO goes GER or OIL RIG 2. Oxidizing and reducing agents

	3. Assigning oxidation states to elements in compounds 4. Balancing redox equations using the bridge method 5. Voltaic cell diagram: anode, cathode, oxidation, reduction, oxidizing agent, reducing agent, plating, electrode, cell potential, half reactions, overall redox reaction, salt bridge, electrode size changes, spontaneous reactions, voltage. 6. Use of a Standard Reduction Potential table to predict redox reactions. 7. Uses of redox reactions (batteries, etc.)