AP® Chemistry
ChemAdvantage

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AP® Chemistry Course Description

The purpose of the full-year online AP® Chemistry class is to provide a college-level course in Chemistry and to prepare the student to seek credit and/or appropriate placement in college Chemistry courses. The course is highly interactive, has a live lab, and is taught by a State of Michigan certified chemistry teacher with over 40 years of chemistry teaching experience. This course is structured around the units and topics in the AP® Chemistry Course Framework provided by the College Board.

The schedule runs for 36 weeks from the fourth week of August up to the week of the AP exam in May. Weekly assignments are posted on the course website at the start of each week and students are expected to manage their own schedule to complete their work by the start of the following week.

Each weekly schedule has an outline with required readings and instructional sheets correlating with the college textbook used in the course. The materials are based on the Unit Topics, Learning Objectives, and Essential Knowledge of the College Board Curriculum Framework. The outlines and instructional materials often bring in extra learning material that is in the AP® Chemistry curriculum but not present in a college textbook such as Photoelectron Spectroscopy (PES). Instructional videos are presented for all major topics, and students can access them at any time to assist in their learning. Videos of demonstrations of chemical principles are utilized so that students can see how the chemistry works.

Student learning is guided and assessed using Cengage's digital learning platform, WebAssign®. Each AP® Chemistry topic is thoroughly covered with interactive questions. The assigned questions are automatically graded, providing immediate feedback to students as well as additional resources for solving the problems. Students are allowed multiple submissions for each question to practice what they are learning. The WebAssign® questions have full graphic capabilities and can be tailored for multiple choice, fill in the blank, numeric (with significant figures and units), multiple select, symbolic type responses, and constructed responses. Students typically spend an hour a day working on the problems. The questions are geared to problem-solving rather than recall of factual material. Many problems are complex requiring the coordination of multiple ideas in chemistry.

Tests and quizzes are used to further assess student learning. For written responses to FRQ questions, students are required to be accurate and succinct. Providing complete justifications without extraneous material is stressed.

To perform the required hands-on labs, each student uses a lab kit containing reagents and equipment to perform 18 labs. Students will use a digital balance with centigram accuracy, a digital thermometer with 0.1°C accuracy, and volumetric labware. The students are also expected to use a color digital camera and photographic software for calorimetry experiments. The labs are primarily run as microscale experiments. Students keep a permanent lab notebook documenting their experiments. Lab write-ups must follow strict lab report protocols.

Students use an online forum for classroom discussion. As students are situated around the world in different time zones, there will typically be students online discussing chemistry at most times of the day or night. There is a discussion thread on each chapter and for each lab. The discussion board is highly interactive providing students a way to share information, help one another and collaborate on homework and lab work.

Text: *Chemistry:* 11th Edition, Raymond Chang & Kenneth Goldsby, ISBN-13: 978-0077666958

Lab Materials: Quality Science Labs *Advanced MicroChem Kit*

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College Board Approved
Syllabus

Weeks	Unit Overview	Learning Objectives
1-5	1. Introduction: Matter and Measurement Accuracy Precision Significant figures Lab measurements 2. Atoms, Molecules, and Ions Isotopes Mass Spectrometer Average atomic mass Moles & molar mass Nomenclature 3. Stoichiometry: Calculations with Chemical Formulas and Equations % Composition & Empirical Formulas Balancing reactions Conservation of atoms and mass Limiting Reactants % Yield 4. Aqueous Reactions and Solution Stoichiometry Concentration Solubility rules Ionic and molecular equations Precipitation Reactions Acid - Base Reactions Solution stoichiometry	Students will examine isotopic mixture ratios and the atomic mass of an element using mass spectrometer data. Students will calculate mass and mole stoichiometry in complete reactions for numerous reactions including reactions with limiting reactants.
6	5. Gases Gas Laws KMT Gas reaction stoichiometry	Students examine the deviations from the ideal gas law in terms of molecular volume and intermolecular attractions and how they will differ from the ideal predictions.
7-8	6. Thermochemistry Energy and Work Specific Heat Capacity 1st Law of Thermodynamics Enthalpy and Calorimetry Hess's Law Bond Energy Lattice Energy	Students will compare the changes of temperature from based and heat energy based on the specific heat of substances.
9-10	7. Electronic Structure of Atoms EMR wavelength and energy EMR and Spectroscopy Electronic structure and energy PES Data 8. Periodic Properties of Elements Trends in atomic size Nuclear charge and shielding IE atomic size and electronegativity	Students will use Planck's equation to compare the energies of photons based on frequency and wavelength. Students will examine the interaction of photos with atoms and molecules.

