

NEWPORT-MESA UNIFIED SCHOOL DISTRICT Course Description

Advanced Placement Chemistry

Content covered in this course is described in the Course of Study. Based upon student needs, teachers select appropriate materials from the Instructional Materials List. Classroom presentations of course content are determined by the instructor and described under Teacher Activities. A more detailed outline of this course can be obtained from the instructor.

Overview:

The Advanced Placement Chemistry course is equivalent to the first year of college level chemistry, including laboratory skills. This course is open to college bound students who are highly motivated and have good math skills. The goal of the course is to prepare students to achieve a passing score on the A.P. exam. Achieving a score of 3 or better (out of a possible 5), on the College Board exam in May can result in college credit being granted. Many collegiate institutions promote a student with a score of "5" to Sophomore level chemistry.

Course of Study Objectives:

1. The student will describe the atomic theory and atomic structure, including evidence for atomic theory, electron energy levels, atomic spectra, and periodic relationships, and perform calculations involving frequency, wavelength, and energy.
 - 1.1 SUGGESTED STUDENT ACTIVITY:
 - Laboratory: Determine of the formula of a compound; Determine of molar mass by vapor density; Determination of a hydrate; atomic spectra lab
 - Solve problems involving Bohr's equations, equations of light, and quantum numbers, and answer questions involving concepts of periodic properties.
 - 1.2 INSTRUCTIONAL MATERIALS USED:
 - Lab supplies
 - Laserdisc
 - Video
 - Atomic models
 - Diffraction grating
 - Gas discharge tubes
 - Power supply
 - 1.3 TEACHER ACTIVITIES:
 - Lecture
 - Gas discharge tube demonstration

- 2. The student will describe and apply the concept of chemical bonding, including types of bonds, polarity of bonds, relationships to states of matter, lattice energies, molecular models, and geometry of molecules. The student will perform bond energy, lattice energy, and bond polarity calculations.**

2.1 SUGGESTED STUDENT ACTIVITY:

- Laboratory: Balloon modeling lab; Synthesis of coordination compounds
- Laboratory: "Geometry of Molecules" (using molecular model kits)
- Draw several dot and line structures including resonance, and isomers. Using the VSEPR theory, predict the shapes & bond angles of these molecules, and using valence bond theory, predict the hybridization of each.
- Answer questions about bond order, bond strength, bond length, and magnetism based on valence bond & molecular orbital theories.

2.2 INSTRUCTIONAL MATERIALS USED:

- Lab manuals
- Laserdisc
- Video
- Periodic table
- Molecular models
- Balloons
- CSUF Chemistry software
- Demonstration software for the Macintosh

2.3 TEACHER ACTIVITIES:

- Lecture
- Molecular model demonstration
- Crystal structure demonstration

- 3. The student will explain and describe nuclear chemistry, including nuclear equations, half-lives, and radioactivity; graph nuclear decay data, and calculate the half life of a radioisotope.**

3.1 SUGGESTED STUDENT ACTIVITY:

- Laboratory: Determinate of the half life of a radioactive isotope.
- Write several nuclear reactions and solve problems using the rate of decay equation.

3.2 INSTRUCTIONAL MATERIALS USED:

- Geiger counter
- Laserdisc
- Video
- Approved radioisotope

3.3 TEACHER ACTIVITIES:

- Lecture
- Discussion of nuclear energy, nuclear medicine, nuclear waste, and other relevant applications.

- 4. The student will describe the behavior and nature of gases, including the gas laws, the kinetic molecular theory, Avogadro's hypothesis, and deviations from ideal gas behavior; explain the kinetic energy distribution in a gas sample based on the Boltzmann distribution curve; perform all gas law calculations, including partial pressure, mole fraction, gas reaction stoichiometry, and the Van der Waals equation.**

4.1 SUGGESTED STUDENT ACTIVITY:

- Laboratory: Determine the molar volume of a gas
- Determine molar mass by gas density
- Boyle's Law (Syringe)
- The student will solve several problems involving the Ideal Gas Law, Dalton's Law of Partial Pressures, & Graham's Law of Diffusion.

