South Hadley Public Schools

Subject: **Advanced Placement Chemistry** **School:** **High School**

Big Idea/Essential Question: How is stuff put together?

Standards	South Hadley Learning Expectations	Skills	Assessments	Content
ATOMIC THEORY 1. evidence for atomic theory 2. atomic mass determination by chemical and physical means 3. atomic number and mass number of isotopes 4. electron configuration and quantum numbers 5. periodic relationships in the periodic table	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. understand the development of atomic theory and its modern version. 2. describe the composition of atoms, ions, and molecules. 3. write formula and names for compounds. 4. describe the difference between classical and quantum models of the atom. 5. write electron configuaration for atoms and ions. 6. apply numerous periodic trends and variations in physical properties in the periodic table.	1. lab - determine the molar mass of a gas 2. lab - determine the molar mass of an ion 3. lab - determination of a mystery compound by flame test and molar mass 4. lab - calculation of photonic energy. 5. test - chapter 7 6. test - chapter 8	text sections: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7 text sections: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9 text sections: 8.1, 8.2, 8.3, 8.4, 8.5, 8.6

Big Idea/Essential Question: How is this stuff held together?				
Standard(s	**South Hadley Learning Expectations**	**Skills**	**Assessments**	**Content**
CHEMICAL BONDING 1. describe ionic, covalent, and metallic bonding 2. describe hydrogen bonding, and van der Waals forces, and dipole intermolecular forces. 3. understand the relationship among state, structure, and properties of matter 4. determine bond polarities by electronegativities 5. draw Lewis structures for molecules 6. describe bonding hybridization, resonance, and organization 7. determine the geometry of molecules and ions according to VSEPR theory 8. apply the geometry of particles to properties such as dipole moments.	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. identify the type of bonding present in substances by formula and properties 2. draw Lewis structures for molecules and polyatomic ions including multiple bonds, resonance structures, and octet rule exceptions. 3. determine the molecular geometry and polarity of molecules by application of VSEPR theory. 4. determine the hybridization of bonded atoms including sigma and pi bond determination. 5. identify the type of intermolecular forces present in substances by formula and properties 6. predict the polarity of compounds based on bond type and geometry.	1. test - chapter 9 2. test - chapter 10	text sections: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10 text sections: 10.1, 10.2, 10.3, 10.4, 10.5

Big Idea/Essential Question: Why is there so much energy in the nucleus?				
Standards	**South Hadley Learning Expectations**	**Skills**	**Assessments**	**Content**
NUCLEAR CHEMISTRY 1. write nuclear equations 2. determine half-lives and understand their meaning in nuclear decay processes 3. describe different types of radioactivity, including detrimental and beneficial uses	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. be able to write and balance various types of nuclear equations 2. predict nuclear stability based on guiding principles 3. perform quantitative and qualitative description of nuclear decay 4. compare nuclear fission and fusion 5. investigate uses of radioactivity to benefit society		text sections 23.1, 23.2, 23.3, 23.4, 23.5, 23.6, 23.7, 23.8

Big Idea/Essential Question: What is this stuff that I am living in?				
Standards	**South Hadley Learning Expectations**	**Skills**	**Assessments**	**Content**
GASES 1. apply the ideal gas law 2. determine partial pressures in gas mixtures 3. understanding of the kinetic molecular theory as an explanation of the property of gases 4. conditions that lead to deviation from the ideal gas law	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. express the conditions of a gas appropriately in terms of pressure, volume, moles, and temperature 2. apply the combined gas law quantitatively and qualitatively 3. solve problems using the ideal gas law 4. solve gas stoichiometry problem at standard and nonstandard conditions 5. describe gases in terms of the kinetic molecular theory 6. recognize conditions that would lead to deviations from ideal gas behavior 7. apply Dalton's law of partial pressure	1. lab - gas stoichiometry 2. lab - measuring vapor density 3. test - chapter 5	text sections: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8

Big Idea/Essential Question: What is it that makes some things solid, others liquid, and other gases?				
Standard(s	**South Hadley Learning Expectations**	**Skills**	**Assessments**	**Content**
LIQUIDS AND SOLIDS 1. kinetic molecular theory as applied to liquids and solids 2. interpret phase diagrams for one-component systems 3. investigate phase changes, including triple points and critical points 4. identify solids as ionic, molecular, covalent network, amorphous, or metallic 5. define lattice energy and relate it to ion charge and size	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. describe liquids and solids in terms of the kinetic molecular theory 2. describe phase changes in terms of equilibrium and energy exchange. 3. interpret phase diagrams for one-component systems 4. categorize solids as ionic, molecular, covalent network, amorphous, or metallic by formula or properties 5. predict the relative size of lattice energies using ion charge and size	1. lab - determine lattice energy by Hess law 2. lab - determine the heat of vaporization by Clausius Clapeyron equation 3. lab - boiling point determination by vapor pressure curve 4. test - chapter 11	text sections: 11.1, 11.2, 11.3, 11.6, 11.7, 11.8, 11.9