11-14	9. Basic Concepts of Chemical Bonding Ionic and covalent bonding Bond energy and covalent bonding 10. Molecular Geometry and Bonding Theories Lewis diagrams VSPER Model Hybridization Sigma and pi bonding Molecular symmetry and polarity	Students will use Potential Energy curves to determine the bond length a relative bond energy of different types of covalent bonds.
15-16	11. Intermolecular Forces and Liquids and Solids Intra vs intermolecular Forces Intermolecular Forces London Forces Induced dipoles Dipole-Dipole Ion-Dipole Hydrogen Bonding Types of Solids Ionic Molecular Covalent Network Metallic Polymers 12. Properties of Solutions Solubility - intermolecular attractions	Students will use Potential Energy curves to determine the bond length a relative bond energy of different types of covalent bonds. Students will compare the physical properties of ionic compounds and molecular compounds.
17-19	13. Chemical Kinetics Reaction Rates Stoichiometry and Rates Rate Law from Instantaneous Rates Rate Law from Reaction Data Graphical representations of rates Half-life and rate constants Reaction pathways and mechanisms Activation energy and temperature Maxell-Boltzmann diagram Intermediates, catalysts Coupled reactions	Students will use instantaneous rate vs. concentration data to predict the order of reactions. Students will plot concentration vs. time to identify the properties of Zero order, First Order, and Second Order reactions. Students will explain reaction kinetics using reaction mechanisms.
20-23	14. Chemical Equilibrium Properties of equilibrium reactions Equilibrium expressions Equilibrium constant vs. quotient Equilibrium conditions I-C-E Le Châtelier's Principle 16. Solubility Equilibrium K_{sp} as a subset of K_p Solubility and Le Châtelier's Principle	Students will use ICE tables to determine equilibrium concentrations from different initial conditions.

24-26	15. Acid-Base Equilibria Strong acid, base rxn's pH, pOH, pK_w Bronsted-Lowry Model Weak acids and base interactions pK_a, pK_b, pK_w, hydrolysis of salts Acid strength prediction 16. Additional Aspects of Acid Base Equilibria Acid base titrations Half-titration levels Indicators and equilibria Polyprotic acids pH curves Buffers and common ion effect	Students make particulate drawings showing the reaction of strong acids with water vs. weak acids with water. Students calculate and plot hydrogen ion concentrations and pH during a titration for both a strong acid and a weak acid being neutralized by a strong base. Students will explain buffers and perform buffer calculations.
27-29	18. Entropy, Free Energy and Equilibrium Thermodynamic drive, AG Gibbs free energy Enthalpy, Entropy, T relationship Phase changes and Gibbs free energy Solubility and Gibbs free energy Gibbs free energy and equilibrium Coupled reactions Thermodynamic vs. Kinetic favorability	Students determine the interplay of entropy, enthalpy and temperature by examining the phase changes and temperature. Students compare the equilibrium product concentration of a reaction that is under kinetic control at one temperature and under thermodynamic control at another using two contrasting activation energy graphs.
30-32	20. Electrochemistry Redox numbers Redox reactions Electrochemical cell reactions Voltage and reduction potential Relative voltages $E°$, standard voltages Nernst Equation Electrolytic cells	Students will compare the voltages of reduction reactions relative to hydrogen under standard conditions to predict the functioning of a galvanic cell. Students will use the Nernst equation and the equilibrium quotient/constant ratio to predict the direction of voltage changes in nonstandard cell conditions. Students will explain and calculate reactions in electrochemical cells.
33-36	Synthesis of essential knowledge and review.	