- The student will answer questions involving the Kinetic Molecular Theory of gases and van der Waal's real gas equation.
- 4.2 INSTRUCTIONAL MATERIALS USED:
 - Laserdisc
 - Video
 - Vacuum apparatus,
- 4.3 TEACHER ACTIVITIES:
 - Liquid nitrogen demonstration
 - Determination of absolute zero demonstration
 - Kinetic motion demonstration on the overhead
- 5. The student will describe liquids and solids in terms of the kinetic molecular theory; draw the phase diagrams of one component systems; explain changes in state, critical temperature and pressure, and the structure of solids in terms of the kinetic molecular theory and these phase diagrams.
 - 5.1 SUGGESTED STUDENT ACTIVITY:
 - Laboratory: Boiling and melting point labs
 - Formation and examination of silver crystals
 - Sulfur crystallization lab
 - The student will analyze and interpret phase diagrams.
 - 5.2 INSTRUCTIONAL MATERIALS USED:
 - Laserdisc, videos, drinking bird, vapor bulb demonstrator, kinetic energy demonstrators
 - CSUF Chemistry Demonstration software for the Macintosh
 - 5.3 TEACHER ACTIVITIES:
 - Lecture,
 - Liquid nitrogen/dry ice demonstration
- 6. The student will describe the nature of solutions, the solvation process, and the relationships between solvents and solutes; determine the concentration (molarity and molality) of various solutions; describe the behavior of solutions in terms of Raoult's law and colligative properties, and deviations from ideal behavior; perform solution calculations involving solution concentrations and colligative properties.
 - 6.1 SUGGESTED STUDENT ACTIVITY:
 - Laboratory: Boiling point elevation, melting point depression, determination of molar mass by freezing point depression, paper chromatography
 - The student will solve several problems involving concentration and colligative properties.
 - 6.2 INSTRUCTIONAL MATERIALS USED:
 - Laserdisc
 - Video,
 - 6.3 TEACHER ACTIVITIES:
 - Osmotic pressure demonstration
 - Conductivity demonstration
- 7. The student will identify, predict the products of, and balance several acid/base reactions using the theories of Arrhenius, Bronsted-Lowry, and Lewis.
 - 7.1 SUGGESTED STUDENT ACTIVITY:
 - Lab activity comparing the strengths of various acids, bases and salts.
 - Predict the products and write a complete acid/base reaction given only the starting reactants.
 - 7.2 INSTRUCTIONAL MATERIALS USED:
 - Lab manual
 - Lab supplies

- Adopted textbook
 - Previous AP exams, and ACS exams.
- 7.3 TEACHER ACTIVITIES:**
- Demonstrate several precipitation and complex ion reactions.
 - Lecture on basic reaction forms and common products.
- 8. The student will write and balance oxidation/reduction reactions by the oxidation number and the half-reaction method.**
- 8.1 SUGGESTED STUDENT ACTIVITY:**
- Balance several redox reactions and will perform an oxidation-reduction titration.
- 8.2 INSTRUCTIONAL MATERIALS USED:**
- Lab manual
 - Lab supplies
 - Adopted textbook
 - Previous AP exams, and ACS exams.
- 8.3 TEACHER ACTIVITIES:**
- Lecture on and give examples of redox reactions.
 - Demonstrate redox reaction, e.g. copper penny and nitric acid.
- 9. The student will solve electrochemical problems involving Faraday's Laws, voltage, Nernst equations, and thermodynamic equations.**
- 9.1 SUGGESTED STUDENT ACTIVITY:**
- Construct electrochemical cells to determine voltage and compare with predicted voltage.
 - Solve several electrochemical problems.
- 9.2 INSTRUCTIONAL MATERIALS USED:**
- Lab manual
 - Lab supplies
 - Adopted textbook
 - Previous AP exams, and ACS exams.
- 9.3 TEACHER ACTIVITIES:**
- Lecture on and give examples of several types of the electrochemical problems.
 - Demonstrate electrolysis and/or electroplating.
- 10. The student will solve stoichiometry problems including writing net ionic equations, determining limiting reagents, mass, moles, and volumes.**
- 10.1 SUGGESTED STUDENT ACTIVITY:**
- Solve several stoichiometry problems including empirical & molecular formulas, percent composition, and proportions.
 - Perform lab experiments to determine mass and mole relationships such as "Determining the Formula of a Compound", "Percentage of water in a Hydrate", and "Analytical Gravimetric Determination".
- 10.2 INSTRUCTIONAL MATERIALS USED:**
- Lab manual
 - Lab supplies
 - Adopted textbook
 - Previous AP exams, and ACS exams.
- 10.3 TEACHER ACTIVITIES:**
- Lecture on and give examples of stoichiometry problems.
- 11. The student will explain the concept of dynamic equilibrium, Le Chatelier's Principle, and predict the shift direction of a reaction in equilibrium.**

