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| **Chemistry** | | | | | | |
| **(1) Scientific processes.** The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to: | | | | | | |
| (A) demonstrate safe practices during field and laboratory investigations; and | √ | √ | √ | √ | | |
| (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials. | | | | √ | | |
| **(2) Scientific processes.** The student uses scientific methods during field and laboratory investigations. The student is expected to: | | | | | The 1999-2002 AP tests always have a mandatory laboratory based question. See APCHEM 1999, 2000, 2002 question #5 and APCHEM 2001 question #6. | Frequent laboratory experiences (40% minimum); inquiry labs encouraged once skills are mastered. |
| **(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;** | √ | √ | √ | √ | | |
| **(B) collect data and make measurements with precision;** | √ | √ | √ | √ | | |
| **(C) express and manipulate chemical quantities using scientific conventions and mathematical procedures such as dimensional analysis, scientific notation, and significant figures;** | √ | √ | √ | √ | | |
| **(D) organize, analyze, evaluate, make inferences, and predict trends from data; and** | √ | √ | √ | √ | • Density lab with Graphical Analysis software*<br>• Density lab with TI-83 calculator* | Should have opportunities to produce hand-written and computer-generated graphs. This should include error analysis (sources of error, predicting results based on error scenarios). |

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| **(E) communicate valid conclusions.** | √ | √ | √ | √ | | |
| **(3) Scientific processes.** The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to: | | | | | | |
| *(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;* | √ | √ | √ | √ | | Students should analyze error in own experiments. |
| (B) make responsible choices in selecting everyday products and services using scientific information; | | | | √ | | |
| (C) evaluate the impact of research on scientific thought, society, and the environment; | | | | √ | | |
| (D) describe the connection between chemistry and future careers; and | | | | | | |
| (E) research and describe the history of chemistry and contributions of scientists. | | √ | | | | |
| **(4) Science concepts.** The student knows the characteristics of matter. The student is expected to: | | | | | | |
| (A) differentiate between physical and chemical properties of matter; | | | | | | Fundamental topic covered in middle school |
| (B) analyze examples of solids, liquids, and gases to determine their compressibility, structure, motion of particles, shape, and volume; | | √ | | | | |
| (C) investigate and identify properties of mixtures and pure substances; and | | √ | | | • 2000 APCHEM question #5 (Freezing point depression lab question)<br>• 2001 APCHEM question #5 (Practical applications incl. conductivity, boiling pt., reactivity, and pH) | Pre-AP* Chemistry classes should include solution preparation, properties and calculations such as molarity, molality, freezing point depression, and boiling point elevation. |

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| **(D) describe the physical and chemical characteristics of an element using the periodic table and make inferences about its chemical behavior.** | | √ | | | • World of Chemistry video–Periodic table for Group I metals<br>• Graphing periodic trends | Use of the periodic table (**not** memorization) should be included throughout the year. |
| **(5) Science concepts.** The student knows that energy transformations occur during physical or chemical changes in matter. The student is expected to: | | | | | | |
| **(A) identify changes in matter, determine the nature of the change, and examine the forms of energy involved;** | | √ | √ | | • Graphing/interpreting data for heating curve of various substances such as water, t-butyl alcohol, or benzoic acid | |
| **(B) identify and measure energy transformations and exchanges involved in chemical reactions; and** | √ | √ | | | • APCHEM 1999 #6, 2000 #6, 2001 #2, 2002 #5 & #8<br>(entropy, enthalpy, free energy, molar heat) | Pre-AP Chemistry students should do thermochemical calculations (some should be based on their own lab data) such as specific heat, calorimetry, thermochemical stoichiometry, Hess's Law, heats of formation, entropy, and free energy. |
| *(C) measure the effects of the gain or loss of heat energy on the properties of solids, liquids, and gases.* | | √ | √ | | • 1999 APPHY-B question #7<br>(PV diagram for an ideal gas)<br>• 2001 APPHY-B question #6<br>(Pressure, volume, temperature in a cylinder) | Pre-AP Chemistry students should do a phase change lab with graphing and calculations. They should also become familiar with phase diagrams. |
| **(6) Science concepts.** The student knows that atomic structure is determined by nuclear composition, allowable electron cloud, and subatomic particles. The student is expected to: | | | | | • 1999 APCHEM question #2<br>(Atomic structure w/ bond energy and line spectra) | |