Big Idea/Essential Question: What happened to the solute, and how do I know it is still their?				
Standards	**South Hadley Learning Expectations**	**Skills**	**Assessments**	**Content**
SOLUTIONS 1. identify the type of solution by the state of the solvent and solute 2. identify the effect of temperature on the solubility of solids and gases 3. identify the effect of pressure on the solubility of gases 4. express the concentration of solutions using percent by mass, molarity, molality, and mole fraction 5. describe the colligative properties of solutions in terms of concentration 6. apply Raoult's law 7. describe non-ideal behavior of solutions	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. identify the type of some common solutions 2. calculate the concentration of solutions using percent by mass, molarity, molality, and mole fraction 3. interpret solubility curves for aqueous solutions with solid and gaseous solutes 4. describe the effect of pressure on gas solubility 5. identify the colligative property of solutions as vapor pressure lowering, boiling point elevation, freezing point depression, and osmotic pressure 6. compare the relative magnitude of the colligative properties for different solutions of various solute types and concentrations	1. lab - determine the molar mass of a substance by freezing point depression 2. test - chapter 12 test	text sections: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7

Big Idea/Essential Question: Is there any pattern to how this stuff reacts?				
Standards	**South Hadley Learning Expectations**	**Skills**	**Assessments**	**Content**
REACTION TYPES 1. identify reaction types 2. predict products based on reaction types 3. write net ionic equations for reactions 4. recognize acid-base neutralizations 5. recognize balance oxidation-reduction reactions 5. analyze electrochemical cells in terms of standard potential, cell potentials, and the directionality of reactions. 6. apply Farady's law and Nernst equation 7. relate standard potentials to equilibrium constants and Gibbs free energy	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. identify reactions as synthesis, decomposition, single replacement, double replacement, precipitation, acid-base, or redox 2. predict the products of a reaction based on reactants and reaction type 3. represent chemical reactions in net ionic form 4. perform gavimetric analysis to determine product mass 5. perform acid-base titrations to determine solution concentrations 6. perform oxidation-reduction titrations to determine solution concentrations 7. balance redox equations 8. diagram electrochem. cells 9. use standard reduction potentials to determine cell potentials and spontaneity 10. determine cell potentials at nonstandard conditions 11. design electrolytic cells and predict the amount of plating based on current flow, ion identity, and time 12. calculate equilibrium constants and Gibbs free energy based on potentials	1. lab - gravimetric analysis 2. lab - redox titration of hydrogen peroxide 3. lab - titration of aspirin 4. lab - construct a standard electrochemical cell and maximize it voltage 5. lab - electroplating coins 6. test - chapter 4 7. test - chapter 19	text sections: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8 text sections: 19.1, 19.2, 19.3, 19.4, 19.5, 19.8

Big Idea/Essential Question: How much product can I make from my stuff?				
Standards	**Learning Expectations**	**Skills**	**Assessments**	**Content**
STOICHIOMETRY 1. write balanced chemical equations, net ionic equations, and redox equations 2. analyze mass and volume relationships in chemical reactions with emphasis on the mole concept and limiting reactant situations 3. analyze compounds in terms of percent compositions, empirical formulas, and molecular formulas	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. relate atomic mass, molar mass, moles, and the number of particles 2. analyze compounds for percent composition, empirical formulas, and molecular formulas 3. write balanced chemical equations, net ionic equations, and redox equations 4. relate quantitatively the amount of reacts and products in a chemical reaction 5. assess reactions for limiting reagent 6. determine reaction yields	1. lab - determine the formula of a mystery compound 2. test - chapter 3	text sections: 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10

Big Idea/Essential Question: Why did this reaction just stop?				
Standards	**Learning Expectations**	**Skills**	**Assessments**	**Content**
EQUILIBRIUM 1. explore the concepts of physical and chemical equilibrium 2. define the equilibrium constant in terms of concentration and pressure and use it to predict concentrations or pressures of reactants and products 3. apply Le Chatelier's principle to equilibrium shifts 4. apply the equilibrium concept to weak acids and bases, using Ka, Kb, pK, and pH in acidic or basic solutions and in titrations. 5. apply the equilibrium concept to the solubility of insoluble ionic compounds including the use of Ksp values 6. Analyze the effect on common ions on acid or base dissociation, or ionic solubility 7. recognize and evaluate buffer solutions	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. recognize situations of dynamic equilibrium in physical and chemical systems 2. Write and solve equilibrium constant expressions in terms of concentrations and pressures 3. predict the directionality of a reaction based on the value of the reaction quotient and the equilibrium constant 4. apply Le Chatelier's principle to equilibrium shifts 5. apply the self ionization of water to the concentration of hydronium and hydroxide ions, pH and pOH. 6. solve for the pH of solutions made from weak acids and weak bases 7. explore the conjugate relationship between acids and bases 8. predict relative acid strength based on molecular structure 9. identify the acidic, basic, or neutral characteristics of salts 10. determine the effect of	1. lab - determine Ka for a weak acid 2. lab - titration curve and determination of Ka 3. lab - determination of Ksp by titration test - chapter 14 test - chapter 15 test - chapter 16	text sections: 14.1, 14.2, 14.3, 14.4, 14.5 text sections: 15.1, 15.2, 15.3, 15.4, 15.5, 15.6, 15.7, 15.8, 15.9, 15.10 text sections: 16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8, 16.9 demo - shifting chemical equilibrium demo - pH and common ions demo - buffer solution