- 11.1 SUGGESTED STUDENT ACTIVITY:**
- Predict the shift direction of the reactions give specific changes to the equilibrium system.
 - Perform a lab experiment to observe shifts in equilibrium such as the ion thiocyanate experiment or the chromate/dichromate experiment.
- 11.2 INSTRUCTIONAL MATERIALS USED:**
- Lab manual
 - Lab supplies
 - Adopted textbook
 - Previous AP exams, and ACS exams.
- 11.3 TEACHER ACTIVITIES:**
- Lecture on and give examples of equilibrium problems.
- 12. The student will solve equilibrium problems including gas equilibrium, solubility products, acid-base equilibrium, and buffers.**
- 12.1 SUGGESTED STUDENT ACTIVITY:**
- Solve several equilibrium problems determining concentrations and equilibrium constants, and write equilibrium expressions.
 - Perform titration experiments making volume and pH measurements.
 - Use this data to determine the molarity of a solution and the equilibrium constant.
- 12.2 INSTRUCTIONAL MATERIALS USED:**
- Lab manual
 - Lab supplies
 - Adopted textbook
 - Previous AP exams, and ACS exams.
- 12.3 TEACHER ACTIVITIES:**
- Lecture on and give examples of several types of equilibrium problems.
 - Demonstrate the effectiveness of a simple buffer solution, e.g. acetic acid and sodium acetate.
- 13. The student will describe the factors which effect the rate of reaction.**
- 13.1 SUGGESTED STUDENT ACTIVITY:**
- Explain how and why certain changes effect the rate of reaction.
- 13.2 INSTRUCTIONAL MATERIALS USED:**
- Lab manual
 - Lab supplies
 - Adopted textbook
 - Previous AP exams, and ACS exams.
- 13.3 TEACHER ACTIVITIES:**
- Lecture on and give examples on the effects of temperature, pressure, volume, concentration, and catalysts on rate of reaction.
 - Demonstrate these factors by experiments, e.g. 30% peroxide and catalyst, clock reactions.
- 14. The student will write rate law expressions given experimental data, give a plausible step mechanism, perform calculations, and draw graphs using the rate expression and the Arrhenius Law.**
- 14.1 SUGGESTED STUDENT ACTIVITY:**
- Determine the rate law expressions and associated calculations.
 - Perform a "clock reaction" to determine the rate and rate constant for this reaction.
 - Write step mechanisms according to the rate law and the stoichiometry.
 - Use graphs to determine rate order, rate constant, and activation energy.
- 14.2 INSTRUCTIONAL MATERIALS USED:**
- Lab manual
 - Lab supplies

- Adopted textbook
- Previous AP exams, and ACS exams.

14.3 TEACHER ACTIVITIES:

- Lecture on and give examples of rate law expression, graphs, step mechanisms, and associated calculations.

15. The student will explain state functions, internal energy (e.g. heat & work), and enthalpy, and solve related calculations including heats of reactions, heats of formations, Hess' Law, bond energies, heats of vaporization and fusion.**15.1 SUGGESTED STUDENT ACTIVITY:**

- Solve several problems involving work, heat, volume, pressure, mass, temperature.
- Perform a calorimetry solving for heat of a reaction experiment.

15.2 INSTRUCTIONAL MATERIALS USED:

- Lab manual
- Lab supplies
- Adopted textbook
- Previous AP exams, and ACS exams.

15.3 TEACHER ACTIVITIES:

- Lecture on and give examples of state functions, internal energy, and enthalpy and related calculations.