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| | | | | | • 2000 APCHEM question #7 (Atomic structure w/isotopes, electron configuration, electron dot structures and ionization energy) | |
| (A) describe the existence and properties of subatomic particles; | | √ | √ | | • 1999 APPHY-B question #4 (Nuclear decay equations)<br>• 2000 APPHY-B question #5 (Photoelectric effect)<br>• 2001 APPHY-B question #7 (Nuclear fusion)<br>• 2002 APPHY-B question #7 (Photon-electron collision)<br>• Alpha, Beta, Gamma Radiation*<br>• It's Beanium* | Although not tested, students enjoy learning about quarks and other subatomic particles (besides protons, neutrons and electrons). |
| (B) analyze stable and unstable isotopes of an element to determine the relationship between the isotope's stability and its application; and | | √ | √ | | • 1999 APPHY-B question #4 (Nuclear decay equations)<br>• 2001 APPHY-B question #7 (Nuclear fusion) | |
| (C) summarize the historical development of the periodic table to understand the concept of periodicity. | | | | | | Students should learn reasons for periodic trends and be able to explain trends in electronegativity, ionization energy, electron affinity, atomic and ionic size, and major exceptions to these trends. |
| **(7) Science concepts.** The student knows the variables that influence the behavior of gases. The student is expected to: | | | | | • APCHEM 1999 #5, 2000 #1 (molar mass, gas laws, phase diagrams)<br>• APPHY-B 1999 #7, 2001 #6,#7 (Ideal Gas Law) | |

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| **(A) describe interrelationships among temperature, particle number, pressure, and volume of gases contained within a closed system; and** | | √ | √ | | • Use of computer/calculator and probes to determine Charles' Law, Gay-Lussac's and Boyle's Law | Students should be able to use and derive the gas laws (including Graham's Law and the determination of molecular mass using gas data). |
| *(B) illustrate the data obtained from investigations with gases in a closed system and determine if the data are consistent with the Universal Gas Law.* | | √ | √ | | | Students should be able to use the kinetic molecular theory to explain why certain gases behave more ideally than others. |
| **(8) Science concepts.** The student knows how atoms form bonds to acquire a stable arrangement of electrons. The student is expected to: | | | | | • 1999 APCHEM question #8 (Bonding and molecular structure)<br>• 2002 APCHEM question #6 (Atomic structure and bonding)<br>• VSEPR worksheet/lab* | Students should be able to draw Lewis structures for covalent molecules, predict bond hybridization, molecular shape and polarity. |
| **(A) identify characteristics of atoms involved in chemical bonding;** | √ | √ | | | | Determine reactivity of metals and nonmetals. |
| *(B) investigate and compare the physical and chemical properties of ionic and covalent compounds;* | | √ | | | | Students should be able to explain properties of a substance such as melting and boiling points, solubility, electrical conductivity based on types of bonding and types of intermolecular attractions. |
| (C) compare the arrangement of atoms in molecules, ionic crystals, polymers, and metallic substances; and | | √ | | | | |

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| **(D) describe the influence of intermolecular forces on the physical and chemical properties of covalent compounds.** | √ | √ | | √ | • 1999 APCHEM question #7 (Practical applications incl. conductivity, freezing pt., vapor pressure, and pH)<br>• 2001 APCHEM question #8 (Chemical bonding and intermolecular forces)<br>• Intermolecular forces demonstration* | Properties of water and hydrogen bonding are also important for APES and APBIO. |
| **(9) Science concepts.** The student knows the processes, effects, and significance of nuclear fission and nuclear fusion. The student is expected to: | | | | | | |
| (A) compare fission and fusion reactions in terms of the masses of the reactants and products and the amount of energy released in the nuclear reactions; | | √ | √ | | | |
| *(B) investigate radioactive elements to determine half-life*. | | √ | | √ | • Half-life lab/worksheet with mini-M&M's* | Relate nuclear decay to first-order reaction kinetics. |
| (C) evaluate the commercial use of nuclear energy and medical uses of radioisotopes; and | | | | | | |
| (D) evaluate environmental issues associated with the storage, containment, and disposal of nuclear wastes. | | | | √ | | |
| **(10) Science concepts.** The student knows common oxidation-reduction reactions. The student is expected to: | | | | | • APCHEM 2000 #1, 2001 #7, 2002 #2 (Electrochemistry)<br>• Electrochemical Fruit/Vegetable Battery Contest* | |
| **(A) identify oxidation-reduction processes; and** | √ | √ | | | • Labs which show the development of an activity series. | In APBIO, photosynthesis and cell respiration are key reactions.<br>In Pre-AP Chemistry, students should be able to determine oxidation |