		common ions of solution equilibrium include acid-base dissociation and ionic solubility 11. prepare and evaluate the properties of buffer solution 12. analyze acid-base titrations involving strong acids, weak acids, strong bases, and weak bases 13. select appropriate indicators for acid base titrations 14. apply Ksp values to solubility equilibrium, including the prediction of precipitates		

Big Idea/Essential Question: Do I have any control over how fast this reaction goes?				
Standards	**Learning Expectations**	**Skills**	**Assessments**	**Content**
KINETICS 1. express reaction rates using appropriate units 2. use experimental data and graphical analysis to determine reactant orders, rate constants, and rate laws 3. describe the effect of temperature on reaction rates 4. understand the concept of activation energy and how it relates to reaction rates. 5. describe the roll of catalysts 6. relate reaction mechanisms and the rate determining step to rate laws	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. describe how to measure the rate of a chemical reaction and express the rate in appropriate units 2. use experimental data and graphical analysis to determine reactant orders, rate constants, and rate laws 3. relate the effect of temperature on chemical kinetics to collision theory 4. relate reaction mechanisms and the rate determining step to rate laws 5. describe how a catalyst affect the rate of a chemical reaction in terms of potential energy diagrams and the activation energy	1. lab - determining chemical kinetics by gas pressure 2. lab - determine reactant order and rate law using a spectrophotometer test - chapter 13	text sections: 13.1, 13.2, 13.4, 13.5, 13.6

Big Idea/Essential Question: Why are some reaction hot and others cold?				
Standards	**Learning Expectations**	**Skills**	**Assessments**	**Content**
THERMODYNAMICS 1. Calculate the enthalpy for a reaction using both standard heats of formation and bond energies 2. apply Hess law to heats of reactions 3. apply heats of vaporization and fusion to phase changes 4. perform heat exchange and calorimetry calculations 5. predict the sign of the entropy change for a reaction based on the chemical equation 6. calculate the free energy change for a reaction based on entropy and enthalpy 7. relate the thermodynamic of a a reaction to its equilibrium constant or cell potential	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. identify reactions are endothermic or exothermic 2. Calculate the enthalpy for a reaction using both standard heats of formation and bond energies 3. analyze calorimetry data and experiments to determine heat capacities of specific heats 4. use heat of solution data for determining the energy exchange during the dissolving process 5. predict the sign of the entropy change for a reaction based on the chemical equation 6. relate the enthalpy and entropy of a reaction to the Gibbs free energy and reaction spontaneity	1. lab - measure the heat capacity of a calorimeter 2. lab - measure the enthalpy of a reaction by calorimetry 3. lab - measure the heat of combustion 4. lab - measure the enthalpy of fusion of stearic acid 5. lab - analyze ice melt products by heats of solutions 6. lab - pairing endothermic and exothermic reactions to give zero temperature change 7. test - chapter 6 8. test - chapter 18	text sections: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6 text sections: 18.1, 18.2, 18.3, 18.4, 18.5

Big Idea/Essential Question: Why is all the good stuff organic molecules?				
Standards	**Learning Expectations**	**Skills**	**Assessments**	**Content**
ORGANIC CHEMISTRY 1. classify organic compounds as alkanes, alkenes, alkynes, cyclic aliphatic, and aromatic compounds 2. name and write structural formulas for organic compounds, including structural isomers 3. identify the functional groups of organic chemistry and relate their structure to chemical properties	LE 1: Read, write, and communicate effectively. LE 2: Define, analyze, and solve complex problems and communicate results. LE 3: Study and work productively both independently and in groups. LE 4: Demonstrate personal, social, and civic responsibility. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. classify organic compounds as alkanes, alkenes, alkynes, cyclic aliphatic, and aromatic compounds by formula and structure 2. name organic compounds and write an appropriate structural formulas for it, including any structural isomers it has 3. identify the functional groups of organic chemistry, including alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, and amines, and relate their structure to chemical properties	1. lab - crosslinking polymers 2. lab - esterification of fragrances 3. lab - soaponification	text sections: 24.1, 24.2, 24.3, 24.4