16. The student will explain changes in entropy, Gibbs' free energy, and direction of reaction, and solve related calculations.**16.1 SUGGESTED STUDENT ACTIVITY:**

- Predict the change in entropy of a reaction, changes in free energy, and direction of spontaneity for a process.
- Will solve several problems involving enthalpy, entropy & free energy.

16.2 INSTRUCTIONAL MATERIALS USED:

- Lab manual
- Lab supplies
- Adopted textbook
- Previous AP exams, and ACS exams

16.3 TEACHER ACTIVITIES:

- Lecture on and give examples of entropy and free energy, how to predict direction of spontaneity, and related calculations.
- Demonstrate reactions, e.g. barium hydroxide with ammonium thiocyanate, and/or powdered sugar with concentrated sulfuric acid and discuss the changes in entropy, enthalpy, and free energy.

17. The student will perform calculations relating thermodynamics properties to equilibrium constants and voltage.**17.1 SUGGESTED STUDENT ACTIVITY:**

- Perform calculations incorporating equilibrium constants, voltage, and thermodynamics properties.
- Perform a lab experiment measuring the voltage of a reaction, the temperature, and concentration.
- Use this data to calculate free energy and the equilibrium constant.

17.2 INSTRUCTIONAL MATERIALS USED:

- Lab manual
- Lab supplies
- Adopted textbook
- Previous AP exams, and ACS exams

17.3 TEACHER ACTIVITIES:

- Lecture on and give examples of problems relating equilibrium constants, voltage, and thermodynamics.

- 18. The student will write full chemical reactions given only the reactants. The types of reactions should include replacement reactions, oxidation/reduction, complex ion formation, synthesis, and decomposition.**

18.1 SUGGESTED STUDENT ACTIVITY:

- Predict the products of several reactions given only the reactants. They will write out the complete reactions and use net ionic equations where necessary.

18.2 INSTRUCTIONAL MATERIALS USED:

- Lab manual
- Lab supplies
- Adopted textbook
- Previous AP exams, and ACS exams

18.3 TEACHER ACTIVITIES:

- Lecture on and give examples of the above mentioned reaction types.

- 19. The student will explain trends on the Periodic Table and compare elements with respect to properties such as electron affinity, ionization energy, electronegativity, atomic and ionic radii, and reactivity.**

19.1 SUGGESTED STUDENT ACTIVITY:

- Compare elements with respect to the above mentioned properties.
- Explain the basic trends across the Periodic Table using concepts of electron configuration and nuclear size.

19.2 INSTRUCTIONAL MATERIALS USED:

- Lab manual
- Lab supplies
- Adopted textbook
- Previous AP exams, and ACS exams

19.3 TEACHER ACTIVITIES:

- Lecture on and give examples of the above mentioned properties and trends.

- 20. The student will identify properties of the main group elements with emphasis on alkali metals, alkaline earth metals, halogens, and the first series of transition metal elements.**

20.1 SUGGESTED STUDENT ACTIVITY:

- Perform a lab activity observing the qualitative chemical tests for various elements such as flame tests, alkaline earth ion tests, halogen ion tests, complex-ions etc.
- Identify ions given experimental data

20.2 INSTRUCTIONAL MATERIALS USED:

- Lab manual
- Lab supplies
- Adopted textbook
- Previous AP exams, and ACS

20.3 TEACHER ACTIVITIES:

- Lecture on and give examples of qualitative ion tests.
- Demonstrate some of these ion tests.

INSTRUCTIONAL MATERIALS:**TEXTBOOKS**

Suggested textbooks: "Chemistry" by Zumdahl (Heath publisher)
 "Chemistry: The Central Science" by Brown & Lemay (Prentice Hall)
 "Chemistry: The Molecular Science" by Olmsted & Williams (Mosley)

SUPPLEMENTARY MATERIALS

Copies of College Board materials
Copies of previous Advanced Placement exams
Copies of American Chemical Society exams
Attend College Board workshops on the teaching of AP courses and the grading of AP exams.
Study guides for taking AP exams (for example, Barrow's study guide).

AUDIO-VISUAL MATERIALS

Laser disc: "Chemistry at Work" by Optical Data
"The World of Chemistry " series video
"Beyond the Quantum Mechanical Universe"