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| | | | | | | numbers, elements oxidized and reduced, and oxidizing and reducing agents in an equation. |
| (B) demonstrate and document the effects of a corrosion process and evaluate the importance of electroplating metals. | | √ | | | | |
| **(11) Science concepts.** The student knows that balanced chemical equations are used to interpret and describe the interactions of matter. The student is expected to: | | | | | • APCHEM 1999-2002 question #4 (Reaction prediction)<br>• Determination of Water of Hydration Lab* | |
| **(A) identify common elements and compounds using scientific nomenclature;** | | √ | | | | Students must memorize symbols and charges of ions (including polyatomic ions). |
| **(B) demonstrate the use of symbols, formulas, and equations in describing interactions of matter such as chemical and nuclear reactions; and** | | √ | √ | | | |
| **(C) explain and balance chemical and nuclear equations using number of atoms, masses, and charge.** | | √ | √ | | • 2000 APCHEM question #3 (Stoichiometry and redox titration)<br>• 2002 APCHEM question #3 (Stoichiometry, gases, thermo, isomerism) | This should be a major part of the year!!! Students should have experience predicting the products of reactions to a greater degree than presented in most high school level textbooks. They should also learn to write net-ionic equations. Redox equations should be balanced using the half-reaction method. Students need extensive |

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| | | | | | | experience with higher level mole and stoichiometry problems. This must involve logic instead of simple recall. College texts are a great source of problems involving real-world applications and higher level thinking. |
| **(12) Science concepts.** The student knows the factors that influence the solubility of solutes in a solvent. The student is expected to: | | | | | • 2001 APCHEM question #1 (Solubility equilibria) | |
| **(A) demonstrate and explain effects of temperature and the nature of solid solutes on the solubility of solids;** | | √ | | | | |
| **(B) develop general rules for solubility through investigations with aqueous solutions; and** | | √ | | | • 13 x 13 lab to write net ionic equations (*Addison-Wesley Small Scale Laboratory*) | Pre-APCHEM students should memorize general solubility rules and be able to determine the identity of precipitates in double-replacement reactions. Students should be able to work $K_{sp}$ problems. |
| (C) evaluate the significance of water as a solvent in living organisms and in the environment. | √ | √ | | √ | | |
| **(13) Science concepts.** The student knows relationships among the concentration, electrical conductivity, and colligative properties of water; and | | | | | • Vernier lab on conductivity (*Chemistry with Calculators* or *Chemistry with Computers)* | |
| (A) compare unsaturated, saturated, and supersaturated solutions; | | √ | | | • Demonstrations with crystal formation such as sodium acetate or sodium | |

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| | | | | | sulfate decahydrate | |
| *(B) interpret relationships among ionic and covalent compounds, electrical conductivity, and colligative properties of water; and* | | √ | | | • Ice cream lab with temperature measurements* | Students need to do calculations with freezing point and boiling point. |
| (C) measure and compare rates of reaction of a solid reactant in solutions of varying concentration. | √ | √ | | | • Demonstrations on rates like Zn or Mg with various concentrations of HCl | Rates of reaction is a very important concept in APBIO and APCHEM, but the reactant is not necessarily a solid. |
| **(14) Science concepts.** The student knows the properties and behavior of acids and bases. The student is expected to: | | | | | • 1999 APCHEM question #1 (Basic equilibria and titration)<br>• 2001 APCHEM question #3 (Stoichiometry, gases and titration)<br>• 2002 APCHEM question #1 (Acid equilibria and titration) | Students must learn to do pH calculations with a calculator for strong and weak acids. |
| (A) analyze and measure common household products using a variety of indicators to classify the products as acids or bases; | | √ | | | | Use pH meters or probes if available. |
| (B) demonstrate the electrical conductivity of acids and bases; | | √ | | | • Titration of barium chloride with sulfuric acid | |
| *(C) identify the characteristics of a neutralization reaction; and* | | √ | | | • 2000 APCHEM question #8 (Titration curve and indicators) | Students should do one or more titration experiments and extensive neutralization calculations. |
| (D) describe effects of acids and bases on an ecological system. | √ | | | √ | | |
| **(15) Science concepts.** The student knows factors involved in chemical reactions. The student is expected to: | | | | | • 2000 APCHEM question #1 (Gas equilibria) | Although chemical equilibrium is not mentioned in these TEKS, students should be able to work simple equilibrium problems and understand |

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| | | | | | | the concept of chemical equilibrium. |
| (A) verify the law of conservation of energy by evaluating the energy exchange that occurs as a consequence of a chemical reaction; and | | √ | | | • Heat of combustion of paraffin or some food product | |
| **(B) relate the rate of a chemical reaction to temperature, concentration, surface area, and presence of a catalyst.** | √ | √ | | | • There are several good microscale kinetics labs that give good results with small amounts of solution. (*Microscale Chemistry Books #1&2*, John Mauch)<br>• The demonstration "The Pink Catalyst" (Flinn)<br>• APCHEM 1999 #3, 2001 #6, 2002 #7 (kinetics) | Students in Pre-AP Chemistry should learn to write rate laws and calculate specific rate constants. |